S. HRG. 107–144 (Pt. 2)

NATIONAL ENERGY ISSUES

HEARING

BEFORE THE

COMMITTEE ON ENERGY AND NATURAL RESOURCES UNITED STATES SENATE

ONE HUNDRED SEVENTH CONGRESS

FIRST SESSION

TO RECEIVE TESTIMONY ON LEGISLATIVE PROPOSALS RELATED TO ENERGY EFFICIENCY, INCLUDING S. 352, THE ENERGY EMERGENCY RESPONSE ACT OF 2001; TITLE XIII OF S. 597, THE COMPREHENSIVE AND BALANCED ENERGY POLICY ACT OF 2001; SECTION 602-606 OF S. 388, THE NATIONAL ENERGY SECURITY ACT OF 2001; S. 95, THE FEDERAL ENERGY BANK ACT, AND S.J. RES. 15, PROVIDING FOR CONGRESSIONAL DISAPPROVAL OF THE RULE SUBMITTED BY THE DEPARTMENT OF ENERGY RELATING TO THE POSTPONEMENT OF THE EFFECTIVE DATE OF ENERGY CONSERVATION STANDARDS FOR CENTRAL AIR CONDITIONERS

TO RECEIVE TESTIMONY ON LEGISLATIVE PROPOSALS RELATED TO REDUCING THE DEMAND FOR PETROLEUM PRODUCTS IN THE LIGHT DUTY VEHICLE SECTOR

JULY 13, 2001
JULY 17, 2001
JULY 18, 2001

PART 2

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NATIONAL ENERGY ISSUES

FRIDAY, JULY 13, 2001

U.S. SENATE,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Washington, DC.

The committee met, pursuant to notice, at 9:35 a.m. in room SD–366, Dirksen Senate Office Building, Hon. Jeff Bingaman, chairman, presiding.

OPENING STATEMENT OF HON. JEFF BINGAMAN, U.S. SENATOR FROM NEW MEXICO

The CHAIRMAN. The hearing will come to order. Today's hearing will focus on proposals to expand existing programs to assist low income consumers to meet their energy needs and to weatherize their homes, also programs to encourage State energy plans and activities and proposals to improve the energy efficiency of buildings, particularly Federal buildings, appliances, and industry.

Yesterday we took testimony on a number of oil and gas supply issues. We will continue the efficiency theme next Tuesday with a hearing on vehicle issues, discussing energy research and development on Wednesday and renewables, distributed power technologies, and hydroelectric relicensing on Thursday, so as we move forward toward a markup of a balanced and comprehensive energy bill, I believe we are trying to have hearings that reflect that same balance of the array of energy options we have before us.

Increasing the efficient use of energy is the single most effective and least-cost policy for both the short term and the long term. Energy efficiency can reduce the demand for tight energy supplies and can reduce the upward pressure on energy prices. Energy efficiency allows us to maintain the same economic productivity and quality of life with less energy input, and efficiency helps us reduce pollution and environmental impacts associated with energy production and use.

There are some interesting statistics that the Alliance to Save Energy, a group that I have been associated with for many years, has come up with. Their analysis shows that energy efficiency provided the Nation with 27 quadrillion Btu's, or quads, or about 22 percent of U.S. energy consumption in 1999. This made energy efficiency the second leading source of energy in 1999, trailing oil consumption, which was 38 quads, but contributing more than natural gas (22 quads), coal (22 quads), nuclear (8 quads), and hydro (4 quads).

We have some excellent witnesses today, including the Assistant Secretary Garman, who is, of course, well-known and respected by

all of us on this committee, so I will stop my remarks and defer to Senator Murkowski, Secretary Garman's former boss.

STATEMENT OF HON. FRANK H. MURKOWSKI, U.S. SENATOR FROM ALASKA

Senator MURKOWSKI. Thank you, Senator Bingaman. Although I think you and I both know that we usually work for our people, they seem to lay out our schedule and dictate the terms and conditions under which we come in, and I understand that it was your staff that set the hearing on Friday, as opposed to the usual procedure, but you have got a good crowd here, and obviously the Senate Energy Committee is working on Friday. The halls are a little hollow out there, but that is all right.

I am pleased to join you here this morning. It seems like only yesterday that we were here, and we were here yesterday.

[Laughter.]

Senator MURKOWSKI. In any event, we are going to hear from a number of witnesses, as you have already outlined. I want you to know I support the measures to improve the energy efficiency and assist those low income families that are facing high energy bills in this country, but in addition to addressing the symptoms of our energy crisis, high energy bills, I am firmly committed to the belief that we must commit ourselves to solving the underlying crisis.

I stand certainly ready to work with you to move an energy bill to the full Senate for consideration, hopefully prior to the August recess, and I hope that we can collectively impress upon the Majority Leader the need to schedule time for the Senate floor. I would hope that we could have consideration for a comprehensive measure no later than the beginning of the week of July 30.

I recognize there are other priorities as well. In any event, we will seek to make sure that any energy bill that leaves this committee will have a balanced approach to our energy security needs. Obviously, that includes increased supply of conventional fuels, energy efficiency, using more technology, and expanded use of alternative fuels and renewables.

One of the things that I am rather interested in—evidently the second panel is going to focus on the debate for standards for central air conditioners and heat pumps. What has been lost in the debate is that, as I understand, the new Department of Energy standard will still increase energy efficiency by about 20 percent, which certainly is encouraging. The administration has proposed a 12-SEER standard, standing for the seasonal energy efficiency ratio. Secretary Abraham recently noted that the new air conditioning standard will save enough electricity by 2030 to light all U.S. homes for more than 2 years. I do not know how much Alaska is going to contribute to that, but nevertheless, we will survive. We will make up for it some other way, perhaps chopping wood, but at the same time the 12-SEER standard will be affordable for consumers, provide a wide array of manufacturers' models to meet consumer needs.

The same is not true of the 30-percent increase proposed by the former administration's 13 SEER standard. The 13-SEER standard would have eliminated 84 percent of new air conditioner models and 66 percent of new heat pump models, which is a rather inter-

esting comparison. In many instances, the installation of larger indoor coils required to meet the 13-SEER standard would increase cost to consumers by many hundreds of thousands of dollars.

I gather that the Justice Department found that the 13-SEER standard would impose disproportionate impacts on low income families, the same low income families that we are trying to help with the increased LIHEAP and weatherization funding. It would also drive many small manufacturers out of business, reduce consumer choice and competition. Perhaps this is just a plan to create additional demand for even more increases in LIHEAP and weatherization funding, but I do not want to make that inference. I will just refer to it.

Clearly, the administration made the right decision to opt for a 12-SEER standard, reasonable cost-effectiveness with real benefits. I hope we can move beyond the inconsistencies on the issue designed perhaps for finger-pointing—and perhaps get on with the business of making the right choices for the American people: choices of balanced economic and environmental concerns, and our need for energy to grow in the next decade.

I hope that we can act quickly on a comprehensive package, and I would certainly like, again, to reiterate since 1973 the economy has grown 126 percent but our energy has only grown 30 percent. Clearly, advanced technology, American can-do spirit and ingenuity, have helped us to make great advances in efficiency, but even with these improvements we can expect that over the next 20 years, oil consumption will increase by one-third. There is no other way to move America. Electricity demand will increase by 45 percent, and natural gas consumption will increase by 50 percent.

Incidentally, I would like to thank my colleague, who was a floor manager late last night when Mr. Griles was voted by a voice vote, and there happened to be three Republicans there and two Democrats, and so it was a close vote, but he is out, and he is confirmed, so we are very pleased. I think it has been 53 days, but nevertheless perseverance does pay off, if you have got enough perseverance.

In any event, I was propounding here on some realizations that oil consumption is going to increase by a third, electricity demand will increase by 45 percent, natural gas consumption will increase by 50 percent.

Now, these are real figures from real people who I think call it as it is. Efficiency and conservation are crucial parts of a balanced, comprehensive energy plan. They are cornerstones of a bipartisan plan that we have worked on as well as the President's plan, but many believe efficiency is the only answer to future energy demand. As these numbers indicate, it is clearly not enough to rely on efficiency alone to power our economic progress. Efforts to increase domestic energy production must go hand-in-hand with efficiency and conservation in order to turn this crisis around.

I would conclude with two thoughts. The standard of living in this country is based on the assumption that we are going to have an affordable and plentiful supply of energy. If we do not, that standard of living is going to change, and the economy is going to change, and our national security interests are going to change.

I am very pleased to see Hon. David Garman here. I have a list of questions for him that were submitted by Alan Steinbeck, and so when we get through with your presentation this morning, then you can expect to have Alan—I guess it is called getting even, but in any event, welcome.

[Laughter.]

The CHAIRMAN. Secretary Garman, why don't you go right ahead, please.

STATEMENT OF DAVID K. GARMAN, ASSISTANT SECRETARY, ENERGY EFFICIENCY AND RENEWABLE ENERGY, DEPARTMENT OF ENERGY

Mr. GARMAN. Thank you, Mr. Chairman. Mr. Chairman and members of the committee, thank you for the opportunity to testify on a variety of legislative measures related to the improvement of energy efficiency. Energy efficiency is a very important part of the administration's overall energy policy.

The national energy policy document released May 16 dedicates an entire chapter to the subject of energy efficiency, and another entire chapter to the importance of renewable energy. Moreover, 54 of the national energy policy's 105 recommendations relate directly or indirectly to the importance of increasing our energy efficiency or increasing our use of clean, renewable energy.

I have a chart or two that I would like to use to illustrate the manner in which we intend to approach our goal of increasing system efficiency. The first chart looks at electricity flow, which represents about a third of our total energy use. As the energy inputs on the left flow toward end uses on the right, you can see graphically how efficiency loss is resulting from conversion, transmission, and distribution of energy.

If we were to increase end-use efficiency—the next chart, please—by 20 percent, therefore saving the equivalent of 2.1 quads of end-use energy, we would actually save 6.7 quads of energy input at the powerplant due to conversion losses in distribution and generation. This illustrates why increasing end-use efficiency is very important, but it is also why a focus on end use should not constitute the sum total of our efforts.

If we can employ technologies that increase end use efficiency and supply efficiency by 20 percent, then we could save 14.7 quads of energy inputs resulting in lower cost and fewer emissions. That is something, Mr. Chairman, your committee clearly recognizes, as evidenced by your hearings today and those scheduled for next week. Although today's focus is on end-use efficiency, next week's hearing will look beyond that to distributed generation and other technologies that can make our overall efficiency much better.

I commend you for this approach, which is in agreement with the approach embodied in the President's national energy policy. We are launching a new analytical effort at the Department of Energy to better understand and track trends in energy intensity. Surprisingly, while DOE has done this in the past on a one-time basis, it has never done this in a sustained and systematic manner.

We envision that this effort can contribute to national goals for energy efficiency improvements, and the sorts of improvements that could be made possible through technology and cooperative ef-

forts with industry, State, consumers, local governments, utilities, and others. We are doing this, again, in direct response to the recommendation in the national energy policy that we make energy efficiency a national priority.

With respect to the specific provisions in legislation before the committee today, I would note that they are all well-intentioned, and with some modifications the administration is likely to be in a position to support many of them if they are part of a balanced, comprehensive approach that also addresses supply and infrastructure issues contained in the national energy policy document. My written testimony goes into specific detail on the measures before the committee, but in the small time I have got I would like to highlight just a few.

First of all, weatherization. The President has proposed $1.4 billion in additional funding for weatherization over the next 10 years. We urge that Congress adopt this increase, and appreciate the efforts of several on this committee who are working to ensure that the President's budget request in this area are fully met.

With respect to the State energy program, the President's budget request for the current fiscal year was $38 million, equal to the 2001 level. We are pleased that both the House and Senate committees fully funded this request in their Interior appropriations bills, and share the view embodied in legislation proposed by both the chairman and the ranking member that we can do more in this area.

On the subject of energy-efficient schools, we believe there are substantial opportunities in increasing energy efficiency in schools, and we are working through our existing programs such as the rebuild America energy-smart schools campaign and a host of other works performed by States under the State energy program. We would like to work with you as you consider additional steps.

With respect to the Federal energy management program, or FEMP, we recognize that the Federal Government is the country's largest energy user, spending almost $8 billion annually on energy costs. We operate 500,000 facilities and almost 600,000 vehicles worldwide. President Bush in a May 3 directive to Federal agencies asked that immediate steps be taken to reduce energy use, particularly peak demand in supply-constrained areas such as California.

Our efforts to promote energy efficiency in the Federal realm, however, will not be a short-term effort driven only by current concerns about energy supply. Instead, we would like to work with you to build a new culture of energy savings that pervades the way the Federal Government procures buildings, appliances, vehicles, and all of the other items we purchase.

I will stop with that overview and submit to any questions you might have. Thank you, Mr. Chairman.

[The prepared statement of Mr. Garman follows:]

PREPARED STATEMENT OF DAVID K. GARMAN, ASSISTANT SECRETARY, ENERGY EFFICIENCY AND RENEWABLE ENERGY, DEPARTMENT OF ENERGY

Mr. Chairman and members of the Committee, thank you for this opportunity to testify on S. 352; Title XIII of S. 597; Sections 602-606 of S. 388; S. 95; and S.J. Res. 15. These measures, of course, all relate to the improvement of energy efficiency.

Energy efficiency is an important part of the Administration's overall energy policy. The National Energy Policy (NEP) document released May 16 dedicates an entire chapter to energy efficiency, and another chapter to the subject of renewable energy. Moreover, 54 of the NEP's 105 recommendations relate directly or indirectly to the importance of increasing our energy efficiency or increasing our use of clean, renewable energy.

When thinking about efficiency, it is useful to consider the nature of our energy systems. The charts on display (see attached)* look at electricity flow, which represents about a third of our total energy use. If we were to increase end-use efficiency by 20%, thereby saving the equivalent of 2.1 quadrillion BTUs (quads) of end-use energy, we would actually save 6.7 quads of energy inputs at the power plant due to conversion losses in generation and the losses associated with transmission and distribution. This illustrates why increasing end-use efficiency is very important . . . but why it should not constitute the sum total of our efforts. If we can employ technologies that increase end-use efficiency and supply efficiency by 20%, then we could save 14.7 quads of energy inputs, resulting in lower costs and fewer emissions.

This is something that your Committee recognizes, Mr. Chairman, as evidenced by your hearings today and those scheduled for next week. Although today's focus is on achieving end-use efficiency, next week the hearings will look beyond end-use savings to the removal of barriers to distributed generation and other technologies that can help us make our overall energy generation, transmission and distribution systems more efficient. I commend you for this approach, which is in close agreement with the approach embodied in the President's National Energy Policy.

Today, I want to take this opportunity to announce that we are launching a new analytical effort at the Department of Energy to better understand and track trends in national energy intensity. Surprisingly, while DOE has done this on a one-time basis, it has never done this in a sustained and systematic manner. We envision that this effort can eventually contribute to national goals for energy efficiency improvements made possible through technological advances and cooperative efforts with industry, state and local governments, consumers, utilities, and others. We are doing this in direct response to the recommendation in the National Energy Policy that energy efficiency be pursued as a national priority.

With respect to the specific provisions in legislation before the Committee today, I would note that they are all well intentioned, and with some modifications, the Administration is likely to be in a position to support many of them if they are part of a balanced, comprehensive approach that also addresses supply and infrastructure issues contained in the National Energy Policy document.

However, I must add an important note of caution. It is, of course, relatively easy to authorize new funding, but relatively difficult to appropriate it. The most generous of the bills before us would authorize $500 million annually for weatherization, $230 million annually for energy efficient schools, $125 million annually for State Energy Programs, and would require an expenditure of roughly $180 million in appropriated funds to create an Energy Bank to finance energy savings measures in federal agencies. That adds up to well above a billion dollars. The comparable level of appropriated funding in my office's 2001 budget was $153 million for weatherization and $38 million for State Energy Programs, or about $191 million. (I am not including the $3.4 billion that would be authorized under one of the bills for Low Income Home Energy Assistance Program, as that is not one of DOE's programs.) As we work together in the weeks and months ahead to determine the appropriate authorization levels for these programs, I urge that there be some linkage between the authorized levels and a realistic expectation of the eventual appropriations that will follow. We also urge Congress to adopt the President's proposal to use $1.2b of ANWR bonus bids to fund R&D projects on solar power, wind energy, biomass power and fuels, geothermal energy and other alternative energy technologies.

WEATHERIZATION ASSISTANCE

The Weatherization Assistance Program provides services to eligible low-income persons, with emphasis on elderly persons, persons with disabilities and children. States (including the District of Columbia) voluntarily participate. Up to an average of $2500 per dwelling unit may be spent for purchase and installation of eligible weatherization materials, and energy audits are used to ensure that the measures employed in a given home are cost-effective.

The Weatherization Assistance Program has reduced the heating and cooling costs of low-income households by weatherizing more than 5 million homes since the program's inception in 1976. The President has proposed $1.4 billion in additional fund-

* The charts have been retained in committee files.

ing for weatherization over the next ten years. The President's budget for FY 2002 proposed a $120 million increase from $153 million to $273 million, which will weatherize 123,000 homes—an increase of at least 48,000 homes over the number weatherized in the prior fiscal year. In its markup of the Interior and Related Agencies appropriations bill, the Senate Appropriations Committee, has provided only half the President's requested increase $60 million to bring the program to a level of $213 million. We hope that this shortfall will be addressed on the Floor.

We support an authorization level that accommodates the President's requests for increases in this program. Our recommended ramp-up of the program anticipates spending levels for the program as outlined in the table below.

($ in millions)

Fiscal year	WAP base	Initiative	WAP total
2002	$153	$120.0	$273.0
2003	$153	$124.1	$277.1
2004	$153	$128.2	$281.2
2005	$153	$132.2	$285.6
2006	$153	$137.1	$290.1
2007	$153	$141.7	$294.7
2008	$153	$146.5	$299.5
2009	$153	$151.4	$304.4
2010	$153	$156.6	$309.6
2011	$153	$161.8	$314.8
10 Year Total	$1,530	$1,400	$2,930

Section 422 of the Energy Policy and Conservation Act statute authorizes "sums as may be necessary" for the Weatherization Assistance Program. Section 3 of S. 352 (Bingaman) would increase the weatherization program authorization to $310 million for each of the fiscal years through 2005.

Section 603 of S. 389 (Murkowski) would also increase the program authorization levels to $250 million in FY 2002; ramping up to $500 million in FY 2005. We note that the authorization levels in S. 389 for FY 2002 would fall $23 million short of the President's request. Unless modified, we would be unable to support this provision. Section 603 of S. 389 would also expand the eligibility of low-income households from 125% of the poverty level to 150% of the poverty level. We are not certain that this change is needed since states may, under current law, elect to use LIHEAP eligibility criteria in administering the DOE weatherization program. The LIHEAP eligibility criteria gives states the option of using the 150% poverty level figure or a figure of 60% of a state's median income as a basis of eligibility.

STATE ENERGY PROGRAM

States voluntarily participate in the State Energy Program (SEP) by submitting grant applications with energy plans to DOE. States are required to contribute 20% matching contributions, and SEP funds are used to finance a variety of projects, including building codes updates, installing eligible energy conservation measures, encouraging the use of clean fuel vehicles, and developing energy emergency plans.

The President's budget request for FY 2002 for State Energy Program funding was $38 million, equal to the FY 2001 level. We are pleased that the Senate Committee fully funded his request in the Interior appropriations bill.

Section 3 of S. 352 (Bingaman) would change the authorization levels for State Energy Conservation Grants from "such sums as may be necessary" to $75 million annually for fiscal years 2001-2005.

Section 604 of S. 389 (Murkowski) would also increase authorization levels for State Energy Conservation Grants compared to past practice in Congressional appropriations. S. 389 also appears to change the State Plan approval cycle from once a year to once every three years, a change that would streamline program administration at both the Federal and State levels. Finally, the Murkowski provision would appear to establish a goal of 25% improvement in a state's energy efficiency by 2010 (against a 1990 baseline).

This is probably an appropriate place to comment on the use of numerical goals in statutory language. Goals that are clearly defined and measurable can be quite useful. In the case of energy savings goals expressed under the Federal Energy Management Program (FEMP), the goals are expressed in terms of energy use per square foot of building space. This is a goal we can measure, understand, and pursue.

Unfortunately, the existing goal in section 364 of the Energy Policy and Conservation Act that S. 389 would amend has never been clearly defined. Is it per capita energy intensity? Is it energy use per unit of economic production? Should the goal be attributable to the actions of a State Energy Program, or should it also measure energy efficiency gains that occur as a consequence of market forces or structural changes in the economy? If the intent is to establish a goal that State Energy Programs can attribute to their activities, we can safely predict that you will hear the view from Governors and State Energy Officials that a 25% goal is unrealistic without substantial increases in appropriated funding.

I cannot tell you today what we believe the funding levels should be in subsequent fiscal years, as this is a component of both our ongoing 2003 budget formulation and a top-to-bottom strategic funding and performance review that is now underway for each of the 31 programs in my office.

ENERGY EFFICIENT SCHOOLS

Section 602 of the S. 389 (Murkowski) establishes an Energy Efficient Schools Program in the Department of Energy. Section 1302 of S. 597 (Bingaman) establishes a program within the Department of Education to promote energy efficient schools.

My office has several existing programs that speak to this issue. Through the "Rebuild America" Energy Smart Schools campaign, my office provides technical assistance for design and financing as well as conservation technology. We also do work in areas of alternative fuel school transportation and a number of supply side management strategies such as micro-cogeneration, combined heat and power, renewable energy and alternative fuel sources. A great deal of what we do is applicable to schools, about $2-3 million worth of our work is directed specifically to schools, not including school-related expenditures under the State Energy Program.

State Energy Programs can already use existing resources to promote energy efficient schools, and of course those efforts must be cost-shared. We view cost sharing with our state partners as a good way to leverage federal resources and ensure that they are directed where they will do the most good. Therefore, it is our preference to use the existing State Energy Programs to promote energy-efficient schools rather than authorizing a new program whose chances of receiving significant funding from the appropriators are unclear. As funds are available, they should be directed to existing programs that can achieve the desired goals we share.

If legislation is deemed necessary to provide greater federal emphasis on promoting energy-efficient schools, we recommend that the Department of Energy lead the effort in concert with the State Energy Offices. We do not believe that a Department of Education administered grant program as proposed in S. 597 would fully leverage the advantages that could be achieved through coordination with our existing energy efficiency programs and the ongoing efforts of the State Energy Offices.

FEDERAL ENERGY MANAGEMENT PROGRAM (FEMP) PROVISIONS

The Federal Government is the country's largest energy user, spending almost $8 billion annually on energy costs. We operate over 500,000 facilities and almost 600,000 vehicles worldwide. The President's National Energy Plan calls on Federal agencies to conserve energy and to reduce energy use during peak hours in areas where outages are likely. Since 1985, the federal government as a whole reduced energy use in its buildings by more than 20 percent in 1999 thereby achieving its year 2000 goal one year early. Our most recent figures for FY 2000 places our reduction at 22% over the 1985 baseline. This represents a $2.2 billion energy savings, expressed in year 2000 dollars.

President Bush, in a May 3rd directive to Federal Agencies, asked that immediate steps be taken to reduce energy use, particularly peak demand in supply-constrained areas such as California. Agencies achieved some important results, including participation in a load reduction exercise on May 24th. During that exercise, 114 Federal facilities, representing 20 different agencies and roughly 80% of the federal load in California, demonstrated reductions in peak demand approaching 10%. To reduce overall demand in California, we have dispatched teams to 25 of the larger sites in California to identify the immediate no-cost/low cost opportunities for reducing demand. These teams are at work now, and we have asked them to report by July 31.

These efforts are important for practical reasons. But they are also important for symbolic ones. We can tell America it must use energy more efficiently . . . but if we fail to lead by example, we undermine our message.

It is our hope that energy efficiency in the federal realm will not be a short-term effort driven by current concerns about energy supply. Instead, we would like to

work with you to build a new culture of energy savings that pervades the way that the Federal Government procures buildings, appliances, vehicles, and all of the other items we purchase.

Whenever the federal government builds a new building, we should strive to design and build it to achieve the "Energy Star" certification. When existing federal buildings are modernized, we should incorporate the energy and water conservation efforts that are cost effective over the life cycle of the facility.

Recently in Kansas City, DOE hosted a Federal Energy Management conference where hundreds of federal procurement officials, building engineers, and program managers gathered to learn the latest approaches to saving energy and money for the taxpayer. We are working to develop that new culture of energy savings among federal government procurement and buildings officials because it makes sense for the taxpayer and it is good for the environment. As an additional benefit, we also find that our workers prefer to work in a building that incorporates the latest energy savings technologies.

One of the keys to successful implementation of federal energy savings measures is through the use of Energy Savings Performance Contracts and Utility Energy Savings Contracts. These financed approaches are being employed to finance energy savings measures without using appropriated dollars. To date, Federal agencies have already leveraged more than $1.3 billion in private sector investment for projects that replace inefficient building systems with state-of-the-art equipment.

The Federal government can also make a difference by making smart purchasing decisions. The Federal government spends more than $10 billion each year on energy-using equipment. The joint DOE/EPA ENERGY STAR® program identifies energy efficient products so that all consumers, including Federal purchasers, can make informed decisions that save energy and money.

So we applaud the effort to address federal energy use in section 4 of S. 352 (Bingaman) and sections 605 and 606 of S. 389 (Murkowski), and would like to work with you to fashion a workable approach in this area. With respect to specific comments, I would offer the following:

Section 4 of S. 352 (Bingaman) would require federal agencies to undertake a comprehensive review of all practicable measures to conserve energy, water, or employ renewable energy resources and to implement measures to achieve 50% of the potential savings within 180 days. Candidly, a comprehensive review of all practicable measures that we could employ in 500,000 federal buildings, followed by the implementation of steps to achieve 50% of identified potential savings, could simply not be done in 180 days. Moreover, sufficient funds have not been provided for this purpose. Our challenge is to change the acquisition planning efforts, and we believe that will be a long-term effort.

S. 389 (Murkowski) would require agencies to reduce energy use per gross square foot by 30% by 2010 and 50% by 2020 relative to a 1990 baseline. The current goals, contained in the National Energy Conservation and Production Act, the Energy Policy Act, and Executive Order 13123 are to reduce energy use per gross square foot by 20% in 2000, 30% by 2005, and 35% by 2010 relative to a 1985 baseline. S. 389 represents an acceleration of these targets and a shifting of the baseline. Thus, it is a very ambitious goal. We believe we might be able to support such a goal were it contained in comprehensive legislation that also addresses the supply and infrastructure issues identified in the National Energy Policy document.

As mentioned earlier, Energy Savings Performance Contracts (ESPCs) are an important tool federal managers can use to achieve their energy savings goals. S. 389 (Murkowski) would extend authority for ESPCs five years, and S. 352 (Bingaman) would repeal the sunset provision entirely. At this time, we can support a five year extension of existing authority for ESPC's to allow us to further quantify the benefits they provide.

S. 389 (Murkowski) would allow utility contracts, which are preferred -source energy savings contracts entered into between federal facilities and the utilities that serve them, to increase from a maximum 10-year term to a maximum 25-year term. This is in line with the 25-year terms allowed ESPCs. However, 25-year ESPC contracts contain performance guarantees as well as provisions to ensure measurement and verification of energy savings. We would like to continue to work with you to ensure that any expansion of utility contracting includes assurances of guaranteed energy savings.

S. 352 (Bingaman) would allow ESPCs to be used for water conservation measures and for replacement facilities. The Administration has concerns regarding the use of ESPCs for replacement facilities. However, provided that it is included in comprehensive legislation that also addresses the supply and infrastructure issues identified in the Administration's National Energy Policy, we could support the use

of ESPCs to conserve water, although we have some technical suggestions that we would like to work out with your staff.

ENERGY BANK PROVISIONS

Both S. 95 (Kohl) and section 1301 of S. 597 (Bingaman) would create an "energy bank" to help in the funding of federal energy management projects. This is a well-intentioned effort, but I am concerned about the practical applications of this particular language. particularly when we haven't yet fully taken full advantage of the opportunities afforded by ESPCs and "super ESPCs."

S. 95 and section 1301 of S. 597 would capitalize the energy bank by collecting 5% of the utility budgets of federal agencies, or roughly $180 million per year. Sharply higher energy prices have already stressed the operations and management (O&M) budgets of many federal agencies in the near term. Requiring agencies to capitalize a new energy bank in the near term, during these times of high energy prices, even if they might produce savings over the long term, would create operational hardships and impair the ability of federal agencies to fulfill their missions.

Moreover, the language of S. 95 and section 1301 of S. 597 is directed at projects with relatively short payback periods of three and seven years. Thus, the Energy Bank projects might "cherry pick" the energy-savings opportunities and actually result in fewer comprehensive energy savings projects.

We need to make sure we take full advantage of the opportunities afforded by ESPCs and Super ESPCs before we experiment with a new tool that could inadvertently result in fewer energy savings projects overall.

AIR CONDITIONING STANDARD

Finally, Mr. Chairman, I will comment on Senate Joint Resolution 15 (Boxer), a resolution of disapproval related to energy efficiency standards for residential air conditioners and heat pumps.

The purpose of S.J. Res. 15 is to force the Department of Energy to adopt new residential air conditioning and heat pump efficiency standards at the 13 SEER (Seasonal Energy Efficiency Ratio) performance level . . . a performance level that represents a 30% improvement over the current standard. We oppose this resolution.

The current efficiency standard is 10 SEER for split air conditioning and heat pump systems and 9.7 SEER for single-package systems. Today, 78% of air conditioning and heat pump sales are at the 10 SEER performance level. Many consumers choose to purchase higher-performing air conditioners and heat pumps, and in some areas of the country this makes very good sense.

However, as a minimum, national standard, to be in effect for virtually all central air conditioners and heat pumps in all areas of the country, the Department of Energy intends to propose a 12 SEER performance level that represents a 20% improvement over the current standard.

It should be noted that the current Administration reviewed and adopted, without change, efficiency standards covering washing machines, water heaters, and commercial heating and cooling systems. Only in the case of residential air conditioners and heat pumps are we proposing any variation from the prior Administration.

We do not take this action lightly. In the current political atmosphere, the convenient and popular approach would have been to simply accept the 13 SEER standard. Our forthcoming supplemental notice of proposal will explain our reasons for withdrawing the 13 SEER standard and for proposing a 12 SEER standard as the maximum technologically feasible level that is economically justified.

With that, Mr. Chairman, let me say that I look forward to working with you and your staff on legislation to promote energy efficiency in the weeks and months ahead. I am pleased to answer any questions the Committee may have.

The CHAIRMAN. Well, thank you, and thanks for your relatively brief summary of things. We encourage that from all witnesses.

Let me just ask first, one of the statements contained in your testimony that you repeated here gives me a little concern. It says that the administration is prepared to support more ambitious goals for the Federal Government related to energy use, and then you add this qualifier of saying, if it is contained in comprehensive legislation that also addresses supply and infrastructure issues.

Now, we intend to do all that, but it sounds as though you think it is sort of, you will agree to go along with improvements in energy

efficiency if we agree to do these other things that you want done, otherwise you will not. Am I reading something in there that is not intended to be there, I hope?

Mr. GARMAN. No, sir, not precisely. What we are trying to stress is the importance of a balanced approach. It is because of the nature of the energy debate.

I think it would be easy for us to go down the road, work together in this effort—candidly, some of the supply issues are not as politically popular as some of the demand issues, and if we were to get down to the end of the road where we were at a Rose Garden signing ceremony on an energy bill, and that bill was not a balanced bill, then we would have, I think, failed in our effort to really try to deliver a balanced package, and it might be, frankly, misleading to members of the public if they thought we had passed a bill that would accomplish goals and deliver us from our supply constraints when, in fact, it would not.

The CHAIRMAN. Well, I certainly agree with your objective of getting a balanced, comprehensive effort, and including efforts to increase supply, as well as improve efficiency.

I just do not want us to be into a quid pro quo kind of a situation where we are not willing to agree to something on the efficiency side unless someone else will agree to something we want in a way of opening ANWR, or something to that effect. I think that would be very destructive of an effort toward getting a comprehensive bill, and I just wanted to flag that.

The Federal Energy Management Program you refer to in the budget that we got, recommended fairly severe cuts in that. What is the position of the administration at this point? Frankly, I am concerned. The bill we passed in the Senate yesterday did not have the funding it should have had for that.

I cosponsored a bill with Senator Cantwell, an amendment with her that was intended to address that, and we were not able to get the support we needed to go ahead, but what is your view on the proper level of funding to support the Federal Energy Management Program?

Mr. GARMAN. Let me address that also, in the context of making an overarching observation about the budget and the process we have gone through in both energy efficiency and renewable energy. Of course, the new administration had to submit a budget covering these items on or about February 27 or so without the benefit of the guidance that was contained in the national energy policy document. That document, of course, came out May 16.

At the same time, the document asked us to undertake a strategic review of all of our programs, including FEMP, beginning with a pretty significant public outreach effort at the outset. We learned during that process, and we heard from stakeholders and the public about the importance of some of these programs. We also internally were beginning our strategic review.

What you have seen in statements of administration position about both the Energy and Water Development and Interior appropriations document that contain these programs is that we believe that the increases that Congress has provided in these programs over and above what we asked for indeed may be consistent with the President's objectives, so we have watched and interacted with

Congress as it has increased funding for some of these programs, including FEMP, over what we had asked for, and we believe that these are consistent with administration objectives.

The CHAIRMAN. So you do not have a problem with the increases that Congress has adopted so far.

Mr. GARMAN. As the overall number, no. We would like to reserve the right, if you will, to quibble with you on issues of priority and funding priorities within that overarching level, but that is a correct characterization, yes, sir.

The CHAIRMAN. With regard to this residential air conditioning rule, that was one of the first items related to energy efficiency that the administration dealt with, or at least one of the first ones I became aware of, and I was concerned. I believe I spoke to Secretary Abraham about this and urged that they stick with the more stringent rule that the Clinton administration had adopted, rather than backing off of that.

The decision was made by this administration to back off and require less of an improvement in residential air conditioning than the previous administration had intended to require. How do you explain that? I mean, particularly at a time when we are in the middle of a hot summer, and we are told that the biggest drain, or the biggest burden we are carrying in trying to keep the lights on in a place like California is the electricity being used in air conditioners. Why would we not want the highest possible level of efficiency in air conditioners?

Mr. GARMAN. The quick answer, and I will start with that, is that the law prescribes us to look at a number of factors. Energy efficiency is one of them, but it is not the only factor, nor is it the absolute factor.

I think it is important to start with the recognition that the incoming administration reviewed and adopted without change efficiency standards covering washing machines, covering water heaters, and covering commercial heating and cooling systems.

Only in the case of residential air conditioners and heat pumps are we proposing any variation from the prior administration, and the reason we did that is, we showed through our analysis, and in fact it was the same analysis used in the prior administration, that the 13-SEER standard would represent an unreasonable burden on consumers, a majority of the consumers, under the 13-SEER, under our analysis would suffer increased life cycle cost. In other words, they would not get a payback for the up-front investment for the higher cost of the equipment.

Based on that, and also based on concerns expressed by the Department of Justice, and borne up by our own analysis about the impacts on the industry, the 13-SEER would have the effect of accelerating the consolidation of the industry, already an industry where 97 percent of the business is controlled by seven large manufacturers. We do not think the consolidation of the industry over the long-term would be good for competition, good for consumers, or good for technological advancements leading to energy efficiency.

So that is just, I guess an overview of some of our thinking that is leading us to propose that 12 is probably the correct number.

The CHAIRMAN. Now, what is the status? You have not yet promulgated a rule at 12, is that right?

Mr. GARMAN. That is correct.

The CHAIRMAN. You are still looking at it?

Mr. GARMAN. Yes, sir.

The CHAIRMAN. I did submit some suggestions to Secretary Abraham and some figures that I would like also to get to you, which indicate to us that the decision was made by your administration here to back off of the more stringent standard that was based on the average cost of electricity in 1996, and that if you look instead at the cost of electricity at peak periods, that the standard that was adopted or agreed to by the previous administration is clearly a better choice.

If you could look at those figures and maybe get back to us, and give us some response to that, because I do not think it is just a question of how good is good enough. I think that there are some substantial savings overall that can be realized if we were to stick with the more stringent standard.

Mr. GARMAN. I can, in fact, in a broad-brush way address some of those issues now, if you care to, or we can do it later, whatever your preference is.

The CHAIRMAN. All right. Well, I am told my time has expired. Let me ask Senator Murkowski to go ahead with his questions at this point. Maybe we will come back.

Senator MURKOWSKI. Thank you, Senator. I am curious, in your chart relative to energy loss, you indicate 33 quads of input, and generating loss of 22, is there technology available to reduce the tremendous loss associated with this, and why are we not making more progress there?

Mr. GARMAN. Part of it has to do with just the nature of the way that our electricity system evolved. We have a centralized grid system, with centralized plants, and many of those plants, say, a coal plant, will have a conversion efficiency—in other words, convert the energy content of the coal, converting that to electricity—and lose two-thirds of the energy potential in that process.

That is the large arrow, the conversion loss, as you see, going off at the top. You have those kinds of conversion efficiencies in many plants. A typical coal plant will have a conversion efficiency of around 35 percent. When you get into combined cycle natural gas, you start to approach 60 percent, so you are doing better there. When you start to look at combined heat and power, and distributed generation, you start to get towards 70 or more percent.

Senator MURKOWSKI. What is nuclear?

Mr. GARMAN. Nuclear, I do not have a precise number on that, but it still suffers a conversion deficiency issue, but nuclear is a little different in that one of the things you are concerned about in the efficiency loss is the burning of fossil fuels, and we are less concerned about efficiency losses in the nuclear context, because it is emission-free.

Senator MURKOWSKI. I would like to pick up on a point Senator Bingaman made relative to your generalization of the effort to work towards a comprehensive bill, and it is certainly my position, and I think it reflects on the responsibility of this committee to not make this mistake we made in 1992, not that this committee made the mistake, but the Senate basically made the mistake, and I am going to refer to this chart behind me which Joe is going to hold

up, and Senator Bingaman has seen it time and time again, but it reflects reality.

And a little history relative to what we did in 1992, when Senator Bennett Johnson was chairman of the committee, we passed efforts to increase domestic production, reduce dependence on foreign oil, expedite infrastructure, develop alternatives, encourage renewables, promote conservation, and increase LIHEAP and weatherization, and I think we funded about $6 billion for renewables and alternatives.

These all passed in this committee, but this is what we got on the floor: We got a little bit of funding for renewables and alternative fuels, energy efficiency, and LIHEAP, but we did not reflect the realities associated with why things are different now, and the next chart which Joe will run over and get will show you why things are different.

The reason things are different this time is, we did not act in 1992 from the standpoint of the responsibility of the Congress, and now our foreign oil dependence is up 56 percent, and it was, what, 37 percent in 1973, when we had the Arab oil embargo. The Department of Energy says we will be in the low sixties by the year 2010. What does that mean to the national security of this country?

Natural gas prices have soared as high as $10. We have seen no new nuclear plants in 10 years or more, no new gasoline refineries in nearly 20 years, no new coal-fired plants since 1995, and now we are faced with the reality that our transmission capacity, whether it be gas or electric, is inadequate.

And when we talk about how we are going to correct this, and you talk about a comprehensive bill, and we talk about the merits of ANWR, instead of just dismissing it, which was generalized yesterday, or suggesting that, well, we are not going to do it if you have this, there is as much justification for encouraging the merits of what ANWR can contribute as opposed to what ANWR offers as a distraction from the standpoint of the environmental community.

So I hope as we develop a comprehensive bill we can recognize the objective here, and the objective is a balanced, comprehensive bill that provides relief for a number of the shortages associated with the fact that we do have a crisis, and we are going to have to do what is good for America, and good for Americans, not necessarily for one segment of the environmental community that has jumped on this issue as a major source of funding and a major source of membership.

As you know, I feel very strongly about that, and we are going to be pursuing that in this committee, and we are going to be discussing the merits, as opposed to superficial discussion on it.

I want to also reflect on another question relative to the anticipated proceeds of the bonus bid associated with the sale of Federal leases in ANWR. I think the estimate is somewhere in the area of $1.2 billion, and the administration's proposal is to use those funds for research and development for renewables, alternatives and so forth.

Now, in your opinion, using these funds for renewables, efficiencies, alternatives, you know, we all talk about energy in general, but we really do not separate energy. We have two types of energy. We have energy that develops electric generation, and that

is nuclear, it is coal, it is hydro, but America and the world moves on oil, and unfortunately we do not have much relief in the foreseeable future. We have fuel cells, and things coming on, but the reality indicates that hydrogen is a way off.

We had in my office the other day a little hydrogen exhibit, and the uniqueness of it was that it worked, but it worked as a consequence of an electric fan being plugged in, so if you did not have the electric fan plugged in I am not sure what would happen. I suppose we would be looking at a stationary hydrogen plant.

But can you tell us from the standpoint of any significant replacement for oil what we might look towards, and is there any estimate of a time sequence where, say, we could look to 15 to 20, 25 percent of our transportation being dependent on something other than oil, or kerosene, or derivatives, that move our ships and our planes and our trucks?

Mr. GARMAN. Well, the way we are approaching this problem is looking at the oil replacement issue as requiring really an R&D portfolio of both short-term and long-term technologies. Oil is a tricky problem in part because of the infrastructure. Clearly, there are things we can do in the short term with respect to hybrid gasoline-electric cars, and some other technologies that can serve as a bridge to fuel cells and the eventual hydrogen, so-called hydrogen economy.

There are also some things we could do in the area of bioenergy with biologically based fuels such as ethanol, or derivatives of ethanol that might form a basis for a transportation fuel, again in the near term, as we keep our eye on the long-term prospective, which is really hydrogen over the long term.

The difficult part, of course, is going to be cost. We estimate that a fuel cell in a car, to compete with the internal combustion engine, is to going to have to come down to the price of around $50 to $100 per kilowatt. Right now those costs are in the neighborhood of $3,000 or $4,000 per kilowatt, and so our R&D effort is driven at bringing down those costs to make that technology more affordable and bring it into the marketplace, but it is going to be an effort that spans, we think, decades.

Senator MURKOWSKI. Is it the process of converting to hydrogen that is the cost? Is there some mechanical process that is extremely complex?

Mr. GARMAN. Creating hydrogen is not difficult. It is more expensive right now because of the energy you have to input into the process of separating the hydrogen from the natural gas, but it is also using that hydrogen effectively. Transporting it is an issue. It is corrosive, it is flammable, it has other issues that are tricky to deal with, so you have to have a portfolio approach to your research and development that tries to deal not only with the creation of hydrogen, but the transportation, distribution, and the final end use of the hydrogen.

Also, hydrogen compared to oil does not have the same kind of energy density. You just do not have the same kind of Btus in any given volume of hydrogen that you have in a hydrocarbon. That is another thing we have to come to grips with.

Senator MURKOWSKI. Would you say as a rule of thumb, relative to how much we could relieve our dependence on oil, you said a

couple of decades before we probably develop a replacement. I would assume, then, that the next 10 years or so we are still going to be pretty much 75 percent dependent on oil for the movement of America, or thereabouts?

Mr. GARMAN. As a transportation fuel, unless we can find dramatic new ways to integrate more bio-based fuels, ethanols or similar derivatives into the system, then yes, we will continue to be dependent on oil and fossil fuels for the foreseeable future.

Senator MURKOWSKI. Thank you.

The CHAIRMAN. Senator Burns.

Senator BURNS. Thank you, Mr. Chairman, and thank you for this hearing today, and I would ask that my full statement be made a part of the record

[The prepared statement of Senator Burns follows:]

PREPARED STATEMENT OF HON. CONRAD BURNS, U.S. SENATOR FROM MONTANA

Mr. Chairman, thank you for calling this important hearing today on energy efficiency and energy assistance programs. LIHEAP, the Weatherization Assistance Program, and the Federal Energy Management Program are all very important initiatives. I look forward to hearing our witnesses testify today.

Energy conservation and efficiency must be a part of a national strategy and the United States has come a long way on this already. Since 1973, the U.S. economy has grown nearly five times faster than energy use. Had we continued to use energy as intensively as in 1970, the U.S. would have consumed about 177 quadrillion Btus of energy last year, compared to about 99 quadrillion Btus actually consumed. The federal government has also made strong advancements in its energy consumption reductions. Largely by installing energy efficient technologies, the federal government has reduced its energy use by about 30 percent from 1990 levels.

The backbone of America, our farmers and ranchers, have done their part to reduce energy as well. Our farmers have reduced their energy use by 41 percent from 1977-1998, while agricultural output grew by about 40 percent over the same period.

What angers me now is that those same farmers are now forced to pay higher prices for irrigation, oil, gas, propane, and electric prices because we have had too many elected officials close off resources and create environmental regulations that hinder new electrical generation. I applaud President Bush for his proposal to double funding for the Weatherization Assistance Program. I applaud President Bush, Chairman Bingaman, and Ranking Member Murkowski's commitment to provide strong funding increases for the Low Income Home Energy Assistance Program (LIHEAP). But I stare in amazement at my colleagues in the U.S. Congress who can vote against allowing oil and gas drilling in areas where it can clearly be done in an environmentally sensitive manner, and still complain about high energy prices.

The figures show how much progress this nation has seen when it comes to conservation. The recent energy crisis shows that conservation alone has not been enough. I say again that I proudly support LIHEAP and the increases for the Weatherization Assistance Programs. However, I think the issues before us today go back to pure philosophical differences. Allowing Americans to increase the energy supply for this country will lower prices for senior citizens and others on fixed incomes. Some members would rather fight every attempt to increase supply, and hold those same seniors and people on fixed incomes under their control and make them dependent on every check from Washington, DC.

It is very clear that we have before us a mandate to conserve more energy, to become more energy efficient. Though we have made many gains, we can do much more. Aside from what we must do to increase energy supply, and what we can do to increase conservation; working on increased funding for LIHEAP and Weatherization Assistance are two things we must do to bring immediate assistance to senior citizens and folks on fixed incomes.

I am confident that this committee will build the consensus to pass legislation needed to address our nations most pressing needs.

Senator BURNS. I want to pick up on a question that the ranking member made this morning about the efficiency of transmitting electricity in our transmission lines.

I visited with a couple of companies that are doing a lot of work on their research on that, and particularly one company has made some real advances as far as making our present-day transmission lines more efficient, and not finding the drop-off that we have had in the past—it is not quite ready yet, but I think it will be ready very soon—about some demonstrations, working with the Department of Energy, I would assume, and working also with private transmission companies in order to see that happen, and also we have legislation now.

I would ask that the Energy Department, or maybe this committee, look at our grid across the Nation. I have long said that we cannot really take advantage of electrical efficiencies unless we have a national grid where we can transfer power almost on a moment's notice, as compared with how we do it today.

We have a tie in Miles City, Montana that does not allow us to move East or West, or West to East, on the northern tier of States, and that tie is at Miles City, Montana. I have legislation now that would address that situation to where it will bring us to a national grid, rather than to regional grids, and to seek out those areas where we have some inefficiencies.

But I also want to reiterate the concerns we have in agriculture. Agriculture was asked to make their efficiencies in the use of energy on their farms and ranches across this country, were asked to do that some time ago, and they have made great strides. In fact, the number is phenomenal on what we have done as far as efficiency on irrigation, on how we power our equipment, everything that we have, and you have got to remember that we are energy-dependent on our farms and ranches, because we can produce the product.

It takes energy to do that, but it also takes the energy to move that product, that food and fiber to market, so we are hit every way that we can be hit as far as energy is concerned, and I think they have done their share of tightening their belt.

But what angers me now most, we are now forced to pay more for our transportation fuels and our electricity, which relates to our cost of irrigation, our cost of transportation, oil and gas, even our natural gas that, of course, increased the price of our fertilizers, because it is a base of fertilizer. It comes out from natural gas, our electrical prices, and yet we find that we are being closed off on certain avenues to increase production so that we might operate.

Weatherization is important, I know, and the LIHEAP program is important, but they do not get us to the point where we can actually produce food and fiber for this country.

I just stared in amazement—yesterday was a good example of that, that vote yesterday on Klamath Falls, and it was indicative of a mind set that we are going to put a sucker fish before farmers because right now that we are finally finding out that there is a flaw in the Endangered Species Act that is going to be very, very costly to this country, and what we have witnessed in the Klamath Falls area is just the tip of the iceberg, and we have to allow new production somewhere in this country, and make it available to people.

Figures show that—I support LIHEAP, but if you look at it—it is still people on fixed incomes are elderly, are dependent on a gov-

ernment check so they can heat their houses, and fundamentally, that is wrong, is to be reliant on the Government to prop up, or to really subsidize the energy companies, because they have their cost of production, and they are tightened down with supplies, and of course the marketplace is going to drive the price.

So mine is not a question, but I would ask Mr. Garman whether these companies—there are two companies primarily in the area of transmission that can increase the efficiency of our transmission—can sit down and visit with him one day and let us try, if we need more research dollars, some R&D dollars in order to take a look at that, I think it is time we looked at it, and I think it is also a time that we take a look at our grids and our transmission abilities across this country, because we are running into it in the Northwest, with the BPA, and everybody on this committee is familiar with that.

But I think the general public—you know, I am still amazed that way last February, that a poll taken that said 54 percent of the people that live in California do not think they have a shortage problem. They filled out that poll in the dark. I have got to believe that. In other words, they just will not face reality that it is going to take more energy—our population is more. We do more with electricity now than ever before.

I work in communications issues. The Internet servers, everything we touch now, we use electricity, a lot more electricity, maybe not in the industrial area, but I mean, our residential and home use of electricity has just—the demand for it has just gone up dramatically because of the things we do in our homes that we did not used to do in our homes and residences.

So Mr. Chairman, thank you for this hearing, but I think those are the areas. When we really know how this grid works, and the efficiency of it, and the technologies out there in transmission, then I think we can start readdressing the problems of transmission of electricity.

Thank you, Mr. Chairman.

Mr. GARMAN. I wonder if I could just amplify on one or two remarks that you made, particularly with respect to the efficiency of transmission. We at the Department are trying to partner with some of the very people you are speaking about, and increasing the efficiency of our transmission system. Today, under the streets of Detroit, we have a test of a high-temperature superconducting transmission wire, if you will, cable, if you will, that is increasing the throughput and reducing the losses associated with transmission.

We are also working on ways to manage the grid through computer algorithms, and some other types of approaches to doing it.

We are also looking at new technologies in distribution transformers and other components of the grid to increase their efficiency, and, of course, as we will talk about next week, we are looking at distributed generation.

You know, you can look at the grid from a top-down approach, but you can also look at it from the bottom up. If we can put smaller distributed generation from the bottom up, we also increase efficiency and reliability. We put the source closer to the user so you

have less of a loss. You can address peak issues, you can address reliability issues.

The bottom line, I guess, with the time I have got, is that there is no one silver bullet to addressing these energy problems. We cannot say efficiency is going to do it. We cannot say supply is going to do it. We have to have a pretty broad approach, and if Americans are waiting for the magic technology that is going to solve all of our energy problems, then it is my observation that that technology does not exist. We are going to have to do a lot of relatively small things extremely well.

Senator BURNS. Well, I agree with you, and I have heard the chairman of this committee, Mr. Bingaman, say that very thing. It has to be a hand-in-glove situation, a cooperative situation, and especially, just to give you a case in Montana, we can really produce a lot of electricity because we have got the coal and we have got a very, very cheap way, low-cost way of producing electricity.

Now, I can get that to my farmers, but we are not the only State in agriculture. We have got Iowa and the bread basket of this great country that also are feeling the effects of this energy crunch at the agricultural production level, and I guess I worry about that as much as anybody does, because I still think the basic purpose of this country is the production of food and fiber for our people.

We cannot put that on the back burner, because I do not know what the first thing you do when you get up in the morning, but I know the second thing you do is, you eat, and you have got a lot of options, the first thing, but that second one you do not, and I worry about that, and the efficiency, and the way we can get food and fiber to our people.

And then an attitude, an attitude that we can do, so it has to be a mix. I agree with my chairman wholeheartedly, it has to be a mix. It cannot be just one single thing, production or efficiency.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you very much. We have two additional panels with a total of eight witnesses, and with that in mind let me thank Secretary Garman very much for being here, and we will continue to talk with you and seek your advice as we move ahead. Thank you very much.

Mr. GARMAN. Thank you, Mr. Chairman.

The CHAIRMAN. Will the second panel please come forward. We have Ms. Mary Ann Manoogian, director of the Governor's Office of Energy and Community Services in New Hampshire, Ms. Joanne Choate, the LIHEAP manager for the State Housing Authority in Maine, Mr. Erik Emblem, the administrator with the National Energy Management Institute here in Virginia, and Mr. Mark Wagner, director of government relations with Johnson Controls.

Thank you all very much for being here. Why don't we go right across, starting on the left here and just go across, and each of you, we will include your full statement in the record as if read, but if you could summarize the main points that you wish to make to us, we would be anxious to hear those, and then we will have some questions.

Ms. Manoogian.

STATEMENT OF MARY ANN MANOOGIAN, DIRECTOR, GOVERNOR'S OFFICE OF ENERGY AND COMMUNITY SERVICES, CONCORD, NH

Ms. MANOOGIAN. Thank you, Mr. Chairman, members of the committee. My name is Mary Ann Manoogian. I am pleased to testify today on behalf of the National Association of State Energy Officials, known as NASEO. I serve as director of the Governor's Office of Energy and Community Services in New Hampshire, where my responsibilities include the oversight of the State Energy Program, known as SEP, the Low Income Weatherization Program, and the Low Income Home Energy Assistance Program, also referred to as LIHEAP.

As you know, NASEO represents 49 of the State energy offices, as well as the territories and the District of Columbia. NASEO's overall objective is to support balanced national energy policies, and to provide State perspectives on energy issues. NASEO members operate energy programs involving all sectors of the economy and all types of energy sources.

As you move forward in addressing our Nation's energy policy needs, we are pleased to provide input on a nonpartisan basis to both the Senate and the House, as well as the administration, and my written testimony elaborates further on NASEO's support of S. 352, the Energy Emergency Response Act of 2001. I would like to, however, highlight the importance for NASEO of the programs we support with respect to the increased authorization for the State energy program to $75 million, the base LIHEAP grant to $3.4 billion a year, and the weatherization program to $310 million per year.

This would be a 4-year authorization, which is a more efficient way for the States to be able to operate these federally funded programs. The State Energy Program, the Weatherization and LIHEAP programs are all deserving of bipartisan support and generally we have received such support in the past.

Recently, I understand S. 352 was added to the Senate-passed bankruptcy reform bill. Provisions similar to S. 352 are included in Senator Murkowski's comprehensive bill, and I understand that if the committee were to begin the final drafting process for S. 352 by starting with provisions common to both Mr. Murkowski's bill and S. 352, that S. 352 would be included in its entirety, and that is a measure that we would support.

As you may know already, SEP activities touch on every sector of the economy. The State energy offices work with residential consumers, the small business sector, manufacturing, industry, agricultural interests, our public schools and hospitals, and nonprofit entities, et cetera. SEP has documented the ability to leverage at least $4 in private sector funds for every Federal dollar that is spent, and that does not even include the State contribution.

Unlike other energy programs funded by the U.S. Department of Energy, SEP is tailored to acknowledge State-by-State and regional differences, including diverse priorities and, in fact, in my written testimony I have been able to provide you with some examples of SEP activities going on in various States throughout the country, and I would encourage you to review that if possible.

I would, however, like to highlight a program that was initiated by NASEO and included Louisiana, Alaska, New Mexico, Oklahoma, Colorado, Wyoming, and Montana, and the project was to increase the energy efficiency of marginal oil wells.

I have provided a copy of NASEO's publication entitled Dashboard Guide to Energy Efficiency in the Oilfield to the committee. Ironically, many scoffed when NASEO began to work on this project, questioning why energy producers would want energy efficiency. Our efforts revealed that the highest cost of energy production is in removing it from the ground, higher than the associated equipment costs, and labor cost. A producer with marginal wells needs every little bit of savings he or she can put their hands on.

As a result of implementation of the recommendations contained in NASEO's guide, a marginal well can expect to cut its lifting or production cost by $1 per barrel with little or no investment of additional funds.

I would also like to call to your attention the value of the weatherization program, which is vital to addressing the disproportionate energy burdens that low-income citizens face. In addition to the meaningful energy conservation measures that help reduce energy bills, the program also addresses important health and safety measures of many families and vulnerable elderly and disabled persons.

The weatherization program has been an essential long-term program that complements the critical short-term assistance provided by the LIHEAP program. One of the reasons that the program has been so effective is due to the fact that the delivery network responsible for implementing the cost-saving weatherization measures are highly skilled. In addition, weatherization program energy auditors play a key role in helping low income households respond to our present energy crisis while addressing their long-term needs as well.

So the issue of the weatherization program is not in producing meaningful results. It has already been proven through a report with Oak Ridge National Laboratory. The issue is that the program does not have sufficient funding to meet the demands of our most vulnerable residents.

For instance, in my State of New Hampshire, using both DOE funds and available LIHEAP funds last year, out of the approximately 7,493 New Hampshire fuel assistance recipients who requested weatherization of services, New Hampshire was able to complete 526 weatherization jobs, only 7 percent of the requests. Low income households know the value of energy conservation. They just do not have the means to get there. The weatherization provides the support to help them reduce their energy bills.

NASEO strongly supports the authorization provided in Chairman Bingaman's bill and Senator Murkowski's bill. What I would like to say also is that if we are serious about dealing with our energy problems, substantial increased funding for weatherization would enable our States to plan for energy emergencies and, when possible, take preemptive action to avoid an energy crisis by promoting energy efficiencies.

NASEO urges the committee to move forward not only on the authorized funding levels but also to support a funding level at least

equal to the House-passed Interior Appropriations bill during conference, and although I have restricted my testimony to the State energy and weatherization programs, I would be rather remiss, as someone who is responsible for the oversight of the LIHEAP program in our State as well, to not underscore the importance and value of that program.

This past year, our State had an 18-percent increase from the number of households served by LIHEAP, and at a funding level that is currently being discussed. What we know is that my office will have a harsh reality of having to deny assistance to more than 11,000 elderly, disabled, and working poor households in the upcoming winter season. What I can tell you is that as I am sitting here spewing these figures and numbers out to you, I also have the benefit, as being the director of a State agency, of telling you the value of these programs that have been implemented, and I am reminded of a story of the woman who is an employee at a well-known department chain and she never expected to be needing LIHEAP assistance.

This past year she was one of the 3,848 requests that we received for emergency assistance, meaning she was in a dangerous situation of being with no heat, or low heat situation, and being out of heat in the middle of winter in New Hampshire is a serious issue. Had it not been for the LIHEAP program, she would not have made it through the winter months with her disability, and be able to support and keep her disabled son warm in her home. She was trying to do the best she could. She tried to do whatever she could do to provide for her son, and she was working full-time. It just was not enough to pay for the heating costs.

Thank you. I appreciate your support, and we look forward to working with the committee.

[The prepared statement of Ms. Manoogian follows:]

PREPARED STATEMENT OF MARY ANN MANOOGIAN, DIRECTOR, GOVERNOR'S OFFICE OF ENERGY AND COMMUNITY SERVICES, CONCORD, NH

Mr. Chairman, members of the Committee, my name is Mary Ann Manoogian, and I am pleased to testify today on behalf of the National Association of State Energy Officials (NASEO). I will be discussing our views on S. 352, introduced on February 15, 2001, and supported by a wide range of Senators. I serve as Director of the Governor's Office of Energy and Community Services in New Hampshire, where I am responsible for the oversight of the State Energy Program, the Low-Income Weatherization Program and the Low-Income Home Energy Assistance Program (LIHEAP).

NASEO represents forty-nine of the state energy offices, as well as the territories and the District of Columbia. NASEO's overall objective is to support balanced national energy policies and to provide state perspectives on energy issues. NASEO members operate energy programs involving all sectors of the economy and all types of energy resources. The state energy officials are also generally our Governors' energy policy advisors, frequently called upon to advise our Governors and legislators on policy, programmatic, regulatory and legislative options to address our energy situation. As you move forward in addressing our Nation's energy policy needs, we are pleased to provide input on a non-partisan basis to both the Senate and the House, as well as the Administration.

S. 352, the Energy Emergency Response Act of 2001, would increase authorizations for: 1) the State Energy Program (SEP) to $75 million; 2) base LIHEAP to $3.4 billion per year; and 3) the Weatherization Program to $310 million. This would be a four-year authorization, which is a more efficient way to operate these federally funded programs. The bill would also encourage expanded use of energy efficiency and renewable energy measures in federal buildings, permit expanded use of energy savings performance contracts in federal buildings, eliminate the "sunset" provision

for energy savings performance contracts and expand federal energy efficiency performance contracts to include water efficiency. In light of the current energy needs of the country, these provisions provide a common sense approach to the challenges before us. These programs save money, save energy, and in many instances reduce air pollution, combat climate change and leverage enormous amounts of non-federal investment for meaningful projects that actually help people.

The State Energy Program, Weatherization and LIHEAP are all deserving of bipartisan support, and have generally received such support in the past. Recently, S. 352 was added to the Senate-passed bankruptcy reform bill. Provisions similar to S. 352 are included in Senator Murkowski's comprehensive bill (Sections 601, 603-604). I understand that if the Committee were to begin the final drafting process for S. 352 by starting with provisions common to both Mr. Murkowski's bill and S. 352; S. 352 would be included in its entirety.

Our experience has taught us that, the State Energy Program, Weatherization, and LIHEAP are critical components of a balanced national energy policy. These programs are both under-valued and under-funded. We applaud you for initiating a comprehensive look at energy programs and policy. We are also encouraged by the Administration's decision to conduct a complete review of the energy efficiency and renewable energy program of the U.S. Department of Energy. Assistant Secretary Garman is to be commended for his work in conducting these reviews. If the analysis is intended to focus on measures of success: energy saved, money saved, leverage of other resources, new technologies deployed, research and development stimulated, SEP would be a huge winner. It offers a balanced approach that recognizes the value of efficiency improvements and encourages development of both supply-side and demand-side resources is responsible and necessary.

STATE ENERGY PROGRAM

SEP is the major state-federal partnership program in the energy area. While it makes up a small portion of overall funding for state energy activities, it is a critical nucleus for many of the states. For example, SEP funds are used to prepare for and respond to energy emergencies and supply disruptions. State energy offices have used these funds to help states effectively respond to these challenges, ranging from western electricity problems to Midwestern natural gas and gasoline price spikes, historically low inventory levels and multiple other problems across the country over the last few driving and heating seasons.

SEP activities touch on every sector of the economy. The state energy offices work with low-income Americans, the small business sector, manufacturing industry, agricultural interests, our public schools and hospitals, non-profit entities, and so on. SEP has documented a leverage of at least $4 in private sector funds for every federal dollar, not even including the state contribution. Unlike other energy programs funded by the U.S. Department of Energy, SEP is tailored to acknowledge state-by-state and regional differences; including diverse priorities.

Examples of innovative projects, funded in part by SEP, include the following:

New Mexico—Assisted the community of Los Alamos in its rebuilding efforts after the Cerro Grande fire. Provided technical assistance and information at several forums to enhance awareness of the benefits of using renewable resources and applying energy efficiency measures in new construction. Sponsored a two-day workshop, "Passive Solar Design Strategies and the Energy-10 Program," October 2000, at the Los Alamos branch of the University of New Mexico (UNM).

Hawaii—The Hawaii energy office operates one of the most comprehensive energy emergency programs in the nation. The threat of typhoons and tsunamis pose a great risk to its citizens. Consequently, the energy office is constantly updating their energy emergency planning and conducting simulations that involve federal, state, and private sector representatives from the 5 big islands and even from the mainland. Hawaii's expertise in the area of energy emergency planning is recognized nationwide and, consequently, members of the state's energy office staff have made numerous presentations and even assisted in writing other state energy emergency plans.

North Dakota—The North Dakota State Buildings Energy Conservation Program provides grant funding to state institutions and agencies for the installation and implementation of energy efficiency measures. Energy audits are required to identify potential energy conservation measures, respective costs, energy savings and payback periods.

Awards have been made to many of the state-supported colleges and universities to match federal energy conservation funds. In addition, grants have gone to projects at the Capitol complex, the State Penitentiary, Department of Transportation buildings, and many others.

Florida—Florida's Energy Office is involved in a number of efficiency and renewable energy activities. One of the most promising activities is in the area of building code development and upgrades. Primarily as a result of Hurricane Andrew, not to mention a number of relatively minor hurricanes since Andrew, the energy office has been working with members of the insurance and home building community to develop building codes that will enable new homes in Florida to withstand stronger winds and coastal flooding while reducing energy usage in the residential and commercial sector. These codes are near the implementation stage and a number of states are watching this process closely.

Oregon—The State of Oregon has some of the most progressive efficiency programs in the nation. One of the most successful efficiency programs is in fact a tax rebate program. The state allows tax rebates on specified commercial business investments in efficiency. Once again, this is a program that is being watched closely by other states, particularly, those with peak electricity capacity problems, which are paying attention to the demand side energy savings resulting from the implementation of tax incentives.

South Dakota—Electricity generated from wind turbines is proving to be a big winner in the Green Power arena. Cost-effective and environmentally sound, wind energy is expected to see tremendous growth over the next decade. South Dakota recently completed a wind farm project that is the subject of a great deal of national attention. The October 2000, conference on wind power in South Dakota was one of the most successful wind energy conferences to date.

Louisiana, Alaska, New Mexico, Oklahoma, Colorado, Wyoming, and Montana were all participants in a project undertaken by NASEO designed to increase the energy efficiency of marginal oil wells. I have several copies of NASEO's publication entitled, *Dashboard Guide to Energy Efficiency in the Oil Field*, which I will leave with the Committee.

Many scoffed when NASEO began to work on this project questioning why energy producers would want assistance in energy efficiency. Our efforts revealed that the highest cost of oil production is in removing it from the ground—higher than the associated equipment costs and labor costs. A producer with marginal wells needs every little bit of savings he or she can put their hands on. As a result of implementation of the recommendations contained in NASEO's guide, a marginal well can expect to cut its lifting or production costs by $1 per barrel with little or no investment of additional funds.

Idaho—The State of Idaho has developed a CD that informs farmers, based upon soil and climate conditions, exactly when to apply irrigation to fields. Idaho also operates a successful low-interest loan program for residential, commercial, agricultural, government, and schools projects. To date, 1,973 loans totaling $13,338,371 have been issued. These loans generate $3,800,919 in annual savings.

Indiana and Kentucky—Like our colleagues in Hawaii, the State of Indiana and Commonwealth of Kentucky operate exemplary energy emergency programs. The states are recognized throughout the Midwest for their work with the propane industry at mitigating the impacts of supply disruptions. On July 25, they will be hosting a regional meeting for the propane industry and major consumers to discuss current and anticipated propane issues.

Illinois—Most recently, staff completed the oversight of the implementation of $20 million in energy-efficiency capital improvements through Energy Performance Contracting arrangements in seven state-owned facilities. This pilot initiative is demonstrating the cost effectiveness of utilizing energy performance contracts in state buildings. In the first two years after implementation the pilot initiative is producing energy savings averaging greater than 27 percent of the $9.4 million utility cost of the facilities and is generating over $2.6 million in annual savings at the seven participating state agency and university facilities.

Like Illinois, my own state of New Hampshire uses SEP funds to support an ambitious performance contracting program. In 1998, Governor Shaheen launched the Building Energy Conservation Initiative, which when completed will save the state $6-$8 million annually in energy costs. The program is surveying 500 state buildings for energy and resource conservation opportunities and then using guaranteed energy savings as the equity to secure financing for building upgrades. Over the next several years, the State of New Hampshire will reduce its energy consumption by as much as 33 million kWh annually and carbon dioxide greenhouse emissions by 132,300 tons each year without incurring any capital expenses. In this example, SEP funds support a program that leverages as much as $25 million in financing.

In addition to the project identified above, New Hampshire, due to Governor Shaheen's leadership and the support of SEP funds, has also reached businesses, public housing projects, schools and municipalities through our Renewable Energy Technology Grants Program, which provided funding for renewable energy dem-

onstration projects at 27 schools, science centers, museums and affordable housing developments across the state. SEP funds have also been instrumental in the success of our Rebuild New Hampshire Program enabling us to conduct public workshops on energy efficiency, and environmentally sound new technologies to more than 90 school districts, public housing agencies, cities and towns in the last two years.

The value of SEP throughout the nation is that it permits innovation over a wide variety of energy activities. The statutory language, which was substantially broadened in the State Energy Efficiency Programs Improvement Act of 1990, encourages states to take any action to improve efficiency, promote technology transfer and assist all types of energy consumers.

The approach the states are taking to energy is to encourage economic development, increase the deployment of new technology, while increasing affordability for homeowners and improving the work environment for employees. This involves helping businesses reduce operating costs, enhancing productivity and reducing energy demand, while providing significant environmental benefits. One of the many roles of state energy offices is to achieve these goals within the framework of SEP. The work of these offices includes installation of cost-effective energy efficient technologies in public school buildings, building code upgrades, implementation of tax credits for energy efficient retrofits, promotion of transportation efficiency (telecommuting, ridesharing), alternative transportation fuels, operation of public benefits programs through restructuring, etc. Our offices promote the use of energy service performance contracts that utilize private financing to conduct energy efficiency programs. This has become a $1-$1.5 billion/year business.

Another critical activity, which has become increasingly important, is the effort to coordinate energy and environmental programs, policies and regulations. A series of state pilot efforts are underway throughout the country. For example, in my region state and local energy and environmental officials are working to develop technical standards for distributed generation so that our environmental programs and our energy programs do not conflict. We have found that approaching these activities together, early on, tends to reduce cost and increase the ability of the private sector to implement energy projects.

Finally, a program not subject to this authorization hearing but one we urge continued support for is the SEP Special Projects. This program provides leveraged funds on a competitive basis for state energy office-initiated projects with business, industry and the public such as the highly successful Industries of the Future Program. I personally know that in my state of New Hampshire, Industries of the Future would not exist without SEP Special Project Funds. In the 18 months since New Hampshire launched our Industries of the Future program, the partnership between state and federal government and private industry has enabled 51 New Hampshire businesses to find high-tech ways to cut their energy use, saving them money on their energy bills and protecting our environment. One example is a paper mill in the southwestern part of the state that is investing in cutting-edge energy efficient technologies. This investment will save this company, which employs 260 people and produces 100 tons a day of specialty paper products, about $500,000 a year on its electricity bills.

We also urge the Committee to strongly endorse the schools energy efficiency program included in both Chairman Bingaman's (Section 1302) and Senator Murkowski's bill (Section 602). Representatives Mark Udall and Sherwood Boehlert first introduced H.R. 1129, which would initiate a new era in implementing energy efficiency projects for hard-pressed schools. This would be a good substitute for the Institutional Conservation Program (ICP) that is no longer is operation. It would encourage both public and private financing of school projects. We can all agree that not enough funding is going to our schools, and certainly wasteful, one-time energy costs do nothing to provide education to our children—we can and should implement this program. It will require authorization and we would urge that the program be implemented by the U.S. Department of Energy.

LOW-INCOME WEATHERIZATION PROGRAM

The Weatherization Program is vital to addressing the disproportionate energy burdens that low-income citizens face. In addition to the meaningful energy conservation measures that help reduce energy bills, the program also addresses important health and safety measures of many families and vulnerable elderly and disabled persons.

It has been an essential long-term program that complements the critical, short-term assistance provided by the LIHEAP program. In general, households that are poor use a dramatically higher percentage of annual income on heating and cooling

than the average American family. While 4-5% of annual income is spent on all energy bills for the average American household, the households that are poor spend more than 20% on energy annually, depending upon the fuel source and location.

The Weatherization Program has proven that it is effective and works for these low-income households. According to an Oak Ridge National Laboratory study conducted in the past few years, the average home saves over 20% on energy costs after Weatherization is completed. Obviously the recent increases in energy costs have created an even greater amount of energy savings. Keep in mind, too, that the work done by Weatherization specialists is permanent, providing a lasting savings over time, a savings that increases as energy costs increase. It is a gift that keeps on giving.

One of the reasons the program has been so effective is that these specialists, the local delivery network responsible for implementing the cost-saving weatherization measures, are highly skilled. In addition, Weatherization Program energy auditors play a key role in helping low-income individuals respond to our present energy crisis while addressing the long-term needs as well. In addition to the energy savings produced, the Weatherization Program also positively impacts the health and safety of the numerous lives that are affected by the program, helping to keep families warmer, dryer, and healthier.

So the issue is not whether the program is producing meaningful results. The issue is that the program does not have sufficient funding to meet the demands of our most vulnerable residents. For instance in New Hampshire, using both DOE funds and available LIHEAP funds last year, out of the approximate 7,493 New Hampshire Fuel Assistance recipients who requested weatherization services, New Hampshire was able to complete 526 weatherization jobs, only 7% of the requests.

BUDGET/APPROPRIATIONS ISSUES

While we strongly support the authorization provided in Chairman Bingaman's bill (S. 352) and Senator Murkowski's bill (Section 603-604), we are aware that an authorization does not mean appropriators will listen. The House Interior and Related Agencies Appropriations Subcommittee provided a $24 million increase for SEP to $62 million and a $96 million increase for Weatherization to $249 million. These funding levels were included in the House-passed bill. Unfortunately, on June 28, the Senate Appropriations Committee provided only a $60 million increase for Weatherization to $213 million and a $0 increase for SEP. These are well below the proposed authorized levels and inadequate for the need. If we were serious about dealing with our energy problems, substantially increased funding for SEP and Weatherization would enable states to plan for energy emergencies and, when possible, take preemptive action to help avoid an energy crisis by promoting energy efficiencies.

The President, during the campaign proposed a doubling of Weatherization and SEP to $306 million and $76 million respectively: "Double the funding for the Weatherization Program and State Energy Program." (See Energy Issues, at 11). By the time of the Budget submission, the proposed SEP doubling was wiped out and Weatherization was proposed to increase by $120 million. I would point out that while other DOE energy efficiency programs have increased since the early 1980's, the combined SEP/ICP program peaked at $178 million in FY'81, while Weatherization peaked at $245 million in FY'83. These are in nominal dollars. These programs need to be substantially funded to enable states to continue to serve our communities while building upon meaningful public/private partnerships particularly during a time of fluctuating energy costs and volatile markets.

NASEO urges the Committee to move forward not only on the authorized funding levels, but also to support a funding level at least equal to the House-passed Interior Appropriations bill during conference.

CONCLUSION

Today, I have restricted my testimony to the State Energy and Weatherization Programs. However, I would like to note that we strongly support LIHEAP and recognize it has a critical, life-saving role to play. For the LIHEAP program, approximately one-half of the states are either out of funds or have very low balances. I also know that New Hampshire is not unique and that many states experienced a significant increase in the number of LIHEAP households served this past program year. In New Hampshire, the number of households served on the program increased by 18% from the prior year. At level funding, my office is confronted with the harsh reality of having to deny assistance to more than 11,000 elderly, disabled and working poor households in the upcoming winter season. Consequently, we desperately need a base funding of $3.4 billion for LIHEAP.

While we are available to discuss other programs, we urge the Committee to support: 1) expanded appliance energy efficiency standards; 2) expanded use and increased funding for the EPA/DOE Energy Star Program; 3) Rebuild America, a DOE program that works with the states to promote energy efficiency in buildings; and 4) increased funding for international market development. We can certainly support targeted tax credits in the energy area, including energy efficiency tax credits for new and existing homes of the type recommended by Chairman Bingaman, Senators Feinstein/Bob Smith and Representative Weller. While each approach is slightly different we should work hard to develop a reasonable compromise.

We look forward to working with the Committee. Thank you for the opportunity to appear before you today.

The CHAIRMAN. Thank you very much.

Ms. Choate, why don't you go right ahead.

STATEMENT OF JOANNE CHOATE, LIHEAP MANAGER, MAINE STATE HOUSING AUTHORITY, ENERGY AND HOUSING SERVICES, AUGUSTA, ME, ON BEHALF OF THE NATIONAL ENERGY ASSISTANCE DIRECTOR'S ASSOCIATION

Ms. CHOATE. Thank you. My name is Joanne Choate. I serve as manager of the LIHEAP program for low-income home energy assistance for the Maine State Housing Authority, as well as the vice chair of NEADA, the National Energy Assistant Directors Association. I am honored, at the request of the committee, to testify today on behalf of NEADA, which represents the State Directors of LIHEAP. We support the development and implementation of programs to help low income households afford the cost of home energy.

Maine is a small New England State with long, cold winters, and we are one of the poorest States in New England. During the last winter heating season, heating oil prices rose sharply to $1.56 per gallon, bringing the average cost per household to $1,000 or more. While the average household spends about 4 to 5 percent of their income on home energy cost, for the low income the total can reach as high as 20 percent.

Without LIHEAP assistance, many of Maine's poorest households would have had to choose between staying warm and other vital household necessities such as food or medicine. Fortunately, LIHEAP was there this year to help over 60,000 households in the State of Maine during the winter months. Many letters come across my desk, and I have brought a few to share with you today that I will leave after my testimony.

From grateful recipients, an elderly recipient of northern Maine, wrote, "thank you very much for fuel assistance. It is, indeed, a much-needed help. I am 82 years old, in poor health, and nearly desperate, with so many bills pushing for payment." A mother wrote, "I want to take this opportunity to sincerely and humbly thank you for your assistance that you approved for my children and I. Things had been looking very bleak. Thank you for the ray of sunshine."

The elderly and the family with small children represent two of the most vulnerable groups in the rising energy costs. About 73 percent of LIHEAP funds in Maine are allocated to assist these groups. In light of the recent rise in energy prices, we have to ask, is LIHEAP funding adequate? Unfortunately, the answer is no. In spite of the fact that Federal funding was increased from $1.1 bil-

lion to $1.4 billion, in addition to $855 million in emergency funds, it is still not enough to meet the need.

The total number of households receiving assistance this year totaled 4.9 million, an increase of almost 1.1 million from the previous year. Still, on average the States were only serving about 17 percent of the eligible households. In my home State of Maine the total households receiving assistance increased by 32 percent this year, while the additional funds went a long way to helping address the needs this winter, unfortunately it was not enough.

As a result of the rising prices, energy bills for the average households increased at least $400 to $500. Many households, not only in Maine but throughout the Nation, were not able to pay these bills. As a result, the States reported significant increases in arrears and shut-offs.

A key indicator for the need for additional assistance is the number of households applying for emergency assistance. Since last year, the number has increased by 400 percent. These are households that exhausted all of their resources as well as their regular LIHEAP benefits and could not afford to purchase any additional fuel.

The average annual income for a LIHEAP recipient in Maine is $10,262, and for an elderly household that applied this year the annual income was $7,200. The average cost of home heating was around $1,000 or more. About 30 percent of the average recipient's annual income is spent on home energy.

We are also experiencing an increase in the number of households that have not applied for assistance before. 67 percent of these households in Maine are frail, elderly households that applied this year. These are proud people who have always paid their taxes, and have never before asked for government assistance.

NEADA did a survey of many utilities across the country and found that they are experiencing significant increases in bad debt. For example, the District of Columbia reported $6.6 million in natural gas arrearages by over 14,000 households. Georgia reported approximately $147 million in arrearages owed by 479,000 households, and Louisiana reported $32.9 million in arrearages owed by about 76,000 households.

We can expect that the problem of arrearages and shutoffs will get worse as the summer cooling season progresses, especially in Southern and Western States, and to a lesser degree in the Northeast. 28 States and the District of Columbia are now out of funds and no longer able to provide households with assistance to cover summer cooling bills and avert shutoffs.

S. 352 would play a significant role in helping to address the needs for additional funds. By increasing the authorization to LIHEAP to $3.4 billion, it would send a signal to the Appropriations Committee that additional funding is necessary to address the needs that low income households face with their winter heating and summer cooling bills.

With the additional money, we would increase outreach efforts to provide funds to underserved populations, take advantage of prepurchase and other payment arrangements to reduce the cost of home energy, and provide higher grant levels to offset the impact of higher prices on poor families.

NEADA would also like to recommend that the committee consider an increase in the set-aside for training and technical assistance funds. Currently, the law limits the Federal Program Office from using more than $300,000 for these purposes. The amount is not sufficient to meet the growing needs to develop new and innovative methods for managing program funds, collecting data for program design and evaluation, and provide training to program managers. We would recommend that training and technical assistance be increased to $750,000.

Mr. Chairman, we are also pleased to see the increased support provided in S. 352 for the State energy program and weatherization assistance. Across the Nation, LIHEAP works in close partnership with these two programs in helping to target assistance to those most in need. The State Energy Program plays an essential role in implementing energy programs at the State and local levels for all sectors of the economy and weatherization assistance delivers energy efficiency services to low income households to help reduce their energy bills.

Taken together, the increased funding for LIHEAP, the weatherization assistance program, and the State energy program contained in S. 352 will go a long way in helping to meet the energy needs of low income households.

Thank you for this opportunity to testify.

The CHAIRMAN. Thank you very much.

Erik, why don't you go right ahead. We are glad you are here, too.

STATEMENT OF ERIK EMBLEM, ADMINISTRATOR, NATIONAL ENERGY MANAGEMENT INSTITUTE, ALEXANDRIA, VA

Mr. EMBLEM. Thank you, Mr. Chairman. My name is Erik Emblem. I am the executive director and administrator of the National Energy Management Institute, and I am enjoying testifying before this most distinguished committee today.

NEMI is a not-for-profit joint labor management corporation created in 1981 by the Sheet Metalworkers International Association and the Sheet Metal and Air Conditioning Contractors National Association. Our mission is to identify emerging markets, employment, and commercial opportunities in the energy management, heating, ventilating, and air conditioning industry.

Towards these ends, we develop and sponsor energy management and HVAC research information and education training programs. In this respect, NEMI sponsors and funds training, education, and provides instructional equipment for over 160 training centers in the United States and Canada. We produce educational material to ensure that sheet metal workers and sheet metal contractors are on the cutting edge of the energy management and HVAC industry.

Within the industry, NEMI is considered the leader in research and development in new HVAC technologies and markets. Within the United States, there are some 5 million commercial and public buildings, 90 million residential structures, and together these buildings account for 35 percent of the Nation's energy consumption.

Most are affected by energy management building technology and indoor air quality issues. By 2003, we expect that $88 billion

per year will be spent on the construction and operation of heating, ventilation, and air conditioning systems alone. A consensus has developed within the professional energy management building technology and indoor air quality community that there is a need for a central organization to initiate, coordinate, and manage a number of important air quality and energy management functions that are currently not being fulfilled by either private industry or Government.

In this respect, there exists an incomplete understanding and appreciation for the multidimensional nature and relationships of energy management and indoor quality, on public health employment and productivity and energy consumption within buildings. Reliable data on these relationships are incomplete, and major information gaps exist on the adverse occupational and environmental health effects of poor indoor air quality.

Moreover, serious information gaps exist on questions concerning assessments of existing and emerging building technologies, employment and training and productivity, commercial market development for the new and improved building technologies, the science of constructing new buildings, and retrofitting older ones, public and consumer awareness of energy management issues, and the state of professional education and training in the emerging energy management and indoor air quality industries.

The challenge, therefore, is to explore the feasibility and efficacy of a national center to gather, develop, pilot, evaluate, distribute data and information on the ways by which the Nation can improve its indoor air quality and at the same time achieve optimum levels of energy efficiency in its commercial and public buildings, industrial facilities, and residential housing units.

The goal of such a center is to combine the economics of building performance for the fundamental functional needs of occupants with the need for more energy-efficient use to achieve a public benefit for the improved health, energy, security, employment, and productivity. Existing data and information on energy efficiency and indoor air quality are suggestive, with serious implications for employment, business, public health, and the environment, the economy and energy consumption.

One of the major problems is, there is no structural mechanism to clearly organize and understand the various aspects of these issues and what effect they have on American society and the economy. In January 2000, NEMI was invited to submit a proposal jointly to the Environmental Protection Agency and the U.S. Department of Energy to undertake an initial assessment of the energy management and indoor air quality issues and the possible needs for a national center on energy management, building technology, and indoor air quality.

Under NEMI's direction, a white paper was prepared and distributed on the specific conclusions and recommendations of the conferees. Mr. Chairman, I have a copy of that white paper with me, and I would like to submit it for the record.*

The CHAIRMAN. We would be glad to have it included.

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* Retained in committee files.

Mr. EMBLEM. Generally, the conference concluded that, given the fragmented state of energy management and indoor air quality issues, the logical next step would be to develop a comprehensive strategic plan exploring the feasibility of a national center for energy management and building technologies.

If I may, Mr. Chairman, deviate slightly from the written record, I am here today to express my concern that this problem may be exacerbated by the renewed efforts to reduce energy use in buildings. NEMI and its sponsors have been involved in energy management and indoor air quality in buildings since the energy crisis years of the late seventies, and we have seen many mistakes made. We have taken a leadership position in the building construction industry towards resolving the conflicts and barriers of efficient and healthy buildings.

We believe there is both a compelling need and broad support for a national center for energy management and building technologies to support, coordinate commercialization, public education, training in public technologies and building technologies that will provide buildings that are both energy efficient and healthy. We believe that the center should be supported under this legislation.

With that, I thank you for the opportunity to testify.

[The prepared statement of Mr. Emblem follows:]

PREPARED STATEMENT OF ERIK EMBLEM, ADMINISTRATOR, NATIONAL ENERGY MANAGEMENT INSTITUTE, ALEXANDRIA, VA

Mr. Chairman, Members of the Committee.

My name is Erik Emblem, and I am the Administrator of the National Energy Management Institute (NEMI). Thank you for inviting us to testify before you on proposed national energy legislation.

NEMI is a not-for-profit, joint labor-management corporation created in 1981 by the Sheet Metal Workers" International Association (SMWIA) and the Sheet Metal and Air Conditioning National Association (SMACNA).

Our mission is to identify emerging markets, employment and commercial opportunities in the energy management and heating, ventilation and air conditioning (HVAC) industry. Towards these ends NEMI develops and sponsors energy management and HVAC research, information, education and training programs.

In this respect, NEMI sponsors and funds training and education programs and provides instructional equipment for over 160 training centers in the United States and Canada. We produce educational material to ensure SMWIA and SMACNA members are on the cutting edge of the energy management and HVAC industry. Within the industry NEMI is also considered the leader in the research and development of new HVAC technologies and markets.

THE CHALLENGE

Within the United States there are some 5 million commercial and public buildings and 90 million residential structures. Together these buildings account for 35% of the Nation's energy consumption, and most are affected by energy management, building technology and indoor air quality issues. By 2003, we expect that $88 billion per year will be spent on construction and operations of heating, ventilation and air conditioning (HVAC) systems alone.

A consensus has developed within the professional energy management, building technology and indoor air quality community that there is a need for a central organization to initiate, coordinate and manage a number of important indoor air quality and energy management functions that are currently not being fulfilled by either private industry or government.

In this respect, there exists an incomplete understanding and appreciation for the multi-dimensional nature and relationships of energy management and indoor air quality on public health, employment and productivity, and energy consumption within buildings.

Reliable data on these relationships are incomplete and major information gaps exist on the adverse occupational and environmental health effects of poor indoor

air quality. There is even less of an understanding of the relationships between improved indoor air quality, on the one hand, and energy efficiency, on the other. Indeed, one of the major policy questions that has yet to be addressed is "What are the energy costs associated with improved indoor air quality, and are there potential building technology solutions to reduce energy consumption and, at the same time, improve air quality?"

Moreover, serious information gaps exist on questions concerning assessments of existing and emerging building technologies; employment, training and productivity; commercial market development for new and improved building technologies; the science of constructing new buildings and retrofitting older ones; public and consumer awareness of energy management issues; and the state of professional education and training in the emerging energy management and indoor air quality industries.

The challenge therefore is to explore the feasibility of a national center to gather, develop, pilot, evaluate, and distribute data and information on ways by which the nation can improve its indoor air quality and at the same time achieve an optimum level of energy efficiency in its commercial and public buildings, industrial facilities; and residential housing units.

The goal of such a center is to combine the economics of building performance for the functional needs of occupants with the need for more efficient energy use to achieve a public benefit of improved health, energy security, employment and productivity.

STATEMENT OF PROBLEM

Existing data and information on energy efficiency and indoor air quality are suggestive with serious implications for employment, business, public health and the environment, the economy and energy consumption. One of the major problems is that there is no structural mechanism to clearly organize and understand the various impacts these issues have on the American society and economy.

Data available in the literature indicate the scope and nature of the problem, and include:

- Some 50 million American workers are adversely affected by poor indoor air quality in commercial buildings. (Dorgan 1997, Woods 1989, Fisk 2000)
- The annual health care cost associated with poor indoor air quality in commercial buildings has been estimated at $8 billion. (Dorgan 2000, Woods 1989, Fisk 2000)
- The cost of productivity losses resulting from poor indoor air quality in commercial buildings—due to absenteeism, short work days, reduced worker output and lethargy—has been estimated at $40-$80 billion annually. (Dorgan 2000, Woods 1989, Fisk 2000)
- About 50% to 80% of commercial buildings have been estimated to not consistently achieve compliance with standards for acceptable indoor air quality. (Dorgan 2000, Woods 1989, Fisk 2000, NIOSH 1998)
- A study commissioned by NEMI found that only 20% of commercial buildings in the United States could be classified as "healthy"; another 40% were found to be "generally healthy; with the remaining 40% classified as "unhealthy"; unhealthy being defined as a building where a significant number (20% or more) of the occupants reported an indoor air quality-related symptom. (Dorgan 1997, 2000)
- Approximately 25% of the $6 billion annual energy consumption by American schools are lost because of inefficient heating, cooling, ventilation, and lighting systems. (GAO 1996)
- Some 15 million children attend American schools with substandard heating, ventilation and air conditioning (HVAC) systems. (GAO 1996)
- About 80% of the building stock that will be available in 25 years are in place today and will require rehabilitation and HVAC retrofit construction. (Woods 1998)

INITIAL ASSESSMENT

In January 2000, NEMI was invited to submit a proposal jointly to the Environmental Protection Agency (EPA) and the Department of Energy (DOE) to undertake an initial assessment of energy management and indoor air quality issues, and the possible need for a national center on energy management, building technologies and indoor air quality.

The vehicle by which the initial assessment was conducted was a two-day conference attended by a small group of nationally recognized authorities on energy management and indoor air quality, representing business, labor, academia, govern-

ment and the professional engineering and public health communities. The conference was held on September 13-14, 2000 in Alexandria, VA.

The focus of the conference was on six related subject areas including energy management and indoor air quality research, technology assessment and application, employment and training, commercial market development, public and professional education, and public policy.

Under NEMI's direction, a "White Paper" was prepared and distributed on the specific conclusions and recommendations of the conferees.

Mr. Chairman, I have a copy of that White Paper with me and ask that it be made a part of this hearing record.

Generally, the conference concluded that given the fragmented state of energy management and indoor air quality issues, a logical next step would be to develop a comprehensive strategic plan exploring the feasibility of a national center for energy management and building technologies.

NEMI is currently in the process of initiating such a strategic plan with its partners; the Sheet Metal and Air Conditioning Contractors National Association (SMACNA) and The Sheet Metal Workers International Association (SMWIA).

THE CONSORTIUM OF INTERESTS

For your information, Mr. Chairman, SMACNA represents some 4,000 contractors engaged in the installation and maintenance of energy management and HVAC equipment and systems in the industrial, commercial, institutional and residential markets. By 2003, it is estimated that the annual HVAC market in the United States will approach $88 billion.

SMWIA represents some 150,0000 members employed in the manufacture, installation and maintenance of energy management and HVAC equipment and systems. SMWIA members are highly skilled in the energy management and HVAC field and are products of apprenticeship training programs developed by the International Training Institute. Like NEMI, SMACNA and the SMWIA created the International Training Institute, which is a joint labor-management-training program dedicated to improving the employment skills of its members to meet new technological demands.

CONCLUSION

Mr. Chairman, NEMI and its partners have been in the energy management business for quite some time. As I indicated, we are the acknowledged leaders in our industry. After nearly two years of intensive study, we have come to the conclusion that in order to adequately meet the growing demand for energy security on the one hand, and safe and healthy buildings on the other, that a national center must be established to undertake and disseminate the kind of research and analysis required to achieve more energy efficient and more healthy buildings.

Thank you, and I would be happy to answer any questions you may have.

The CHAIRMAN. Thank you very much for your testimony.

Mr. Wagner, why don't you go right ahead.

STATEMENT OF MARK F. WAGNER, DIRECTOR, FEDERAL GOVERNMENT RELATIONS, JOHNSON CONTROLS, INC., ON BEHALF OF THE FEDERAL PERFORMANCE CONTRACTING COALITION

Mr. WAGNER. Thank you, Mr. Chairman. My company is Johnson Controls, but I am also here testifying on behalf of the Federal Performance Contracting Coalition. We are a group of energy service companies who upgrade Federal facilities. We do this by installing, designing, and servicing energy-efficient equipment such as monitoring control systems, heating ventilation systems, lighting, so that Federal buildings can be more energy-efficient.

Mr. Chairman, last month, when you attended the energy efficiency forum sponsored by Johnson Controls and the U.S. Energy Association, you said energy efficiency is a bipartisan issue, and we could not agree with you more. You also talked about energy-saving

performance contracting at Federal facilities, which is where I would like to concentrate my remarks.

Assistant Secretary Garman mentioned that the Federal Government is the largest consumer of energy in the country, and that is true. We are spending billions in heating those 500,000 buildings in the Federal inventory. This year, the Federal Government's energy electric bill is going to be higher than ever, just as it is for many consumers. The Department of Defense alone, their overbudget, or unanticipated electric bill is $500 million this fiscal year. That is where energy savings performance contracting comes in.

As you know, you can see from the chart, energy service companies privately finance the investment of energy efficient equipment with no up-front cost to the Government. The building owner, the Government, then pays for those retrofits for this new equipment over time.

The CHAIRMAN. Can you just turn that thing a little bit? There is a big glare on it, so we cannot see it. That is better, thanks.

Mr. WAGNER. The energy service company guarantees those savings. That means the Government does not pay more for utility costs than they would have paid under the ESPC, and they get the new equipment after the investment is paid off. The Government gets all the subsequent savings. It is truly a win-win situation. Energy service companies are helping Federal agencies all over the country do this.

One new project that we just installed is at the Denver Federal Center, where we upgraded 27 buildings. This entire project will save the Government $450,000 per year in energy and operational cost, while reducing more than 6.6 million pounds of harmful emissions.

There is a number of ESPC examples at Federal facilities. I am proud to say one of the first ones ever was in New Mexico at Los Alamos, where that ESPC is still saving the Government over $2 million a year, and has a 40-percent reduction in emissions, and so this is truly a great program, but it can be even better, and I would like to quickly mention six quick, specific legislative proposals to comment on. First of all, we support expanding authority of ESPC's to include water in addition to energy.

Currently, water projects are not really allowed under civilian agency ESPC programs. Consequently, many Federal facilities miss out on tremendous potential cost savings, and water resources continue to be wasted. In contrast, water savings have been allowed at defense facilities, because they are authorized under a different statute.

You can see from the Fort Polk project that we did at an Army military base the benefit of combining energy and water savings. When you change out and you save hot water as well and you can take those water savings you are much better able to finance projects and put together much more comprehensive projects. At non-defense facilities like veterans' hospitals, water savings often cannot get approved, and many Federal agencies could benefit by such change.

Second, we advocate removing the sunset provision for ESPC's and grant permanent authority for this great program, because

they are a proven, reliable method to save energy for the Federal Government.

Third, the FPCC also supports expanding the ESPC authority for replacement authorities. Having this could open up new opportunities for energy savings. However, it could mean developing some projects where we do not have a lot of experience. I might suggest that the committee think about developing some pilot projects in this area, or authorizing some. This could do a number of interesting things.

First, we could get off the ground quickly with some pilot projects where there is opportunities already identified without waiting for the Department to implement regulations and policy, which might take months, or maybe even longer.

Second, we would get some lessons learned from those pilot projects that could help develop regulations, and then third, during those pilot projects we could inventory them to find out where else we could do these types of projects. That is just a suggestion.

Fourth, the FPCC supports high performance school programs, insofar as grant funding could be used to help defray some of the contracting costs for ESPC.

Fifth, the Federal Procurement Contracting Coalition strongly opposes any effort to extend the utility financed contracts currently beyond their 10-year time frame.

ESPC contractors are required to guarantee their savings. In other words, if the savings do not materialize, we do not get paid, and we are required to perform measurement and verification methods. Unfortunately, under those utility projects they do not have to do that, so if there is any extension, we would encourage extending those requirements to utility contracts.

Finally, we support the concept of an energy efficiency bank, or source of Federal funds that could be used to implement energy efficiency projects at facilities. Financing projects with ESPCs may not be the appropriate tool in every instance, and over the years there has been a lack of Federal funds to do projects directly rather than financing. The committee may also wish to consider making these funds available to buy down the ESPC projects that have longer terms, or to help make renewable energy projects more feasible under ESPC.

On behalf of the FPCC, I appreciate the opportunity to speak before you today and provide testimony. Thank you, Mr. Chairman.

[The prepared statement of Mr. Wagner follows:]

PREPARED STATEMENT OF MARK. F. WAGNER, DIRECTOR, FEDERAL GOVERNMENT RELATIONS, JOHNSON CONTROLS, INC.

Mr. Chairman and members of the Subcommittee, thank you for inviting me to address the various legislative proposals related to energy efficiency. I am Mark Wagner, Director of Federal Government Relations for Johnson Controls, Inc. and am testifying today on behalf of the Federal Performance Contracting Coalition (FPCC), a group of Energy Savings Performance Contractors who upgrade federal facilities. I would like to concentrate my remarks on proposals that affect private sector financing of energy improvements in Federal government facilities.

Johnson Controls is a global market leader in facility services and control systems. Since the 1880s when Warren Johnson invented the thermostat, Johnson Controls has been working with government facilities, schools, hospitals and commercial buildings to help create comfortable, productive and safe building environments that are energy efficient.

Like other energy service companies that are members of the FPCC, we design, install and service new energy efficient equipment, such as monitoring and control systems, HVAC systems, chillers and lighting, so that buildings use less energy. Included in our service offering is energy savings performance contracting (ESPC) which I will discuss in more detail later.

According to the U.S. Department of Energy, there are some 4.5 million existing commercial buildings involving 55 billion square feet of space. These buildings consume 30-40% of all energy and use 60% of all electricity. It's estimated these facilities use 20-40% more energy than necessary.

The largest single consumer of energy in the United States is the federal government, spending $4 billion a year for its 500,000 buildings. According to the Department of Energy, the federal government has over three billion square feet of floor space, located in all climates. High-rise offices, research laboratories, aircraft hangars, libraries, hospitals, tourist areas, parks, and prisons must all be considered. In total they consume over 60 billion kilowatt-hours of electricity each year.

This year, the federal government's electric bill will be even higher, just as it is for many consumers. For the Department of Defense alone, its unanticipated energy bill for this year is expected to be $500 million.

Immediate conservation measures such as turning up the thermostats this summer and shutting down escalators are only temporary solutions, saving energy today but doing nothing about the problem tomorrow. True energy efficiency is achieved—not by fiddling with the thermostat, but by retrofitting existing building with energy efficient equipment.

That is where Energy Savings Performance Contracting (ESPC) comes in.

Under an ESPC, an energy services company like Johnson Controls, Honeywell, Duke Solution, Sempra Energy Services, NORESCO and others, privately finance the investment of installing energy efficient equipment with no up-front costs to the customer. The investment includes identifying building energy requirements and acquiring, installing, operating, and maintaining the energy-efficient equipment. The building owner pays for these retrofits and new equipment over time with dollars saved on energy and maintenance bills. The energy service company guarantees the savings. This means the government agency does not pay any more for utility costs than they would have paid without the ESPC and the new equipment. After the investment is paid off, the building owner gets all the subsequent savings. It's a win-win situation.

Energy service companies are helping federal agencies all over the country save energy through ESPCs. For example, Johnson Controls, entered into an ESPC with the Denver Federal Center to upgrade 27 buildings. New chillers, building controls and lighting are being installed, and we are re-commissioning an existing solar domestic hot water heating system. The entire project will save $450,000 per year in energy and operational costs for the next 11 years while reducing more than 6.6 million pounds of carbon dioxide emissions. As mentioned, other ESPC companies are making similar improvements to federal facilities all around the country—and at a cost to the government customer of only contracting and auditing.

Other good examples of federal ESPCs are at:

- Los Alamos National Lab in New Mexico, saving $2.3 million annually;
- Army National Training Center at Fort Irwin, California, saving $169,000 per year;
- Veterans Affairs Medical Centers in San Francisco and Salt Lake City, each saving $500,000 per year.

ESPC is a great tool for the federal government. But it can be even better. I would like to outline several provisions included in pending legislation under this Committee's jurisdiction that enhance the program and save more energy and tax dollars.

1. Expand the Authority of ESPCs to Include Water, in Addition to Energy

Currently water saving projects are not allowed under civilian agency ESPC programs. Consequently, many federal facilities miss out on tremendous potential cost savings and water resources continue to be wasted by the government. DOE General Counsel has ruled that water savings are limited under the statute governing ESPCs at civilian agencies (42 USC 8287).

In contrast, water savings have been allowed for years at DOD facilities. A different defense statute, (Title 10, Sections 2865 & 2866) authorizes ESPCs for DOD facilities and it allows water savings. When the Defense Department originally passed Section 2865, it quickly realized that water savings were not allowed under the legislation. One year later Congress, through the Armed Services Committees, approved DOD's request to add water cost savings to ESPC under Section 2866.

The Army's Fort Polk in Louisiana is a great example of an ESPC project which combines both energy and water savings. The project includes:

- Replacing bathroom equipment (toilets, flush valves, showerheads and faucets) with water conserving models in the barracks.

  Water Savings: 42 million gallons of water annually
  Energy Savings: 43,500 therms of natural gas annually
- Replacing all 450 washers and dryers on base with new horizontal axis washers that use half the water and clean just as well.

  Energy Savings: 46,000 therms of natural gas and 135,000 kWh of electricity
  Water Savings: 14.4 million gallons of water and sewerage annually
- Installing hot water loop controls brining water temperature up only when needed.

  Energy Savings: 517,000 therms annually

In total this project is saving Fort Polk over $500,000 per year in energy, water and operational costs.

At non-defense sites like Veterans Hospitals, water savings often cannot get approved. Many federal agencies could benefit greatly from a change in the ESPC authority to allow water savings, such as the provision included in section 7 of S. 352.

2. Remove the Sunset ESPC Contractual Authority as Provided by S. 352

ESPCs are a proven, reliable method to save energy, reduce operations and maintenance costs, provide new equipment for federal agencies and reduce pollution. Why would the federal government want to stop?

Unless the statute is again extended, current authority for federal agencies to enter into ESPCs will expire in 2003. Certainly another four-year extension could be granted for the program as provided by S. 388, but we would advocate removing the sunset provision completely and provide permanent authority for ESPCs. Experience has shown that when the sunset date approaches, some agencies become concerned and reluctant to begin developing projects for fear the authority may not last. Removing the sunset provisions would solve that problem.

3. Allow Replacement Facilities To Be Eligible for Federal ESPCs as Provided by S. 352 and S. 388

The Federal Performance Contracting Coalition also supports expanding ESPC authority programs to allow them to be applied to replacement facilities. Having this new authority could open up new opportunities for energy savings. However, it would mean developing some projects for which there is little or no experience either in the government or commercial arena.

The Committee may want to consider authorizing several pilot projects. This would have numerous advantages, including:

- Several projects that already have been identified could begin immediately, without waiting for the Department of Energy to spend months or longer developing regulations and policy governing the implementation of this new authority.
- Government and industry would quickly gain from the lessons learned at these sites, which could then aid in writing better regulations and policy for broader authority.
- While the pilot projects are being developed, the Department of Energy could identify other federal buildings that could be candidates for projects and determine the magnitude of the potential.

4. High Performance Schools Program in Section 1302 of S. 597

The FPCC supports this legislation insofar as the grant funding for school facility improvements can be used for the contracting costs of Energy Savings Performance Contracts.

5. Oppose Extending Utility Contracts to 25 Years Without Safeguards

The Federal Procurement Contracting Coalition strongly opposes any efforts to extend the term of utility financed contracts beyond their current 10-year time frame without requiring a guarantee of energy savings, a measurement and verification of those savings and a reporting requirement to Congress. When Congress passed the Energy Policy Act of 1992 providing authority for ESPC, it wisely required certain safeguards. Congress demanded that if agencies were allowed to commit future unappropriated dollars to pay for energy-financed contracts, the dollar savings would have to pay for the cost of the contract. To ensure that result, ESPC contractors are required to:

1. Guarantee the energy savings. In other words, if the savings don't materialize we don't get paid.

2. Perform annual measurement and verification, which is the method to prove the savings are real.

Unfortunately, utility financed contracts currently do not have these same requirements and safeguards. But they should.

Our position is also consistent with separate memorandums (June 1999) from the DOE General Counsel and from the GSA Assistant Commissioner of the Office of Financial and Information Systems. Both memos call for guarantee of savings and measurement and verification for utility financed energy contracts. However, it is not clear that these requirements have been enforced consistently for utility contracts.

6. Federal Energy Efficiency Bank

We support the concept of an energy efficiency bank or source of federal funds that could be used to implement energy efficiency projects at federal facilities. Financing projects with an ESPC may not be the appropriate tool in every instance. Over the years there has been a lack of federal dollars to directly pay for worthwhile energy efficiency projects. The committee may also wish to consider making funds from the bank available to "buy down" ESPC projects that have long terms or help make renewable energy measures more affordable under ESPCs.

On behalf of the FPCC, I also want to mention two "congressional actions" that can assist in helping the Federal government get the maximum out of the ESPC process.

First, the Department of Energy's Federal Energy Management Program (FEMP) provides technical assistance for many of these projects. Their appropriated funding must continue at a robust level. This assistance is critical to helping federal agencies implement ESPC projects.

Second, congressional oversight could make all the difference in assuring that federal agencies are indeed taking advantage of the energy savings provided by ESPCs. A few years ago, a hearing on ESPCs by the Veterans Affairs Oversight Subcommittee sparked a dramatic increase in projects at VA Medical Centers. The Subcommittee asked the Department of Veterans Affairs to provide quarterly reports on ESPCs being implemented at medical centers throughout the country. Similar oversight could be very helpful in getting agencies to use these innovative types of energy efficiency and infrastructure improvement contracts. In other words, we should stop asking agencies, "Where can you do an ESPC" and begin asking, "Why aren't you using them everywhere?"

Thank you for the opportunity to testify today and I would be happy to answer any questions.

The CHAIRMAN. Well, thank you, thank all of you very much for your testimony here. Let me just ask a few questions.

Ms. Manoogian and Ms. Choate, maybe you could both respond to this. One of the differences that exist in our pending bills here is that in the proposal to increase the LIHEAP funding for the future we have two different ways we are proposing to do it. I have proposed in the bill that I have introduced to increase the base program more, and not really increase the emergency contingency fund authorization.

Senator Murkowski's proposal was to increase the emergency level. Is there a preference on the part of LIHEAP administrators as to how this authorization ought to be accomplished, this increased authorization? Do either of you have a point of view on that?

Ms. MANOOGIAN. It would be preferable to have the base funding increased, only because, for example, it provides us with an opportunity to be able to establish what is necessary to operate the program for the program year. Instead of raising the contingency funds, then it is on an emergency basis, so it does not provide a meaningful tool to be able to identify what should your eligibility criteria be for an upcoming season, what should your benefit level be set at.

I know that in the past 2 years we have relied heavily upon emergency funds to help us get through the winter season and avert any type of catastrophes for our households. The problem has been, it has been a crisis management approach, and it is after the fact, so our preference would be that the base level be increased and not just emergency contingency funds.

The CHAIRMAN. Ms. Choate, did you have a point of view?

Ms. CHOATE. I agree with Mary Ann that the base funding would be useful for the same reasons, not only that many States try to make plans in advance, such as Maine. We would borrow the money to start our program early to lock in prices in the summer months, where the Federal funds are not received until October, and we cannot do that if we do not know what the base funding is going to be, or how much it will be, so it would make a difference.

The CHAIRMAN. The administration has proposed to direct a portion of Federal oil and gas royalties to the LIHEAP program during times of high oil and gas prices. Do either of you have a point of view on that proposal?

Ms. MANOOGIAN. Not specifically, and I do not know the details of the proposal. My only concern, again, is with respect to—is that it makes the program much more vulnerable and volatile to what is going to happen, the amount of funds received from the royalties, in addition to, it is not clear to me if it is, again, going to be able to enable us to do the important and necessary program management that Ms. Choate and I have already identified.

The CHAIRMAN. Erik, let me ask you, obviously, in trying to move toward a more energy-efficient economy, one of the real obvious requirements which you are working on is this business of having an adequate workforce, a workforce that is adequately trained in how to do that. To what extent do you see that as a real bottleneck for getting from here to where we need to be?

I mean, is the problem that we have not adopted the right policies at the Federal level, or do we really have a shortage of people in the field all around this country who are trained to put in place the energy efficiency measures that we all think make sense?

Mr. EMBLEM. Mr. Chairman, the answer is yes to all three. We have had policies in the past that have exacerbated the problem, and we also have the issue of getting a workforce of trained individuals who are trained to implement these new technologies, and this energy-efficient equipment that is needed to properly ventilate the buildings.

We also deal with the Government and regulatory issues. After the energy crisis of the seventies, the ventilation rates for buildings were reduced by 67 percent. In 1970, they were 50 cfm per person. They were reduced to 5 cfm per person, and now they are back up to 20 cfm per person, but in the lag time, these buildings have been designed around changes in government regulations and government standards where we have to have people now that are able to go back into these buildings and assure that the proper ventilation rates and air conditioning is obtained, and it is through training.

The CHAIRMAN. Mr. Wagner, let me ask you about, at the current time, there is an executive order that requires a certain level of en-

ergy efficiency to be built into new Federal energy, or Federal construction projects, is that right?

Mr. WAGNER. Yes, sir, and there is also a requirement to have sustainable type designs in buildings, yes, sir.

The CHAIRMAN. How effective is that requirement, the way it is presently operated?

Mr. WAGNER. It is effective, because oftentimes designers try. The problem is, sometimes there is a limit in terms of funding, in terms of the building, so you have a push and pull in terms of the type of things that you can implement in a building up front when you design it, but those requirements are definitely there.

The CHAIRMAN. Do you think there is a genuine effort by architects and others who are proceeding to construct new Federal buildings to build this in?

Mr. WAGNER. I think that there is a number of new ways of approaching buildings. We have seen it in the commercial sector a lot. I think it takes a lot of innovation that you do not see everywhere, but I think there are tremendous examples of buildings where you can build this in at a first cost, and it does not cost as much as you think it might.

The CHAIRMAN. And does that extend in this area of schools? We give a lot of speeches about how we want energy-efficient schools. Is there really anything in place Nation-wide that causes that planning and thinking to be built in as new schools are designed?

Mr. WAGNER. Well, there is probably nothing real comprehensive, because most of those designs are at the local level.

The Department of Energy does have some good school programs providing that type of assistance and guidance in that. The other thing we have got to think about is, we have got a huge inventory of schools out there, many old, that probably—well, we can concentrate on the few new ones being built, and many of them are—there are a lot of older buildings out there that are wasting 20 to 40 percent of the energy out there, and concentrating on trying to retrofit those for not only the indoor environment but also the energy savings I think is probably really where much of the focus needs to be.

The CHAIRMAN. What role do you see this committee or the Federal Government playing in causing that to happen? I am persuaded that we are way behind in adequate school construction in this country, and that there is going to have to be a very substantial increase in that effort over the next decade or so. How do we ensure that that construction be designed and accomplished in a way that makes sense?

Mr. WAGNER. Well, I think if there is Federal funding that has been discussed in the past, that might be available to localities for school construction, or to assist in school construction, we may want to think about requiring that certain standards of efficiency are met, as opposed to providing assistance and say, build whatever type of building you want, I think, because it will continue to cost you in operation and maintenance cost throughout the future, and waste money in the future, so if you build them right the first time, that is extremely important.

The CHAIRMAN. All right. Well, I think this is all useful testimony. We need to digest it all and try to understand it, and hope-

fully get it reflected in the legislation that we try to enact here. Thank you very much.

Let us take a 5-minute break, and then we will have the next panel.

[Recess.]

The CHAIRMAN. Why don't we go ahead here. This is our third and final panel, and we are very glad to have them here. First, we have Mr. Steven Nadel, who is the executive director of the American Council for an Energy Efficient Economy here in Washington, thank you for being here. Mr. Clifford Rees, president of the Air Conditioning and Refrigeration Institute in Arlington, Virginia. We appreciate you being here.

Mr. David Parks, president of Goodman Manufacturing Company in Houston, Texas—thank you for being here—and Dr. Malcolm O'Hagan, who is the president of the National Electrical Manufacturers Association in Rosslyn. Why don't you go ahead, and we will just go across in that order, if that works to everyone's satisfaction.

STATEMENT OF STEVEN NADEL, EXECUTIVE DIRECTOR, AMERICAN COUNCIL FOR AN ENERGY-EFFICIENT ECONOMY

Mr. NADEL. Thank you, Mr. Chairman. As you said, I am here representing the American Council for an Energy-Efficient Economy. We are a nonprofit organization dedicated to increasing energy efficiency as a means for both promoting economic prosperity and protecting the environment. I appreciate the opportunity to appear before this committee today.

In specific, I have been asked by committee staff to talk about the Federal efficiency standards program. Federal appliance and equipment efficiency standards were first adopted in 1987 because many market barriers inhibit the purchase of efficient appliances in the unregulated market. These barriers include rush purchases, when the existing appliance breaks down, and purchases by builders and landlords, who pay for the initial cost but do not pay operating costs.

Standards remove inefficient products from the market, but still leave consumers with a full range of products and services to choose among. These standards are one of the Federal Government's most effective energy-saving programs. They are already reducing peak electric demand by the equivalent of more than 200 powerplants, reducing consumer bills by about $9 billion annually.

In order to provide additional cost-effective savings under this program, we recommend that Congress extends the standards program to several additional products. Congressional action is needed, because in many cases DOE lacks the authority to set new standards.

Congress should take three specific actions. First, under current law, DOE has authority to adopt new standards on consumer products. The same authority should be extended to commercial products, since many of the best opportunities for new standards are in the commercial sector.

Second, Congress should direct DOE to set standards on several products with large opportunities for energy savings, or for which additional technical work is needed before specific efficiency standards can be set. Products that fall into this category include resi-

dential ceiling fans, a residential furnace and heat pump circulation fans, and refrigerated vending machines.

I would note that this provision is now included in legislation that passed the House Energy and Commerce subcommittee yesterday.

Third, Congress should set standards on specific products in cases where standards already developed by States, as well as current voluntary standards such as Energy Star standards, FEM standards, and industry standards provide a sufficient foundation for Federal action.

By adopting standards directly, instead of calling for a multiyear DOE rulemaking, Congress speeds up the date that savings begin to accrue. Also, direct congressional adoption frees up DOE resources for those products for which DOE data collection and analysis are truly needed. Products that fall into this category are distribution transformers, commercial refrigerators, exit signs, traffic lights, floor lighting fixtures for residences, ice-makers, commercial unit heaters, and consumer electronic equipment, and my written testimony provides written recommendations along these lines.

Consumer electronic equipment merits a little further discussion. This equipment is the source of the energy-wasting vampires that President Bush discussed in his June 28 remarks at the Department of Energy. This equipment continuously uses electricity, even when switched off.

President Bush has directed that Federal agencies only purchase equipment with standby power use of 1 watt or less. By adopting minimum efficiency standards at this same level, we can move these savings beyond the Federal Government to other users, and drive a stake through the heart of this energy waste.

Analysis by my organization indicates that adopting reasonable and cost-effective standards on these products will reduce U.S. electric use in 2020 by about 5 percent of projected residential and commercial use, and will reduce peak electrical demand by the equivalent of about 40 to 50 powerplants. We estimate that the benefits of these standards will be about five times greater than the cost, highly, highly cost-effective.

In addition to new standards, I wanted to briefly mention two other issues. First, there has been a lot of controversy during the last 6 months about the new standard for residential air conditioners and heat pumps. We strongly support the SEER 13 standard that was published in the *Federal Register* in January. The distance between a SEER 12 and a SEER 13 standard amounts to about 18,000 megawatts over the next 3 decades, equivalent to the production of 60 new powerplants.

By our calculations, based on current electricity price structures and reasonable estimates of the cost of a SEER 13 unit, the simple payback to the consumer to go from SEER 12 to SEER 13 is only about 3.8 years. It is quite cost-effective to consumers. As you noted in your initial remarks, part of the reason DOE came up with much higher numbers is, they are using 1996 summer electricity prices.

There has been a lot of changes in electricity markets over the last 5 years, and summer prices are higher. Winter prices may be lower, but summer prices are higher, and this needs to be reflected

in the DOE analysis. Also, as I believe the representative from Goodman Manufacturing will report, that as this new equipment moves from a niche product to a mass-produced product, cost should come down significantly relative to current cost, and therefore DOE has overestimated the cost. With reasonable cost estimates, with reasonable estimates of the electricity price, this SEER 13 standard is clearly cost-effective for American consumers.

Second, I wanted to note that DOE is many years behind the congressionally set schedule for revising some of the current efficiency standards. DOE does an annual process to set priorities for new rulemakings. We recommend that after DOE completes this process, in September or October of this year, that this committee schedule an oversight hearing to review DOE's standards plans for 2002. Such an oversight hearing should explore options for picking up the pace so that these rulemakings can be completed in a more timely manner, and perhaps also explore ways to have the rulemakings be a little bit less controversial.

In conclusion, I want to note that according to our analyses, expanded appliance and equipment efficiency standards are one of the most effective policies Congress could adopt this year to reduce U.S. energy use over the next 2 decades. The only other policies that we have analyzed with greater potential energy savings are CAFE standards on passenger vehicles and the utility sector systems benefit fund.

Efficiency standards can make a significant contribution towards bringing U.S. energy supply and demand into better balance, thereby improving the long-term reliability of our electric grid, also helping our environment, our rural economy, and individual consumer pocketbooks. Thank you very much.

[The prepared statement of Mr. Nadel follows:]

PREPARED STATEMENT OF STEVEN NADEL, EXECUTIVE DIRECTOR, AMERICAN COUNCIL FOR AN ENERGY-EFFICIENT ECONOMY

INTRODUCTION

ACEEE is a non-profit organization dedicated to increasing energy efficiency as a means for both promoting economic prosperity and protecting the environment. We were founded in 1980 and have contributed in key ways to energy legislation adopted during the past 20 years, including the Energy Policy Act of 1992 and the National Appliance Energy Conservation Act of 1987. I appreciate the opportunity to appear before this Committee. Specifically I have been asked to discuss the federal appliance and equipment standards program.

THE FEDERAL STANDARDS PROGRAM

Federal appliance and equipment efficiency standards were signed into law by President Reagan in 1987 and expanded under President Reagan in 1988 and President Bush in 1992. Minimum efficiency standards were adopted in order to address market failures, replace a patchwork of state standards, save consumers money, and reduce energy use and peak electrical demand. Among the market failures addressed by standards are lack of consumer awareness, rush purchases when an existing appliance breaks down, and purchases by builders and landlords who do not pay appliance operating costs and hence have no financial incentive to value efficiency. Standards remove inefficient products from the market but still leave consumers with a full range of products and features to choose among. Since adoption, standards have sharply cut the energy use of major energy using appliances and equipment while not interfering with manufacturers' ability to offer excellent performance and a wide array of features. For example, the typical refrigerator manufactured today uses less than half the energy of an average 1987 model, but is bigger and offers more features.

Appliance and equipment standards are clearly one of the federal government's most effective energy-saving programs. In 2000, standards on refrigerators and many other products reduced U.S. electricity use by 2.5% and total U.S. energy use by 1.3%, including displacing the need for 70,300 MW of generating capacity (the equivalent of 234 power plants, 300 MW each). These standards reduced consumer energy bills in 2000 by approximately $9 billion with energy bill savings far exceeding any increase in product cost. Consumer energy bill savings to date total about $50 billion with a typical benefit-cost ratio of more than 3:1. By 2020, standards already enacted will save 4.3 quads per year (3.5% of projected U.S. energy use), and reduce peak electric demand by 120,000 MW (more than a 10% reduction).[1]

APPLIANCE STANDARDS IN THE ADMINISTRATION ENERGY PLAN

The Bush/Cheney *National Energy Policy* devotes half-page to the federal standards program and notes that these "standards will stimulate energy savings that benefit the consumer, and reduce fossil fuel consumption, thus reducing air emissions." The Plan then recommends that the Secretary of Energy: (1) "support [the] appliance standards program for covered products, setting higher standards where technologically feasible and economically justified;" and (2) "expand the scope of the appliance standard program, setting standards for additional appliances where technologically feasible and economically justified."

SUMMARY OF ACEEE RECOMMENDATIONS

In order to provide additional cost-effective savings under this program, we recommend three actions:

1. Congress should enact new efficiency standards for products now or soon to be covered by state efficiency standards and by several voluntary standards programs.
2. The Bush Administration should permit a SEER 13 efficiency standard for residential central air conditioners and heat pumps to proceed.
3. DOE, with adequate funding and encouragement from the Congress, should complete Congressionally-mandated rulemakings in a timely manner.

In the balance of this testimony I will elaborate on these three recommendations.

OPPORTUNITIES FOR NEW PRODUCTS TO COVER UNDER THE STANDARDS PROGRAM

The most recent federal legislation on standards, the Energy Policy Act, was passed in 1992. Since then there have been many technical and programmatic developments that make it possible and desirable to extend the federal standards program to additional products. These developments include work on new standards by several states, development of Energy Star specifications for many efficient products, and additional research on the amount of energy used for different energy end-uses. In particular, for the past year, the California Energy Commission (CEC) has undertaken a rulemaking to develop new standards for several products not currently covered by the federal standards program.

Based on the work of the CEC and others, we recommend that the federal standards program be extended to cover eleven additional products. These products fall into two general categories: (1) eight products for which sufficient technical information is available for Congress to enact specific new standards; and (2) three products for which the U.S. Department of Energy (DOE) needs to conduct additional research before specific standards can be set. In our opinion, where possible, Congressional action is preferable to DOE action, since a DOE rulemaking takes at least three years, and often far longer (DOE is still working on several rulemakings called for in the 1992 Energy Policy Act). Furthermore, for the majority of the standards in both categories, Congressional action is needed because under current laws, DOE is only authorized to extend the standards program to "consumer products" and many of the opportunities for new standards involve products used by businesses and not consumers. In the paragraphs below, I briefly describe the eleven products which should be covered under the standards program. I list products in approximate order of likely energy savings.

Torchiere lighting fixtures. Torchieres are portable lighting fixtures that aim light upward and bounce it off the ceiling to provide indirect lighting. In recent years they have become ubiquitous in American homes and apartments due to their high light levels and low purchase price. However, these products are major energy hogs, and can be fire hazards as well (more than 400 fires have been traced to halogen torchieres). The typical product consumes 300 Watts or more of power. Much more

[1] Geller, Kubo, and Nadel. 2001. *Overall Savings from Federal Appliance and Equipment Efficiency Standards.* Washington, D.C.: American Council for an Energy-Efficient Economy.

efficient torchieres based on high-output compact fluorescent designs use less than 100 Watts and provide the same or equal light output without creating a potential fire hazard. The simple payback for these more efficient units is typically less than two years (simple payback is the number of years for operating cost savings to offset the incremental cost of the efficiency improvements). The CEC has developed minimum efficiency standards for these products that cap energy use at 190 Watts and include other important technical details.[2] These same standards should be adopted nationally.

Furnace and heat pump fans. The efficiency of residential furnaces and heat pumps is covered by current federal standards, but these standards don't include the energy consumed by the blower used to circulate conditioned air around the home. The typical furnace fan uses 800-1000 kWh per year, but more efficient fans now on the market use less than 300 kWh, a saving of more than 60%.[3] In high volume mass production the more efficient fans should cost on the order of $100 more than a conventional fan, resulting in a simple payback to the homeowner of less than three years.[4] Additional technical work is needed to decide how best to set a fan power limit (i.e., these limits need to take account of the heating capacity and airflow of the system), so responsibility for setting the standard should be delegated to DOE.

Electronic equipment and power supplies. Many types of electronic equipment used in the home continuously use small amounts of power, even when they are turned off. Examples include TVs, VCRs, microwave ovens, and many rechargeable products. Aggregated over the many hours in a year and the number of products in place in a typical home, this "standby" power use amounts to about 5% of electricity use in a typical home according to analyses by Lawrence Berkeley National Laboratory and others.[5] More efficient power supplies and other technical improvements can reduce this standby power use by an average of about 75% in the vast majority of cases, at a typical cost of no more than a couple of dollars per product.[6] For some of these products, the Energy Star program awards special labels to identify power-stingy designs. We recommend that Congress adopt a standby power limit of one watt for all of these products, but to allow DOE to set looser standards where manufacturers can demonstrate that a one watt limit is not technically feasible or economically justified.

Commercial unit heaters. Unit heaters are used in open commercial and industrial spaces to provide heating. The typical system has a seasonal efficiency of about 63%, whereas systems with power or induced-draft burners typically have seasonal efficiencies of about 82%. The more efficient systems reduce energy use an average of 23%, and have a simple payback of about two years.[7] Due to the impact of federal standards, residential heating systems now predominantly use power or induced-draft burners and DOE has just adopted new regulations for commercial furnaces that require similar improvements.[8] We recommend that Congress adopt requirements for unit heaters the same as those just adopted by DOE for commercial furnaces.

Ceiling fans. Large "Casablanca style" ceiling fans are used in many homes to circulate air around the room and help occupants feel more comfortable. However, most of these fans have inefficient motors and blade designs, not to mention inefficient lighting systems (many of these fans also include lights). A major manufacturer has recently introduced an improved design that reduces energy use by 40%. The incremental cost of this efficient model relative to standard models with similar features is about $20, resulting in a simple payback to the consumer of about 3½

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[2] California Energy Commission. "Appliance Efficiency Regulations (draft of April 2001)." Sacramento, CA.

[3] GAMA. *October 2000 Consumers' Directory of Certified Efficiency Ratings.* Arlington, VA: Gas Appliance Manufacturers Association.

[4] Kubo. Sachs and Nadel. 2001. *Opportunities for New Appliance and Equipment Efficiency Standards: Energy and Economic Savings Beyond NAECA and EPAct* (draft). Washington, DC: American Council for an Energy-Efficient Economy.

[5] Rainer, Greenberg and Meier. 1996. "You Won't Find These Leaks with a Blower Door: The Latest in 'Leaking Electricity' in Homes." In *Proceedings 1996 ACEEE Summer Study on Energy Efficiency in Buildings.* Pp. 1.187-1.191. Washington, DC: American Council for an Energy-Efficient Economy.

[6] Kubo et al. See note 4.

[7] Calculations by ACEEE from incremental cost and energy savings estimates in Krauss, Hewett, and Lobenstein. 1992. *Commercial Gas Space Heating Equipment: Opportunities to Increase Energy Efficiency.* Minneapolis, MN: Center for Energy and the Urban Environment.

[8] DOE. 2001. "Energy Efficiency Program for Commercial and Industrial Equipment: Efficiency Standards for Commercial Heating, Air Conditioning and Water Heating Equipment; Final Rule." *Federal Register* (66)9, Jan. 1 2, pp. 3336-3356.

years.[9] The Energy Star program is launching a program this fall for residential ceiling fans that will require better blade/motor designs and more efficient lighting.[10] DOE should be directed to review the new Energy Star specification and set minimum efficiency standards that build upon this specification.

Distribution transformers. Distribution transformers are used in many commercial and industrial buildings to reduce voltage from line voltage to voltages used to power building systems. These systems are typically purchased on the basis of first costs, leaving significant opportunities for cost-effective energy savings. The National Electrical Manufacturers Association (NEMA) has developed a recommended standard that reduces the energy losses associated with this equipment by an average of about one-third, with the added cost of the more efficient equipment paying back in about three years.[11] Massachusetts and Minnesota have adopted the NEMA standard as a mandatory standard and California and New York are now in similar adoption processes. DOE was instructed in the Energy Policy Act of 1992 to develop standards for these products but nine years later this process is still dragging on. We recommend that Congress adopt the NEMA standard, thereby saving the time and expense of continuing the DOE rulemaking process.

Vending machines. Vending machines are primarily purchased by beverage distributors and placed in a variety of locations at no cost to the property owner. However, the property owner does pay for the electricity to operate these machines. Since the purchaser does not pay operating costs, there is little incentive to purchase efficient machines and most vending machines are inefficient as a result. A study by Arthur D. Little Company for DOE estimated that the energy use of vending machines can be reduced by 44-51% using measures with an average simple payback of 2.4-3.2 years.[12] However, there is insufficient information on the energy use of the full range of machines sold today, so further data collection is needed before standards can be set. The CEC is now planning to collect this data. DOE should be directed to set new standards based on this data and its own technical and economic analyses.

Commercial refrigerators and freezers. Federal standards currently cover residential refrigerators and freezers but do not cover the larger commercial units used in restaurants, hotels, hospitals and other commercial applications. Research by Arthur D. Little Company for DOE found that the energy use of typical commercial refrigerators and freezers can be reduced by 45-55% using improvements with an average simple payback to the user of just over 2 years.[13] The California Energy Commission (CEC) has developed minimum efficiency standards for these products based on the energy use of the average product on the market today.[14] These same standards should be adopted as national standards.

Traffic lights. Like exit signs, most traffic lights use incandescent bulbs, but new "light emitting diode" (LED) are now available that reduce energy use about 90% and have additional maintenance and safety benefits Unlike incandescent lamps, the LED lights operate for many years without bulb changes, and when LEDs age, they just get dimmer until they are replaced, avoiding the safety problems that can happen when a lamp in a traffic light burns out.[15] The Energy Star program has established an energy and safety performance specification for the more-efficient traffic signals.[16] California is in the process of adopting this specification as a mandatory minimum performance standard.[17] A similar standard should be adopted at the national level. Such a standard should apply to red and green lights, since these account for the vast majority of traffic light energy use, and have the most favorable economics (typically simple payback periods of 1-4 years, depending on the application).[18]

Exit signs. Many exit signs use incandescent bulbs (40 Watts is typical), and since they are continuously illuminated, typically cost around $30 per year to operate.

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[9] E Source Tech News—5/15/01.

[10] Ecos Consulting. 2001. "Final Draft Energy Star® Specification for Residential Ceiling Fans. June.

[11] Barnes, Das, McConnell, and Van Dyke. 1997. *Supplement to the 'Determination Analysis" and Analysis of the NEMA Efficiency Standard for Distribution Transformers.* Oak Ridge, TN: Oak Ridge National Laboratory.

[12] Arthur D. Little Co. 1996. *Energy Savings Potential for Commercial Refrigeration Equipment.* Washington, DC: U.S. Dept. of Energy.

[13] *Ibid.*

[14] CEC 2001. See note 2.

[15] Kubo et al. 2001. See note 4.

[16] EPA. "Energy Star Program Requirements for Traffic Signals." Washington, DC: U.S. Environmental Protection Agency. Also, CEC 2001 (see note 2).

[17] CEC 2001. See note 2.

[18] Kubo et al. 2001. See note 4.

New exit sign designs use LEDs and consume on the order of 3 Watts, reducing energy use by more than 90% relative to an incandescent sign. The simple payback for using LED signs instead of incandescent signs is generally less than two years. In addition, the LED signs do not require periodic bulb changes, resulting in substantial maintenance cost savings.[19] As with traffic lights, there is an Energy Star specification that California is now adopting as a mandatory state standard.[20] A similar national standard should be adopted.

Ice-makers. Ice-makers are commonly used in hotels, motels, restaurants and hospitals to produce ice in large quantities. Ice-makers use a substantial amount of energy in order to freeze water, and then keep the ice cold. Products now on the market vary substantially in efficiency, with the most efficient products typically using about 30% less energy than the least efficient. Relative to the least efficient machines, the most efficient ones typically have a simple payback of one year or less.[21] The Federal Energy Management Program (FEMP) has developed a specification that identifies the top performing units on the market today for each product category (features and size).[22] This specification should be adopted as a national standard.

Energy and economic savings. My organization, ACEEE, is now completing an analysis of the energy and economic savings from adopting standards on these products. Our preliminary results indicate that these standards will save approximately 73 billion kWh of electricity in 2010 and 164 billion kWh in 2020. The savings in 2020 amount to about 5% of projected residential and commercial electricity use in that year, and reduce peak electrical demand by the equivalent of 40-50 power plants (300 MW each). In addition, the unit heater standard by itself will reduce commercial building gas consumption by about 3% in 2020, a remarkable achievement for a product with annual sales of only about 1/4 million units. These standards will also result in substantial economic savings to consumers and businesses. Our preliminary analysis indicates that for products purchased through 2020, discounted net benefits (benefits minus costs) will total about $80 billion, with a benefit-cost ratio of more than 5:1. Furthermore, as noted in the Administration National Energy Policy, the energy savings will reduce air pollutant emissions. We estimate that these standards will reduce carbon emissions by more than 20 million metric tonnes (MMT) in 2020, which can be a useful component of U.S. efforts to reduce greenhouse gas emissions. Standards will also result in significant reductions in SO_2, NO_X, and mercury emissions, thereby helping power companies to meet new standards that might be set in near-term amendments to the Clean Air Act.

NEW STANDARDS FOR RESIDENTIAL CENTRAL AIR CONDITIONERS AND HEAT PUMPS

When Congress passed the National Appliance Energy Conservation Act of 1987, it established initial efficiency standards for residential central air conditioners and heat pumps and called for DOE to set revised standards no later than January 1, 1994. The rulemaking formally began in September 1993 and a final rule was published in January 2001 in the closing days of the Clinton Administration. This final rule was the result of more than seven years of effort, but was seven years behind schedule. In our opinion, while this rule fell short in several respects,[23] it was a reasonable one. This rule established a new minimum efficiency standard of SEER 13, effective January 2006 (SEER is the Seasonal Energy Efficiency Ratio, a measure of average unit efficiency over the full cooling season). There are now more than 600 distinct models on the market that meet this standard, including models from most manufacturers. We estimate that a SEER 13 standard will cost the consumer an average of about $170,[24] but that the more efficient models will reduce electricity bills by an average of about $50 per year, resulting in a simple payback to the consumer of about 3½ years. Furthermore, this rule is an important part of efforts to

[19] Kubo et al. 2001. See note 4.

[20] EPA. "Energy Star Program Requirements for Exit Signs." Washington, DC: U.S. Environmental Protection Agency.

[21] Kubo, Nadel and Suozzo. 2000. "Commercial Packaged Refrigeration: An Untapped Lode for Energy Efficiency. In *Proceedings 2000 ACEEE Summer Study on Energy Efficiency in Buildings.* Pp. 3.203-3.218. Washington, DC: American Council for an Energy-Efficient Economy.

[22] FEMP. *Commercial Ice-Maker Efficiency Recommendation.* Washington, DC: Federal Energy Management Program, U.S. Dept. of Energy.

[23] The rule fails to address two very important issues: high temperature performance (which affects utility peak loads) and the ability to maintain high efficiency across a broad range of outdoor temperatures and installation conditions. There are straightforward solutions to both of these issues, but unfortunately these were not included in the final rule.

[24] DOE estimates the incremental cost at about $340, but we reduce the DOE estimate by 50% to account for DOE's long history of overestimating incremental costs for new appliance standards (see note 35).

avert future electric reliability problems. This rule will reduce peak electric demand by about 57,000 MW over the next three decades, averting the need for about 190 new 300-MW power plants.[25]

Unfortunately, in April 2001, the Administration announced that it will soon propose rolling back the standard from SEER 13 to SEER 12.[26] We believe this action is misguided and may well be illegal. This action is misguided because it will substantially reduce the energy, peak demand, and economic savings achieved by the new standard. This decision is also misguided because it relies on several unreasonable analysis assumptions, assumptions which need to be corrected if DOE is going to proceed with a new rule. This decision is probably illegal because it ignores a Congressional directive in NAECA as well as several Court decisions.

The difference in energy, peak demand and financial savings between SEER 12 and SEER 13 is very substantial. According to analyses by ACEEE, relative to a SEER 12 standard, a SEER 13 standard will:

- Reduce peak demand by 13,000 MW by 2020 and 18,000 MW by 2030, the equivalent of 43 and 60 new power plants respectively (300 MW each);
- Increase energy savings by 45% or more;
- Reduce consumer electric bills by more than $18 billion over the next 30 years;
- Have a typical simple payback period to the consumer of less than four years.[27]

DOE estimates that a SEER 13 split air conditioner will cost the average consumer $122 more than a SEER 12 unit, which is 5% more than a SEER 12 unit. While we believe that DOE has overestimated the price increase, even the DOE cost estimate is small relative to the benefits I have just described.

In recent statements before Congress, Administration officials have defended the Administration's decision to propose a SEER 12 standard, arguing that this decision was based on analyses by career staff that showed that low-income consumers would be disadvantaged by a SEER 13 standards, that a SEER 13 standard could increase the use of electric resistance heat, and that a SEER 13 standard would adversely affect competition. However, such statements ignore the fact that only 21% of low-income households have central air conditioners in their homes and the majority of low-income households rent and do not own their homes.[28] Renters will benefit from standards, for without standards most landlords will purchase a low-price unit for their tenants. For these and other reasons, many low-income advocacy organizations support the SEER 13 standard.[29] If the Administration is truly concerned about low-income households, it should set up a program to help low-income households replace their present air conditioners (recall that the difference between SEER 12 and 13 is only $122) rather than weakening standards for all American households.

Similarly, the Administration alleges that the difference in price between a SEER 12 and SEER 13 split heat pump ($188) will cause many households to switch from heat pumps to electric resistance heat, despite the fact that electric resistance heat will approximately double heating bills relative to use of a heat pump (such a doubling will increase average annual heating bills by about $350,[30] making for a very poor return on the first cost savings).

And with regard to competition, concerns about impacts on competition are contained in a Department of Justice (DoJ) letter, but this letter does not provide an explanation for these concerns nor does it state how DoJ arrived at its concerns.[31] We do know that DoJ staff interviewed many manufacturers, but DoJ did not to our knowledge interview efficiency advocates, state government officials, or other inter-

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[25] Our peak demand estimates are different from DOE's because DOE used only two field studies to estimate peak—demand savings, including one that is inconsistent with all other available data. ACEEE used five studies from various regions of the country.

[26] DOE. 2001. "DOE to Propose New 20% Increase in Energy Efficiency Standards for Residential Air Conditioners and Heat Pumps." Press Release, April 13. Washington, DC: U.S. Dept. of Energy.

[27] This estimate is based on DOE's estimate of the cost difference between a SEER 12 and 13 unit, reduced by 50% (see note 24) divided by annual operating cost savings of $19 which reflects a 2.5 cents/kWh summer electricity price differential not included in the DOE analysis.

[28] EIA. *A Look at Residential Energy Consumption 1997.* Washington, DC: Energy Information Administration, U.S. Dept. of Energy.

[29] Organizations that have written letters in support of the SEER 13 standard include the Consumer Federation of America, National Consumers League, and several low-income weatherization agencies.

[30] The average annual cost for space heating for homes with heat pumps was $352 in 1993 (EIA. *Household Energy Consumption and Expenditures, 1993.* Washington, DC: Energy Information Administration, U.S. Dept. of Energy).

[31] Nannes, John. Letter to Eric Fygi, Acting General Counsel, DOE, dated April 5, 2001. Washington, DC: U.S. Dept. of Justice.

ested parties. Thus, the DoJ process is a "black box" and a potentially biased process. DoJ needs a broader and better documented process for its concerns to receive the same weight as other data in this rulemaking that have been publically-vetted and documented.

From material published by DOE, concerns about impacts on manufacturers and competition primarily relate to the fact that many manufacturers make much of their profits on "high-end" units with extra features and above average efficiency. The concern is that a minimum standard at SEER 13 will make it hard to differentiate a higher efficiency unit for high-end sales. We disagree for two reasons. First, with new compressors, new heat exchangers, and other technical improvements it is possible to produce reasonably-priced SEER 14 and SEER 15 units. For example, just this week Amana announced a full line of SEER 15 units that use single-speed compressors (single-speed compressors are less expensive than the multi-speed compressors that many other manufactures use to achieve SEER 15).[32] Second, we believe it is possible for manufacturers to develop and successfully market value-added SEER 13 and SEER 14 units that perform better in the field than baseline SEER 13 units. Due to common installation problems as well as optimization of many air conditioner designs for a single test temperature, many air conditioners perform at a lower efficiency in the field than in a laboratory. My organization is now working with utilities, federal, state and regional organizations, and some manufacturers to develop a voluntary program to promote "robust" air conditioners that warrant a price premium because they perform better in the field.[33] It is products like these that will allow manufacturers to continue to sell high-end products and continue to earn the profits they depend on.

Statements by DOE officials also ignore several major errors in the DOE analysis. First, the DOE analysis is based on summer 1996 electricity prices, adjusted downward for assumed long-term declines in electricity prices. In reality, as wholesale markets and many retail markets have restructured, electricity pricing is increasingly based on season of use (and often time of use as well). A December 2000 analysis of U.S. wholesale electricity prices in 1998-2000 by Synapse Energy Economics found that electricity prices in the summer afternoons and evenings when air conditioners are primarily used are 2-9 cents per kWh higher than the 1996 prices used by DOE.[34] Second, the DOE analysis is based on today's technologies for achieving improved efficiencies. New technology developments and continuing productivity improvements will bring these costs down by 2006 when the new standard goes into effect, just as they substantially reduced the costs of the current SEER 10 standard relative to prior DOE and industry projections.[35] If DOE is going to reassess the central air conditioner standard, it needs to correct these analysis errors before proceeding.

The Administration's attempt to roll back the air conditioner standard also ignores clear language in NAECA that new standards cannot be set that are weaker than previous standards, and several court decisions that a new Administration faces a high burden of proof before it can roll back final rules of a previous Administration. When Congress passed NAECA it was concerned about administrative rollbacks of standard levels and added a specific provision that "The Secretary may not prescribe any amended standard which increases the maximum allowable energy use, or decreases the minimum required energy efficiency of a covered product." The Bush Administration's proposal to roll back the air conditioner standard violates this provision. The Bush Administration proposal also is based on very limited technical arguments, and will probably have trouble getting past the Supreme Court decision that "an agency changing its course by rescinding a rule is obligated to supply

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[32] Schultz, Matt, Product Manager, Amana Heating and Air Conditioning. Email dated July 9, 2001.

[33] Sachs. 2001. "Draft Prospectus: Sustained High Performance Central Air Conditioners and Heat Pumps: Delivering Energy Efficiency in Use." Washington, DC: American Council for an Energy-Efficient Economy.

[34] Woolf, Biewald, Allen, White and Johnston. 2000. *Marginal Price Assumptions for Estimating Customer Benefits of Air Conditioner Efficiency Standards.* Cambridge, MA: Synapse Energy Economics.

[35] In 1982, DOE estimated that the incremental cost to raise air conditioner efficiency to SEER 10 would be $349 (DOE, 1982, *Consumer Products Efficiency Standards, Engineering Analysis Document*). U.S. Census Bureau data shows that when the SEER 10 standard took effect, air conditioner prices did not go up at all (Current Industrial Reports, Refrigeration, Air Conditioning, and Warm Air Heating Equipment). Interestingly, the Air Conditioning and Refrigeration Institute (the industry trade association) was even farther off the mark; in the early 1980's they estimated that the incremental cost of a SEER 10 unit would be $762 (as cited in CEC. 1984. "Staff Report on Proposed Revision of Appliance Efficiency Standards for Central Air Conditioners Under 65,000 Btu/Hour, P400-84-015. Sacramento, CA: California Energy Commission).

a reasoned basis for the change beyond that which may be required when an agency does not act in the first instance."[36] Finally, all of the actions to date to roll back the standard have been made without any opportunity for public comment, which appears to be in violation of the Administrative Procedures Act. Several state attorney generals and environmental, consumer and low-income advocacy organizations recently brought suit challenging these actions.[37] Given the energy problems facing the U.S., it would be far more productive to put resources into developing and implementing new policies to save energy, rather than using large amounts of resources to pursue a legally-questionable action that will increase energy use.

At today's hearing the President of the Air Conditioning and Refrigeration Institute (ARI) will also testify. Based on past ARI statements, in addition to some of the some arguments DOE is making, he is likely to argue that DOE underestimated the installation costs of meeting a new air conditioner standard, that a SEER 13 standard would be particularly burdensome in manufactured housing, that a SEER 13 standard would eliminate approximately 85% of current units from the market, and that a SEER 13 standard will raise unemployment.[38] In our opinion, most of these allegations are wrong and others are half-truths. Specifically:

- DOE's analysis does consider installation costs. While some SEER 13 units are significantly larger than current units, others are not. For example, Goodman Manufacturing's SEER 13 units are only about three inches larger than basic units. The size of the unit depends on the technologies that a manufacturer uses to improve efficiency, and some of these technologies do not increase unit size.
- DOE's final rule specifically treats "space constrained products," such as units for manufactured housing, as a separate product class. Required efficiency levels for this special class have yet to be decided.
- Manufacturers are correct that a substantial majority of current products do not meet the SEER 13 standard. However, an even higher percentage of then-current products did not meet the SEER 10 standard when it was enacted and manufacturers had little difficultly meeting that standard.[39]
- A SEER 13 standard will increase employment, not reduce it. According to DOE's analysis, employment in the industry will modestly increase since SEER 13 units require more materials and labor than SEER 10 units.[40] An old DOE analysis does find that overall national employment will modestly decline with a SEER 13 standard due to the impacts of higher air conditioner costs on consumer purchases,[41] but that analysis was based on very high estimates of the extra cost to produce SEER 13 units. DOE has substantially decreased its cost estimates but did not revise the national employment analysis before publishing the SEER 13 final rule.

Senator Barbara Boxer has introduced a resolution (S.J. Res. 15) calling for Congressional disapproval of the rule submitted by DOE relating to the postponement of the effective date of central air conditioner standards under the terms of the Congressional Review Act of 1995. We thank Senator Boxer for introducing this resolution and for bringing attention to this important issue. We recommend that this Committee should do all it can to encourage the Administration to drop its rollback proposal.

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[36] *Motor Vehicle Manufacturers Association* v. *State Farm Mutual Ins Co. et al.*, 463 U.S. 29 (1983).

[37] State of New York and State of Connecticut, Petitioners against Spencer Abraham. June 18, 2001. "Petition for Review." New York, NY: U.S. District Count, Southern District of New York. Also, a similar suit was filed the same day by Natural Resources Defense Council, Consumer Federation of America, and Public Utility Law Project.

[38] ARI. "ARI Asks DOE to Increase Efficiency by Fairer 20 Percent," press release. April 6, 2001. Arlington, VA: Air Conditioning and Refrigeration Institute.

[39] In 1986, when NAECA was negotiated, probably less than 10% of then-current models met the 1992/93 NAECA standards. ARI data from 1984 (in "ARI Comparative Study of Energy Efficiency Ratios") indicate that 6.8% of unitary air conditioner shipments had a SEER of 10 or more while only 4.8% of heat pumps exceeded a SEER of 10. We do not have 1986 data, but during the mid-1980s, SEER grew only modestly, hence our estimate that less than 10% of models in 1986 had a SEER of 10 or more.

[40] DOE. 2000. *Technical Support Document: Energy Efficiency Standards for Consumer Products: Residential Central Air Conditioners and Heat Pumps.* Oct. Washington, DC: U.S. Dept. of Energy.

[41] *Ibid.*

REVISIONS TO OTHER CURRENT STANDARDS

Under existing legislation, DOE is supposed to review and revise existing appliance and equipment efficiency standards every five years. Unfortunately, DOE is very far behind in this process. For example, DOE is just now starting a proceeding to revise the residential furnace standard, a proceeding that under current legislation should have been completed by Jan. 1, 1994. Similarly, DOE has not yet started the revision process for dishwashers, even though that process should have been completed in 1996. And I discussed earlier, DOE is still working on a rulemaking for distribution transformers that was originally called for in the Energy Policy Act of 1992. There is a need to work through this backlog which will require improved management at DOE as well as increased annual appropriations.

According to our analysis, if DOE can complete the major scheduled rules, substantial energy and financial savings will result. Our analysis includes development of new standards on commercial air conditioners, dishwashers, commercial boilers, and reflector lamps over the next few years, and further revisions to refrigerator, water heater, and residential air conditioner standards in the longer term. We estimate that in 2020 these standard revisions can save 53 billion kWh of electricity and 187 trillion Btu's of natural gas. The electricity and gas savings together will reduce consumer energy bills by more than $4 billion annually by 2020.

Under DOE's appliance standards "Process Improvement Rule" priorities are set in the summer for rulemakings for the new fiscal year. With the change in Administration, this annual process is modestly delayed but is scheduled to begin soon. We recommend that after this annual process is completed in September or October, that this Committee schedule an oversite hearing to review DOE plans for standards rulemakings in 2002, including any new rulemakings that may be called for under comprehensive energy legislation that will likely be pending at that time. Such an oversite hearing should explore options for "picking up the pace" so that rulemakings can be completed in a more timely manner, and perhaps also with less controversy than some of the recent rulemakings.

CONCLUSION

Appliance and equipment efficiency standards have been one of the federal government's most effective energy-saving policies. These standards have also provided substantial net economic benefits to consumers and businesses and contributed to reduced emissions of air pollutants. It has been nearly a decade since the scope of the appliance and equipment standards program has changed. Based on state and voluntary standards developed over this past decade, Congress should expand the scope of the standards program to include 11 additional products. These additional standards will reduce energy use in the residential and commercial sectors by about 5% in 2020, reduce peak electrical demand by the equivalent of 40-50 new power plants, and result in net savings to consumers and businesses of more than $80 billion. The standards we recommend are primarily based on state and voluntary standards that are either now in effect or that are expected to be finalized in the next month or so. These state and voluntary standards have not been controversial. Hopefully these same standards can also be adopted at the national level without controversy. To the extent issues arise, ACEEE stands ready to provide technical information and to negotiate in good faith with affected trade organizations, similar to the role we played prior to the adoption of standards legislation in 1987, 1988, and 1992.

With the savings from standards on new products, plus savings from existing standards (including the SEER 13 air conditioner standard) and from new standards now being considered by DOE, U.S. electricity use in 2020 will be reduced by more than 10% relative to what use would be without the federal standards program. While these savings will not solve U.S. energy problems, they will make a significant contribution towards bringing U.S. energy supply and demand into better balance, helping our environment, our economy, and our pocketbooks.

That concludes my testimony. Thank you for the opportunity to present these views.

The CHAIRMAN. Thank you very much.

Mr. Rees, go right ahead.

STATEMENT OF CLIFFORD REES, JR., PRESIDENT, AIR CONDITIONING AND REFRIGERATION INSTITUTE, ARLINGTON, VA

Mr. REES. Mr. Chairman, thank you very much for the opportunity to appear before the committee today. As you mentioned, I

represent the Air Conditioning and Refrigeration Institute, or ARI, a national trade association of over 240 manufacturers who produce over 90 percent of North American-produced central air conditioners and commercial refrigeration products. I am here today to voice our support for the Department of Energy's proposed 20-percent increase in the SEER standards for central air conditioners and heat pumps.

The industry has worked diligently over the last 20 years to improve the energy efficiency of residential air conditioners and heat pumps. We are proud that we have been able to provide our customers with equipment that is at least 40 percent more efficient than 20 years ago. Concurrently, the industry is making a seamless transition to nonozone-depleting refrigerants, and has introduced new compressor technologies, while continuing to offer the consumer affordable choices for their comfort, for their health and safety.

As you know, the current SEER standard is 10, and has been since it was initially set in 1992. For the past few years, DOE has conducted rulemaking procedures to determine new, more rigorous, and minimum standards for the industry to meet. I congratulate the U.S. Senate for encouraging the development of the Department of Energy's process improvement rule, which has created a balanced, rational, inclusive approach to rulemaking.

I commend the Department's staff for their openness and diligence throughout the process, and their fairness in meeting the economically justified and technologically feasible standard set forth in the National Appliance Energy Conservation Act. Parenthetically, let me add that whoever the ultimate decisionmaker is in setting the standard, the decisionmaker would benefit greatly from analyzing carefully over $2 million of DOE analyses, including those done by independent contractors, which were developed during the residential air conditioner and heat pump rulemaking.

During the rulemaking, the overwhelming majority of the air-conditioning industry, indeed, 237 of ARI's 240 members, came to support, I will admit, however, in some cases reluctantly, a 20-percent increase in the standard, and that is to say, a 12-SEER.

I say reluctantly only because even a 20-percent increase will carry with it significant burdens in cost, and impact on consumers and considerable redesign and retooling cost in the industry. I want to assure the chairman, however, that while this appears to be a split within my own membership in my association, in fact we are unanimous in supporting the goal of improved conservation and energy efficiency. The split is a difference of opinion about how best to go about attaining that goal.

I do not want to spend my time today speaking to you about the last-minute effort in January at DOE to impose a 30-percent increase in the standard, and I am not here to tell you that a 13-SEER minimum standard cannot be implemented by the industry. Obviously, air conditioners with a 13-SEER are manufactured and sold today. So are 14's, 15's, and 16's. They cost a lot more to make, and we are very proud of these products, but they are, in fact, more expensive, yet they are made and sold to the fortunate few who can afford them and to those who believe they will recoup the added cost through energy savings.

This latter group lives predominantly in the Southern tier of the United States, primarily Florida, Texas, Arizona, and southern California. Frankly, if the industry had only its immediate self-interest in mind, it would rally behind the 13-SEER standard and take the money and run, but the short-term monetary boon to the industry from 13-SEER standard would be outweighed by the impact on the industry's customers, on jobs, and ultimately on the industry.

I want to summarize briefly what a 30-percent increase in the SEER standard would mean to consumers, to jobs and, in the long run, the industry. First, as the map of the United States attached* to my testimony clearly demonstrates, there will be no meaningful economic payback for the overwhelming majority in this country. 75 percent of consumers purchasing of 13-SEER will incur a net cost.

In other words, at the end of the lifetime of the product the savings and operating costs will not be sufficient to offset the incremental first cost of the product. The situation is even worse for low-income consumers. 83 percent of them will not benefit from the 13-SEER standard. In effect, the 13-SEER only makes clear economic sense in the tip of Florida and the tip of Texas. This simply makes no sense as a national policy.

Indeed, it is economically dangerous to consumers and industry alike, and runs counter to our mutual goal of energy conservation, and there could be a significant health risk to senior citizens and lower income families who rely upon affordable air conditioning today not just for their comfort but for their health and for their safety.

Second, the increased cost to the consumer going from a 10-SEER product to a 13-SEER product will be over $700. In what I believe to be an incredibly, and in fact what is an incredibly price-sensitive market, I believe that the average consumer who still has a choice could very well make the choice of repairing and keeping the old equipment, which is quite often and could be even as low as a 6-SEER, but even with 9-SEER equipment retaining that old equipment is less energy-efficient, and it runs counter to our mutual goal, and God forbid that those who rely upon air conditioning not just for their comfort but for health and safety, but would make the decision that they could not afford to replace the equipment at all.

The increased cost of a 13-SEER minimum standard will have a disproportionate impact on lower income homeowners and the elderly. It is simply inaccurate to suggest that those in low income brackets do not purchase homes and therefore would be unaffected by the cost of a 13-SEER standard. There are 13 million homeowners with incomes below $21,000. There are 34.8 million with incomes below $52,000, and $52,000 may sound like a lot of money, but if you are trying to house, feed, clothe, and education children, this additional cost without the return on the investment is a significant burden.

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*Attachments have been retained in committee files.

For older Americans, there is a significant burden as well. Half the households headed by persons 65 and older live on less than $37,000 annually.

Third, there are 9 million manufactured homes in this country. Most often, there is simply insufficient physical space to fit the indoor coil of a 13-SEER air conditioner with a cooling capacity of three times and up in the standard 20-inch wide by 22-inch deep alcove or closet used to store the heating and cooling equipment in manufactured homes. Many of these homes are now built in two or three sections with cooling loads of as much as 5 tons. These manufactured houses will require extensive retrofits in addition to the added cost of the 13-SEER equipment.

Contrary to the belief of some, air conditioners made for manufactured houses are conventional products and are, in fact, covered by the rule. They are not part of the space-constrained products exempted from this rule by DOE. Retrofitting these homes would require significant costly modifications.

Fourth, a 13-SEER would eliminate 84 percent of all new central air-conditioning models in the market today. For some manufacturers, 100 percent of all their air conditioner product lines will not satisfy the 13-SEER standard.

And fifth, according to DOE, thousands of jobs will be lost between the years 2006 and 2030 if a 13-SEER minimum standard is adopted.

Consequently, here is what the 12-SEER standard achieves: a 20-percent increase in current efficiency standards, affordable air conditioning for Americans, preservation of jobs in the United States, and preservation of competition in the industry.

Our belief in the fairness and value of the 12-SEER is shared by others. In fact, the Department of Justice expressed a concern that a 30-percent increase in the standard to a 13-SEER would have anticompetitive implications for the industry. Additionally, because thousands of jobs would be lost between 2006 and 2030, the Small Business Administration opposed a 13-SEER standard and supported a 12-SEER.

Of significance, the Air Conditioning Contractors of America, representing top air conditioning and refrigeration contractors in this country, who best understand the dynamics of the marketplace, believe that the 12-SEER represents the best, fairest approach to increasing energy efficiency and achieving the greatest energy conservation. The Manufactured Housing Institute has voiced its concern regarding the 13-SEER because of the higher cost to residents of millions of homes. The National Association of Homebuilders opposes the 13-SEER standard, cautioning that each $1,000 added to the cost of new homes disqualifies up to $400,000 buyers.

And finally, and perhaps most significantly, even the DOE staff did not support a 13-SEER during last year's rulemaking, believing a 12-SEER to be in the Nation's best interest.

Additionally, there are alternative means to achieving the increased energy efficiencies desired without imposing the hardships of a 30-percent increase on consumers. Our studies reveal that poor installation and servicing of air conditioning equipment can result in up to a 40-percent loss in energy efficiency.

As a result, the entire industry, contractors, wholesalers and manufacturers, banded together several years ago to develop the North American technician excellence program to voluntarily improve technician training, require certification for technicians, and improve the installed performance of our equipment through better installation and servicing.

Wholesaler and contractor associations provide much of the training, distribution, and administration of the testing. Manufacturers, except for one, have provided over $6 million to date for the development and management of this independent nonprofit association, similar to what the automobile industry did some 20 years ago.

Even if only 25 percent successful, when added to the enhanced consumer awareness of the benefits of periodic checkup and maintenance contracts, and the 12-SEER, the energy savings would exceed that of a mandated 13-SEER without having citizens bear the cost burden.

Finally, Mr. Chairman, by 2030 the 12-SEER standard would save 3 quads of energy at a cost to the Nation of $1 billion. Increasing the SEER an additional 10 percent increases the cost to the Nation to $4 billion.

In summary, we support the 20-percent increase in the SEER standards because it is fair, balanced, and economically justifiable. It meets our energy conservation needs without punishing those in working families, senior citizens, and the vast majority of the country who will never recover in energy savings the increased cost of a 13-SEER product. A 12-SEER product is beneficial to both consumers and industry, and represents a significant additional contribution to the Nation's goal of conserving our energy supplies. I appreciate the chairman's indulgence and my time, and I would be pleased to answer any questions, sir.

[The statement of Mr. Rees follows:]

PREPARED STATEMENT OF CLIFFORD REES, JR., PRESIDENT, AIR CONDITIONING AND REFRIGERATION INSTITUTE, ARLINGTON, VA

Thank you Mr. Chairman for the opportunity to appear before the Committee today. I represent the Air-Conditioning & Refrigeration Institute (ARI), a national trade association that represents the manufacturers of over 90% of North American-produced central air conditioners and commercial refrigeration equipment. I am here to voice our support for the Department of Energy's (DOE) proposed 20% increase in the Seasonal Energy Efficiency Ratio (SEER) standards for central air conditioners and heat pumps.

The industry has worked diligently over the last 20 years to improve the energy efficiency of residential central air conditioners and heat pumps. We are proud that we have been able to provide our customers with equipment that is at least 40% more efficient than 20 years ago. Concurrently, the industry effected a seamless transition to non-ozone depleting refrigerants, and introduced new compressor technologies, while continuing to offer the consumer affordable choices for their comfort, health and safety.

As you know, the current SEER standard is set at 10 SEER, and has been since it was initially set in 1992. For the past few years, DOE has conducted rulemaking procedures to determine new, more rigorous minimum standards for the industry to meet. I congratulate the U.S. Senate for encouraging the development of the Department of Energy's Process Improvement Rule, which has created a balanced, rational, inclusive approach to rulemaking. I commend the Department of Energy staff for their openness and diligence throughout the process, and their fairness in meeting the "economically justified and technologically feasible" standard set forth in the National Appliance Energy Conservation Act. Parenthetically, let me add that whoever the ultimate decision maker in setting this standard is—whether it be Con-

gress or DOE—the decision maker would benefit greatly from analyzing carefully over $2 million of DOE analyses—including those done by independent contractors which were developed during the residential air-conditioner and heat pump rule-making. During the rule-making, the overwhelming majority of the air conditioning industry—indeed 237 out of ARI's 240 members—came to support (I will admit, in some cases, somewhat reluctantly) a 20% increase in the standard, that is to say a 12 SEER. I say reluctantly only because even a 20% increase will carry with it significant burdens in cost and impact on consumers.

I do not want to spend my brief time today speaking to you about the last minute effort in January at DOE to attempt to impose a 30% increase in the standard to a 13 SEER. And I am not here to tell you that a 13 SEER minimum standard could not be implemented by the industry. Obviously, air conditioners with a 13 SEER are manufactured and sold today. So are 14's, 15's and 16's. We like those products. But, they are more expensive—and for good reason. They cost a lot more to make. Yet they are made and sold today to the fortunate few who can afford them and to those who believe they will recoup the added cost through energy savings. This latter group lives predominantly in the southern tier states, primarily in Florida, Texas, Arizona and Southern California. Frankly, if the industry had only its immediate self interest in mind, it would rally behind a 13 SEER standard and take the money and run. But the short-term monetary boon to the industry from a 13 SEER standard would be outweighed by the impact on consumers, jobs, and ultimately, in the long term, the industry.

I do want to summarize briefly what a 30% increase in the SEER standard would mean to consumers, to jobs and, in the long run, to the industry:

First, as the map of the United States attached to my testimony clearly demonstrates, there will be no meaningful economic payback for the overwhelming majority of the country. Seventy five percent (75%) of consumers purchasing a 13 SEER will incur a net cost. In other words, at the end of the lifetime of the product, the savings in operating cost will not be sufficient to offset the incremental first cost of the product. The situation is even worse for low-income consumers—83% will not benefit from a 13 SEER standard.

In effect, a 13 SEER only makes clear economic sense in the tip of Florida and the tip of Texas. It simply makes no sense as a national policy. Indeed, it is economically dangerous to consumers and industry alike, and runs counter to our mutual goal of energy conservation. And, there could be significant increased health risks to senior citizens and lower income families who rely on affordable air conditioning today not just for their comfort, but for their health and safety.

Second, the increased cost to the consumer going from a 10 SEER product to a 13 SEER product will be over $700.00.

- In what is an incredibly price-sensitive marketplace, what do you think the average consumer will do when confronted with that? Probably exactly what you or I would do . . . keep the old one . . . which is likely to be a 6 to 9 SEER product manufactured in the 1980's. This is less energy efficient. Keeping older equipment operating longer runs counter to our mutual goal of energy conservation.
- The increased costs of a 13 SEER minimum standard will have a disproportionate impact on lower income homeowners and the elderly. It is simply inaccurate to suggest that those in low income brackets do not purchase homes and therefore would be unaffected by the costs of a 13 SEER minimum standard. There are 13.2 million homeowners with incomes below $21,920.00 per year; another 9.8 million—or 23 million total—with incomes below $35,072; and an additional 11.8 million—or 34.8 million total—with incomes below $52,608 according to the National Low Income Housing Coalition. $52,000 may sound like a lot of money, but if you are trying to house, feed, clothe and educate children, this additional cost—without a return on the investment—is a significant burden.
- For older Americans, there is a significant burden too. Half of the households headed by persons 65 and older live on less than $37,000 annually.

Third, there are 9 million manufactured homes. The 13 SEER standard will not allow sufficient physical space to fit the indoor coil of air conditioners with a cooling capacity of 3 tons and up in the standard 2″ wide x 22″ deep alcove or closet used to store the heating and cooling equipment in manufactured houses. Many of these homes are now built in 2 or 3 sections, with cooling loads of as much as 5 tons. These manufactured houses will require expensive retrofits in addition to the added cost of the 13 SEER equipment. Contrary to the belief of some, air conditioners made for manufactured houses are conventional products and are, in fact, covered by the rule. They are not part of the "space-constrained" products exempted from this rule by DOE. Retrofitting these homes would require significant, costly modi-

fications to house the larger 13 SEER equipment in addition to the greater cost of the 13 SEER equipment. The 13 SEER standard will have a significant impact on manufacturers selling to this market.

Fourth, a 13 SEER would eliminate 84% of all new central air conditioning models in the market today and 86% of all new heat pumps, at a cost of $350 million to the industry for redesign and retooling. For some small manufacturers, 100% of all their air conditioner product lines will not satisfy the 13 SEER standard.

Fifth, according to DOE, thousands of jobs will be lost between the years 2006 and 2030 if a 13 SEER minimum standard is adopted. Accordingly, the U.S. Small Business Administration supports the 20% increase in the SEER standard and opposes a 13 SEER minimum standard.

By contrast, here is what a 12 SEER standard achieves:

(1) A 20% increase over current energy efficiency standards;
(2) Affordable air conditioning for many more Americans;
(3) Preservation of jobs in the United States; and
(4) Preservation of competition in the industry.

Our belief in the fairness and value of the 12 SEER is shared by others. In fact, the Department of Justice expressed concerns that a 30% increase in a standard to a 13 SEER will have anti-competitive implications for the industry. Additionally, because of the thousands of jobs which would be lost, between 2006 and 2030, the Small Business Administration opposed a 13 SEER standard and supported a 12 SEER. Of significance, the Air Conditioning Contractors of America (ACCA), representing top air conditioning and refrigeration contractors in this country, who understand the dynamics of the marketplace best of all, believes the 12 SEER represents the best, fairest approach to increasing energy efficiency and attaining the greatest energy conservation. The Manufactured Housing Institute has voiced its concern regarding a 13 SEER because of the higher costs to residents of 9 million homes, mostly occupied by families on limited incomes. The National Association of Home Builders opposes a 13 SEER standard, cautioning that each $1,000 added to the cost of new homes disqualifies 400,000 buyers. And finally, and perhaps most significantly, even the DOE staff did not support a 13 SEER during last year's rulemaking, believing a 12 SEER to be in the nation's best interest.

Additionally, there are alternative means to achieve the increased energy efficiencies desired, without imposing the hardships of a 13 SEER minimum on the consumers. ARI studies reveal that poor installation and servicing of air conditioning equipment results in up to a 40% loss in energy efficiency. Consequently, the entire industry—contractors, wholesalers and manufacturers—banded together several years ago to develop North American Technician Excellence (NATE) to voluntarily improve technician training, require certification for technicians and improve the installed performance of our equipment through better installation and servicing. Wholesaler and contractor associations provide much of the training, distributing and administering of the certification testing. Manufacturers—except for one—have provided over $6 million dollars to date for the development and management of this independent non-profit association similar to what the automobile industry did with Automotive Service Excellence (ASE) over 20 years ago. Even if only 25% successful, when added to enhanced consumer awareness of the benefits of periodic checkup maintenance contracts, and the 12 SEER, the energy savings would exceed that of a mandated 13 SEER without having the citizens bear the cost burden.

Finally, by 2030, the 12 SEER standard would save 3 quads of energy at a cost to the nation of $1 billion dollars. Increasing the SEER an additional 10% increases the cost to the nation to $4 billion dollars.

In summary, ARI supports a 20% increase in the SEER standards because it is fair, balanced, and economically justifiable. It meets our energy efficiency needs without punishing those in working families, senior citizens, and the vast majority of the country that will never recover in energy savings the increased costs of a 13 SEER product. A 12 SEER product is beneficial to both consumers and industry, and represents a significant additional contribution to the nation's goal of conserving our energy supplies.

I would be pleased to answer any questions the Committee may have.

The CHAIRMAN. Thank you for your testimony.

Mr. Parks.

STATEMENT OF DAVID PARKS, PRESIDENT, GOODMAN MANUFACTURING COMPANY, HOUSTON, TX

Mr. PARKS. Mr. Chairman, thank you for your invitation to testify here today. As you stated, my name is David Parks. I am president of Goodman Manufacturing in Houston, Texas. I have worked both on the supply side and the demand side of this equation.

Let me start by giving you a brief background of our company. Goodman is the second largest residential heating and air conditioning manufacturer in the Nation. We produce a complete line of residential and light commercial air conditioning and heating products with facilities in Houston, Texas, as well as Fayetteville, Tennessee, and Dayton, Tennessee. Name brands sold by Goodman include Amana, Goodman, GmC, and Janitrol.

The three major messages I would like to bring to the committee today, first of all, in America we are struggling to meet energy demand. Secondly, there are actions we can take towards solving these problems. By strengthening energy efficiency standards to the 13-SEER, we can avoid the need for more powerplants and also lower the bills of consumers across the Nation.

Lastly, this debate contains several misconceptions. Stronger 13-SEER standards do not limit the consumer's choices, they do not impose unreasonable costs, and they do not hurt low income families.

Let me expand on these points further. At the time when our Nation is struggling to meet increased energy demands, it is clear we must embrace the most effect energy efficiency measures available for consumer products. In the State of Texas, air-conditioning represents more than 50 percent of a homeowner's electric costs. The use of more efficient energy appliances, specifically air-conditioners and heat pumps, will significantly reduce energy consumption, cut utility costs for consumers, and improve air quality by reducing the number of pollutants emitted from our fossil fuel electric power generating facilities.

Looking to the DOE's own data, it indicates that moving from a 13 standard, up from the current 10 level standard, will avoid the need for the equivalent of 53 new 400-megawatt powerplants by the year 2030. As you heard earlier in testimony, the ACEEE has estimated this number would actually be up to 41,000 megawatts, which is equivalent to 100 new powerplants.

Goodman strongly recommends raising the minimum efficiency standard for air-conditioners to 13-SEER. Given the tremendous benefit associated with the 13-SEER standard, Goodman believes that the DOE decision to roll back the original standard to the newly proposed standard of 12-SEER lacks merit. In our opinion, the DOE appears to be basing its decision on several misconceptions surrounding this 13-SEER.

First is the claim that not all manufacturers have capabilities to produce the more efficient equipment, thus limiting choice. In fact, the 13-SEER technology has been available to both large and small manufacturers for approximately 15 years. Based on the Air-Conditioning and Refrigeration Institute data, virtually all manufacturers produce 13-SEER equipment today. The chart to my right lists those companies.

In reality, the only difference between a 10-SEER, a 12-SEER, and a 13-SEER is a little more copper and a little more aluminum used in manufacturing coils. Given the fact that these units have equivalent technologies, at Goodman we run all of our equipment through the same facilities and same assembly lines.

The second misconception is that the 13-SEER standard would cost consumers substantially more money than the proposed 12-SEER standard. This is not true. According to DOE, the average difference in cost between a 13-SEER and a 12-SEER is approximately $122. Since a 13-SEER is 8 percent more efficient than a 12, consumers will save more on their electric bills each and every month for the life of the unit. Thus, over an average life of a unit, the savings will easily cover the cost.

Moreover, Goodman is confident, with the implementation of the 13-SEER standard the market will drive down prices and make more efficient equipment even more affordable for all consumers. How do we know this? From experience.

In 1992, when the Government implemented efficiency standards at the 10-SEER, the cost of 10-SEER air-conditioning dropped dramatically across the Nation. The reason for this change is simple. Once the standard is set, more sales of that type of unit will occur, and more volume is manufactured, thereby allowing the manufacturers to run their plants more efficiently and pass the savings on to the consumers.

Since most consumers tend to purchase at the minimum standard, it is critically important to establish the standard at the correct level, the 13-SEER. This would allow for the most efficient equipment to be available at an affordable price.

Some believe that this slight increase in cost will deter consumers from purchasing more efficient units. We believe the opposite is true. When considering the purchase of a unit, the cost difference between a 12 and a 13 is negligible. In any case, the additional cost of the 13 would only take a few years to recoup longer than the 12, according to DOE's Nation-wide analysis, and payback analysis occurs much faster in higher cooling zones. This is true even based upon the outdated electric cost used in this analysis. After that time, the consumer will profit continuously from the more efficient 13-SEER.

Critics of the 13-SEER have routinely expressed that this standard will negatively impact lower income families and the elderly. This, too, is a misconception. The Census Bureau has determined that most low-income families with central air-conditioning rent their home.

It is an assessment that this benefit from the energy savings and lower electricity bills associated with a 13, without bearing the up-front costs, would actually enhance low-income families' purchasing power for other needed items. For these low income families who must purchase central air-conditioning, the incremental costs of improved efficiency will be made up through lower utility bills.

Goodman has a marketing philosophy of selling in volume, and the incremental cost to the manufacturer to produce 13-SEER is only about $100. We feel the most efficient technology should be made available to people of all income levels at affordable prices. Unfortunately, not all manufacturers have the same marketing

philosophy. Instead, some manufacturers may be seeking protection of higher profit margins on their more efficient equipment, as a 13-SEER standard would force all manufacturers to be truly competitive and provide all consumers with the most affordable energy technology for air conditioners today.

We believe there are actions that Congress can and should take to address the unfortunate decision by the DOE to roll back the higher standards. In fact, the 13-SEER standard we believe would be more consistent with the President's effort to promote energy efficiency and conservation.

To provide long-term solutions to meet our energy and environmental goals, we need a national energy policy that promotes efficiency, conservation, and new supply technologies. Goodman urges Congress to focus attention on improving efficiency standards for these products.

In conclusion, the most important message I bring, I feel, is that we are struggling to meet demand, there is a solution to this, and we strongly suggest that we strengthen energy standards for 13-SEER. If we act now, we can avoid the need for additional powerplants and reduce energy costs for all consumers, including the elderly and low-income families.

Again, thank you for the opportunity to appear before you today. I have submitted my comments for the record, and am pleased to answer any questions.

[The statement of Mr. Parks follows:]

PREPARED STATEMENT OF DAVID PARKS, PRESIDENT, GOODMAN MANUFACTURING COMPANY, HOUSTON, TX

Goodman is the world's largest privately held air conditioning, heating and appliance manufacturer and the second largest manufacturer here in the United States. Founded in 1975 by the late Harold Goodman, Goodman remains entirely family-owned. We produce a complete line of residential and commercial air conditioning and heating equipment with facilities in Houston, Texas as well as Dayton and Fayetteville, Tennessee. Name brands sold by Goodman include Amana®, Goodman®, GmC®, Janitrol®, Caloric® and Modern Maid®.

At a time when our nation is struggling to meet increasing energy demand it seems clear that we must embrace the most effective energy efficiency measures available today for consumer products, including household appliances. Electricity used for heating and cooling accounts for the bulk of total electricity use in U.S. households. In the state of Texas, air conditioning represents more than 50 percent of a home's electricity cost.[1] The use of more energy-efficient appliances, specifically air conditioners and heat pumps, will provide a significantly reduced energy consumption, cut utility costs for consumers, and decrease the amount of harmful pollutants emitted in the environment.

The simplest method for reaching these three goals is raising the minimum standard for air conditioners to a level of 13 SEER (seasonal energy efficiency ratio) from the current level of 10 SEER.

Looking to the future, the Department of Energy's (DOE's) own data indicates that moving to a 13 SEER standard from the 10 SEER level will avoid the need for the equivalent of 53 new 400 megawatt power plants by 2030[2] (Attachment A). Other organizations such as the American Council for an Energy-Efficient Economy (ACEEE) estimate that DOE's analysis is extremely conservative and does not attribute the correct portion of peak demand to air conditioning use. In fact, ACEEE estimates indicate that 41,500 megawatts of energy would be saved which is equivalent to 103 new 400-megawatt power plants would be avoided by 2030.[3] Increased

[1] Public Utility Commission Release, *"PUC Urges Energy Conservation Hotter Temperatures Create Higher Demand for Electricity"*, 7/31/99.
[2] DOE Press Release, 1/18/01 and 4/13/01.
[3] American Council for an Energy-Efficient Economy (ACEEE) Website.

air conditioner efficiency would help provide both a short and long-term solution to energy shortages.

Accordingly Goodman recommends raising the minimum efficiency standard for residential air conditioners to 13 SEER. Higher efficiency units save consumers more money on their monthly electricity bills and reduce harmful pollutants in the environment.

Goodman has conducted studies showing that more efficient air conditioners reduce power plant emissions because each unit requires less electricity to operate. Research also shows that the deployment and use of high efficiency air conditioners significantly reduces air pollutant emissions including nitrogen oxides (NO_X), sulfur dioxide (SO_2) and greenhouse gases from fossil-fueled electric power plants.

Given the tremendous benefits associated with the 13 SEER standard, Goodman believes that the Department of Energy's (DOE's) decision to rollback the original standard of 13 SEER to a newly proposed standard of 12 SEER lacks merit. In our opinion, DOE appears to be basing its decision on several misconceptions surrounding the 13 SEER standard. Let me explain.

The first of these misconceptions by DOE is that not all manufacturers have the capability to produce the more efficient equipment, thus limiting consumer choice. In fact, the 13 SEER technology has been available to both large and small manufacturers for approximately 15 years. As you can see from this list (Attachment B) generated based on Air Conditioning and Refrigeration Institute data, virtually all manufacturers are able to and do produce 13 SEER equipment today. In reality, the only difference between a 10 SEER unit, a 12 SEER unit and a 13 SEER unit is a little more copper and aluminum used in manufacturing different sized evaporator coils. A 12 SEER unit has a slightly larger coil than a 10 SEER unit, a 13 SEER unit slightly more than a 12 SEER unit. Given the fact that the units have equivalent technologies, at Goodman we run all of our equipment down the same assembly line.

You will also note that what are considered to be small manufacturers are included in the list. Goettl Air Conditioning, a small manufacturer based in Arizona, supports the stronger standard. With respect to small manufactures of specialty products for markets like manufactured housing, where space constraints limit efficiency with conventional technology, DOE has said that the final rule would be open to exemptions. Here is a case where an exemption would make sense.

A second misconception has been that the 13 SEER standard would cost consumers substantially more money than the proposed 12 SEER standard. This is not true. According to the DOE, the average difference in cost between a 13 SEER unit and a 12 SEER unit is approximately $122.[4] The difference in costs for Goodman units is comparable to this estimate (Attachment C). Since a 13 SEER unit is 8 percent more efficient than a 12 SEER unit, consumers will save more on their electric bills each and every month for the life of the unit. Thus, over the life of a home cooling unit, the savings will easily cover the increase in cost, between a 12 SEER unit and a 13 SEER unit.

Moreover, Goodman is confident that with the implementation of a 13 SEER standard, the market will drive prices down and make the more efficient equipment even more affordable for all consumers. How do we know this? From experience. In 1992, when the government implemented the efficiency standard at 10 SEER , the cost of the 10 SEER air conditioning unit dropped dramatically across the nation. The reason for the change in price is simple. Once the standard is set, more sales of that type of unit will occur and more volume is manufactured, thereby allowing the manufacturers to run their plant more efficiently and pass the savings on to the consumer.

Some believe that this slight increase in cost would deter a consumer from purchasing a more efficient unit. However, we believe that when considering the purchase of a unit that is between 2000 and 5000 dollars, the difference in cost between a 12 SEER unit and a 13 SEER unit is negligible and, in any case, the additional cost of the 13 SEER unit would only take 1.2 years[5] longer to recoup according to DOE. After that time, the consumer will profit continuously from the more efficient unit. It should be noted, however, that DOE's payback estimates took into account significantly reduced electricity prices of only 7.42 cents per kilowatt hour. Whereas today the nation is facing increasing energy costs greater than previously estimated.

In fact, the Public Utility Commission (PUC) of Texas issued a news release on June 20, 2001 stating that customers may face higher electricity bills this summer than last summer because of higher natural gas costs. The release went on to state that utilities surveyed by the PUC indicate a statewide average increase of approxi-

[4] Department of Energy Press Release, 4/13/2001.
[5] Department of Energy Press Release, 4/13/2001.

mately 18 percent this summer over last for a typical household. Some customers can expect electric bills to increase as much as one-third this summer compared to last summer for the same amount of electricity. Thus taking updated energy cost information into account would yield shorter pay back periods of the more efficient equipment for consumers. It should also be noted that on November 16, 2000, the PUC of Texas sent former Secretary of Energy Bill Richardson a letter supporting the 13 SEER standard.[6]

A third misconception has been that there is an enormous difference in the size of the units and a tremendously higher related cost for installation. It is clear that an increased efficiency standard will be established at least at a level of 12 over the current 10 SEER standard. When the decision is made to adopt the 12 SEER standard, the unit size will be slightly bigger and will require some structural modifications to install the indoor portion of the system including ductwork during installation of the unit. Once we acknowledge that there will be a standard that will likely require some structural modification, one must compare the 12 SEER unit to the 13 SEER unit. The difference between our 13 SEER and 12 SEER external equipment is only 3-5 inches in height. The internal equipment size for the 12 and 13 are similar, and there is almost no difference in the installation costs associated with a 13 SEER unit and a 12 SEER unit.

In addition, critics of the 13 SEER standard have routinely expressed that the 13 SEER standard will negatively impact lower income families and the elderly. This too is a misconception. The Census Bureau has determined that most low-income families with central air conditioning rent their homes.[7] It is our assessment that they would benefit from the energy savings and lower electricity bills associated with a 13 SEER unit without bearing the actual up front equipment costs. For those low-income families who must purchase a central air conditioning unit, the incremental cost of improved efficiency will be made up through lower utility bills.

Finally, in our opinion, Goodman has a marketing philosophy of selling in volume. The incremental cost to the manufacturer to produce a 13 SEER unit is only about a $100 and we feel that the most efficient technology should be available to people of all income levels at an affordable price. Unfortunately, not all manufacturers have this same marketing philosophy. Instead some manufacturers may be seeking protection of higher profit margins on their more efficient equipment. A 13 SEER standard would force all manufacturers to be truly price competitive and provide all consumers with the most affordable energy efficient technology for air conditioners that is available today.

CONCLUSIONS

In conclusion, Goodman is a supporter of the 13 SEER standard because we believe it is a cost-effective way to reduce energy use, lower high energy costs for the consumer over the long-term and reduce emissions of harmful pollutants from power generating facilities.

Goodman has been and will continue to support a higher energy efficiency standard as the "right thing to do" for the consumer, the environment, energy conservation and the industry. We believe that there are actions Congress can and should take to address the unfortunate decision by the Department of Energy to roll back the higher standard for central air conditioners and heat pumps to only a 20 percent increase in efficiency. In fact the 13 SEER standard would be more consistent with the President's effort to promote energy efficiency and conservation.

In addition to the air conditioner standard itself, it is also important to support both financial incentives and programs that promote the use of more efficient equipment. To this end, Goodman has been supportive of increasing efficiency requirements for the EnergyStar Program as well as providing incentives to consumers that use high efficiency appliances including air conditioners. Goodman has been supportive of legislation such as S. 207, "The Building Incentives Act", where the message can be reinforced that energy efficiency is a good investment for consumers, building owners and tenants, and the nation as a whole. These combined efforts provide incentives for higher levels of energy efficiency than would otherwise occur.

To provide longer-term solutions, we desperately need a national energy policy that promotes energy efficiency, conservation, and new supply technologies. Goodman urges Congress to continue to focus attention on improving appliance efficiency standards for air conditioning and heating products.

The CHAIRMAN. Thank you very much for your testimony.

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[6] PUCT letter of support, 11/16/00.

[7] Bureau of the Census, Annual Demographic Survey, March Supplement, 2001.

Dr. O'Hagan, why don't you go ahead.

STATEMENT OF DR. MALCOLM O'HAGAN, PRESIDENT, NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION, ROSSLYN, VA

Dr. O'HAGAN. Good morning, Mr. Chairman. My name is Malcolm O'Hagan. I am president of the National Electrical Manufacturers Association. On behalf of the 450 members of NEMA who manufacture all of the products in the electricity supply chain from the generator to the light bulb, I thank you for this opportunity to share with this committee the good news on energy-efficient technologies.

The President's energy report estimated that we could save the equivalent of 600 300-megawatt powerplants through the deployment of energy-efficient technologies and conservation measures. We agree, and that is a lot of energy.

How is it possible to realize these savings? Let me offer a few examples. Lighting and HVAC upgrades in commercial buildings can cut energy consumption by up to 40 percent while saving $1 per square foot in electricity cost. This, Mr. Chairman, has been documented in a publication of 1,000 upgrades, and I would like to submit this, with your permission, for the record.*

The CHAIRMAN. We would be glad to have it. Thank you.

Dr. O'HAGAN. Commercial buildings account for 22 percent of electricity consumption. Transformers that meet NEMA TP-1 efficiency levels can greatly reduce power losses in getting electricity from the generating station to the outlet. NEMA Premium efficiency motors, combined with industrial control systems, can substantially reduce energy consumption in steel mills, water treatment plants, irrigation systems, and myriad other industrial applications which account for 51 percent of electricity consumption.

Solutions exist to significantly cut transmission and distribution line losses, which currently account for 8 to 10 percent of production.

Mr. Chairman, the technology exists. NEMA members offer it, but that is not enough. The technology must be used. With efficient products unfortunately comes higher first costs, presenting an economic barrier. Consequently, there are three additional requirements to stimulate greater use of more efficient technologies.

First, we need economic incentives to drive technology solutions, and let me stress that it is not enough to substitute high efficiency products and normal replacement times. We need to provide incentive for accelerated replacement. This is how the immediate and big savings will be realized.

Second, we need the Government to lead by example, not by fiat. For example, all government buildings should be upgraded to meet Energy Star building requirements as soon as possible, and all government procurements should be based on industry consensus standards for energy efficiency.

Third, and finally, we need the Government to spearhead a massive education campaign to promote the use of energy-efficient technologies.

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*The publication has been retained in committee files.

Our specific comments on the legislation under consideration today are as follows. With respect to Federal building energy efficiency, we agree with the proposals in S. 597 and S. 388 that would impose new energy efficiency requirements on Federal buildings and require agencies to undertake a review of and implement practical energy and water conservation and renewable energy measures. These goals should be met, and reviews undertaken by emphasizing a systems approach, not merely component change-outs.

In addressing these proposals, we urge the committee to consider NEMA's specific recommendations as detailed in our written testimony for upgrading the Federal building energy code and requiring Energy Star rating for all Federal buildings.

In upgrading Federal facilities, the Government should procure only products that meet or exceed NEMA Premium efficiency levels for motors, NEMA TP-1 efficiency levels for transformers, and ASHRAE 90.1-1999 efficiency levels for lighting and HVAC systems.

I would like to point out that the State of Wisconsin now requires the use of TP-1 transformers in all State buildings. I would also like to note that the NEMA Premium efficiency levels for motors exceed the efficiency levels mandated by the Federal Government under the Energy Policy Act, and applied to more categories of motors. Recently, NEMA, with the support of DOE, the utilities, the Edison Electric Institute, and others, launched a major program to promote the use of NEMA Premium efficiency motors in the marketplace.

In connection with financing for Federal energy efficiency programs, whether through the proposed Federal Energy Bank or through energy-saving performance contracts, we have two recommendations. First, as we have stated before, the projects that take a systems approach should have priority for assistance.

Second, we support the 7-year-or-better payback period set forth in your legislation S. 597. It should be noted that comprehensive upgrade programs with correspondingly higher first cost but greater savings in the longer run may be ruled out by shorter payback periods. Programs targeting schools for energy efficiency improvement should also emphasize the systems approach that combine advanced controls with energy-efficient technologies to achieve the maximum benefits.

NEMA believes greater attention needs to be paid to increasing energy efficiency and the industrial sector, which accounts for 51 percent of electricity consumption. To this end, the proposal in S. 597 to encourage voluntary commitments to reducing industrial energy intensity is most welcome.

NEMA supports the low income home energy assistance, weatherization, and State energy programs. With respect to the weatherization program, we would suggest the committee consider including electricity efficiency retrofits as an eligible measure to permit the upgrading of air conditioners and water heaters, which will have long-term energy savings benefits. California has adopted a similar approach, and we would recommend it at the Federal level as well.

Finally, with respect to energy efficiency standards, NEMA believes that it is critical that the Department of Energy fully adhere

to all aspects of the Process Improvement Rule, which has three basic principles—one is technology feasibility, economic justification, and significant energy savings—and that it adhere to all aspects of its process improvement rule in every standards-related activity.

In our written testimony, we expand on these comments, and we stand ready to provide the committee with whatever additional information would be helpful to its deliberations.

Mr. Chairman, we thank you very much for the opportunity to testify this morning.

[The statement of Dr. O'Hagan follows:]

PREPARED STATEMENT OF DR. MALCOLM O'HAGAN, PRESIDENT, NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION, ROSSLYN, VA

INTRODUCTION

Good morning Senator Bingaman, Senator Murkowski and members of the Committee on Energy and Natural Resources. I am Dr. Malcolm O'Hagan and I am President of the National Electrical Manufacturers Association (NEMA). NEMA, celebrating its 75th anniversary, is the leading trade association in the United States representing the interests of electroindustry manufacturers. Founded in 1926 and headquartered near Washington, D.C., our 450 member companies manufacture products used in the generation, transmission and distribution, control, and end-use of electricity. Annual shipments of these products total $100 billion.

NEMA welcomes the opportunity to offer testimony on the energy efficiency legislative proposals pending before the Committee. My testimony today will focus on the following four main areas:

1. The role of NEMA products and services to achieve energy efficiency and conservation in helping to meet out national energy needs;
2. The federal government's role in promoting conservation and efficiency and the use of new technologies and innovative practices that use energy more efficiently.
3. The barriers to the widespread application of energy efficient practices and technologies; and
4. Our recommendations to encourage the greater use of energy efficient technologies.

The issues of energy efficiency and conservation are crucial aspects of the energy policy debate and your attention to these matters is applauded by the 450 NEMA member companies. We have also been encouraged by the work of the Administration and its recommendations, as incorporated in the National Energy Policy Plan. NEMA has reviewed the President's recommendations, and I have attached our findings for your reference.* NEMA has also reviewed many other energy legislative proposals, including those that are the subject of today's hearing. NEMA is very encouraged about the prospects for a comprehensive, balanced and bipartisan national energy policy, and we are committed to supporting the development of that policy in every way possible.

NEMA ELECTRICAL ENERGY AND ENERGY EFFICIENCY POLICY PRINCIPLES

NEMA has crafted a set of electrical energy and energy efficiency principles for your guidance and consideration as you and your colleagues proceed on a comprehensive national energy policy. I have included the principles for your reference, but let me take this opportunity to highlight the three main points from our principles:

- A comprehensive electrical energy policy should rely on affordable, proven technology to address energy supply and demand;
- Second, it is critical to understand that energy efficiency and conservation don't mean sacrifice and reduced access, but rather doing more with existing capacity by achieving reduction in energy usage through the use of more efficient products and systems; and
- Third, market-based incentives and solutions should be the primary vehicle to enhance energy efficiency and conservation. However, NEMA acknowledges that, on a case-by-case basis, there is value in other interventions such as targeted government research and development, incentives and standards.

*Attachments to this statement have been retained in committee files.

With regard to energy efficiency issues, NEMA specifically proposes the following concepts as guidelines:

- NEMA believes energy efficiency is a national concern that should be driven by market forces to achieve energy efficiency and conservation. The litmus test for efficient products and control systems is technological feasibility, economic justification, energy savings and commercial availability.
- NEMA acknowledges the key role the federal government should play in fostering public use of energy efficient products and systems. Specifically, NEMA believes that the federal government should promote user education on energy efficiency; support energy efficient upgrades through programs such as the Federal Energy Management Program, encourage performance-based incentives in the private sector; and promote the use of economically sound energy efficient products and systems.

NEMA MEMBER COMPANY PRODUCTS AND SERVICES ACHIEVE ENERGY EFFICIENCY AND CONSERVATION

NEMA recognizes that a comprehensive national energy policy requires a mix of conservation and production, and the promotion of new technologies that promise greater efficiency and environmental protection. NEMA member products are at all stages of the electrical energy process, from generators, transformers, wire and cable, to lighting, motors, and switches at the consumer and end-user points. As an intriguing example of how technology can save energy, NEMA manufacturers have developed technology and products for Intelligent Transportation Systems (ITS), a project under the auspices of the Department of Transportation. This project is a highly cost-effective means of reducing transportation fuels consumption, associated air pollution, and also reduces the non-productive time workers spend commuting. As you will see in our recommendations, these and other NEMA products serve to make the system work better and faster without compromising availability. NEMA members are able to do this by taking the best of industry technology and standardizing those products so that they are available globally, delivered locally, competitively priced, able to perform predictably and are safe and environmentally sound.

Industry experts estimate that the energy to run buildings in the United States costs about $70 billion a year. NEMA products can be found in a wide variety of projects and applications, and such technology has the potential to reduce energy costs 40 percent and save businesses $28 billion per year. A recent study in the trade journal *Energy User News* found that upgrades and retrofits of lighting, HVAC, motors and drives, and building automation can achieve energy savings of between $1.00 and $1.50 per square foot of floor space, especially when the project involves a combination of each eletrotechnology element. Moreover, the payback periods are attractive with the return on investment and energy savings lasting the entire span of the products, usually 10-20 years. As testimony to these findings, energy efficient products helped a government agency overhaul their lighting system as a result of a mandated relighting program. The agency installed energy saving occupancy sensors as well as new electronic ballasts, T-8 lamps and specular reflectors in 1.5 million square feet of working space. The effort has translated into an annual savings of $399,057.

NEMA member companies also provide energy efficient technologies to help industrial energy users make the most of the electricity they consume. For instance, in Indiana, the Alcoa North American Extrusions aluminum extrusion plant reviewed eight areas for efficiency upgrades under the auspices of the Department of Energy's Office of Industrial Technology program. From motors and pumping systems to compressed air and variable speed drive systems, the review revealed that in a payback period of a little over one year, Alcoa could realize a potential annual savings of $1.9 million with an initial capital requirement of $2.3 million. NEMA member companies provided the motors, systems and services to help Alcoa meet its goal in Indiana and at other Alcoa plants around the United States. In Baton Rouge, Louisiana, ExxonMobil Corporation realized an annual savings of one million dollars and an annual energy savings of 43 million Btu with a cost payback of four million dollars over four years at its chemical plant. ExxonMobil modernized the plant control systems to recover these substantial savings. NEMA member company Thermadyne, a California-based manufacturer of inverter-type welding machines, recently found that welding machine power consumption can be reduced between 20% and 50% from the older transformer based designs. At Disney World in Florida, the complex used a metering company that identified ways to make hydraulic equipment run for shorter periods of time, time the operation of compressed air motors, and drop electricity consumption in a chiller plant by an amazing 28 percent. NEMA TP-1 quality transformers (manufactured by, among others, Square D) helped the

Johnson & Johnson facility in New Jersey realize such significant energy savings that the corporation changed their purchasing specification to require nothing but Square D TP-1 Transformers (or its equivalent) in any future transformer purchases.

NEMA company technologies can also make a significant contribution in improving the efficiency of electricity transmission and distribution. About 10% of the electricity generated is lost in inefficiencies in transmission and distribution. During peak load periods the losses are higher. The losses have a retail value of about $25 billion per year. Transmission line losses (70% of the transmission losses) may be reduced by, for example, upgrading conductors, increasing voltage, improving the power factor, or using high voltage DC transmission.

Finally, NEMA-member software products, such as ABB Energy Interactive's Energy Profiler Online™, facilitate energy load management for commercial and industrial customers, and are being used in California today to manage a variety of mandatory and voluntary utility load curtailment programs necessitated by California's current energy crisis. NEMA member companies have a track record of achieving energy cost savings and stand ready to help the nation continue to improve upon its strong record of achieving energy efficiency goals.

THE FEDERAL GOVERNMENT'S ROLE IN PROMOTING ENERGY EFFICIENCY

As mentioned earlier, NEMA acknowledges the key role the federal government should play in fostering public use of energy efficient products and systems. Industry appreciates those government programs that educate and inform business and the consumer about energy efficiency. Specifically, NEMA believes that the federal government should promote user education on energy efficiency; support energy efficient upgrades through programs such as the Federal Energy Management Program, the Department of Energy's Office of Industrial Technology, Building, Technology State and Community programs, and aspects of the Energy Star program; and promote the use of economically sound energy efficient products and systems.

I have communicated with NEMA manufacturers about a variety of federal government programs. They recognize the value of several energy efficiency programs. In the motors and industrial controls area, the Department of Energy Office of Industrial Technology Best Practices program works to promote those industry practices that promote efficiency. The Motor Challenge program adds credibility to efficiency messages and broadens the communications efforts beyond industry. In the lighting area, industry appreciates the "LightRight" and the "Vision 2020" programs. These and other programs, such as the Federal Energy Management Program, all serve to help American consumers and businesses use energy more efficiently and effectively.

NEMA believes that the federal government can set the standard—and a good example—for energy efficiency by starting with the public's own facilities. In this regard, the cooperative Department of Energy and Environmental Protection Agency Energy Star Buildings Program has made significant advances in improving the efficiency of commercial buildings. However, the vast majority of Federal facilities have not yet achieved the Energy Star rating, a classification given only to the top 25% of buildings in terms of watts used per square foot. Therefore, NEMA recommends that existing Federal buildings be upgraded to meet the Energy Star Building Program requirements.

A program to require energy efficient upgrades of building systems in existing Federal buildings offers the potential for significant energy savings. As the President and Congress have recognized, the Federal government is a major consumer of electrical energy. NEMA proposes that, with respect to existing buildings, an upgrade program should riot require adherence to a rigid standard, but rather should provide flexibility to agencies to adopt the most efficient systems that meet their needs. For new construction or buildings that undergo major renovation/remodeling, it is appropriate to require adherence to the most current consensus energy efficiency standards, which are contained in ASHRAE/IESNA 90.1-1999. The Federal government should move promptly to update Federal building energy codes, and to facilitate action by the States to update their building codes consistent with the latest update to the ASHRAE/IESNA standards.

The Federal government also has important regulatory responsibilities, particularly in the area of energy efficiency standards for appliances and other consumer products. In setting such standards, the Department of Energy must fully adhere to the provisions of the so-called "Process Improvement Rule." By way of background, in July 1996, the Department of Energy published an interpretive rule setting forth procedures for the consideration of new or revised energy conservation standards for consumer products (see 61 Fed. Reg. 36973 (July 15, 1996)). The

"process improvement" rule was produced with the input of all stakeholders in the appliance and consumer products efficiency standards program. Designed to remedy shortcomings in the standards process utilized by the Department of Energy, the process improvement rule is intended to encourage consensus on energy efficiency standards. To this end, the rule language includes a series of rebuttable presumptions, agreed to by all sectors of industry and the energy efficiency community, which provide a basis for mutual understanding and cooperation in the development of consensus standards.

The process improvement rule incorporates critical principles for every stage of the energy efficiency standards setting process. Careful observance of these requirements is essential for any standards program to be effectively implemented. However, as good and practical as this rule is, it is not a binding requirement on the Department of Energy. NEMA manufacturers—and all of the regulated community—require additional assurance that there will be careful adherence to all aspects of the process improvement rule in all future standards setting rulemakings for consumer, commercial and industrial products. Greater certainty will be provided if the process improvement rule is formally incorporated into the Department of Energy's regulations governing the establishment of energy efficiency standards.

The Federal government should also take the lead in the acquisition of energy efficient products. For example, an opportunity is presented for the government to take advantage of consensus standards developed by industry to increase energy efficiency in equipment including electric motors and distribution transformers. These two standards, NEMA Premium™ for electric motors and NEMA TP-1 for distribution transformers, offer significant energy savings. Government should recognize these industry-led efforts to increase energy efficiency and provide for the most rapid possible integration of technologies meeting the latest efficiency standards into Federal facilities. Increasing the deployment of these technologies throughout the Federal government offers a ready means to significantly reduce energy consumption.

BARRIERS TO THE WIDESPREAD APPLICATION OF ENERGY EFFICIENT PRACTICES AND TECHNOLOGIES

While much good has been done to promote energy efficiency, there remains work to be finished. NEMA believes the primary barriers to investing in energy efficient technology include: (1) the cost of investment in energy efficient technologies and whom should receive the financial benefit of the energy efficient investment; (2) the lack of awareness of a systems and controls based approach for energy efficient cost effectiveness; (3) and issues surrounding codes and standards.

Currently, the federal tax code does not fully encourage an investor to make energy efficient investments, upgrades or retrofits to facilities. To that end, NEMA recognizes the efforts to encourage the private sector use of energy efficient products and systems through a variety of tax incentives included in S. 596, S. 389 and other pending measures. While NEMA has not taken a position on the wide variety of incentive proposals currently being considered, we would generally emphasize the need to explore and promote those incentives that make the maximum use of energy efficient products and systems and delivers the incentive to the individual or entity that makes the investment.

NEMA believes that energy efficiency should be evaluated and rewarded on a energy savings and systems basis. When creating incentives, the beneficiary of the cost incentive should be the investor in the equipment. Very simply put, if a building owner makes the capital investment, that owner should get the benefit. As a result the energy savings benefit can get passed on down the line in the form of savings to electricity consumers through lower bills.

While the technology exists to achieve broad cost savings through energy efficient devices and controls, there is a lack of awareness of the benefits of a systems and control based approach. This is opposed to a piecemeal component approach, to achieve the maximum level of cost effective energy efficiency. To that end, NEMA proposes that the federal government move from strictly encouraging products or components, to promoting the implementation of systems and controls to efficiently manage energy on a wider basis. For example, California recently enacted legislation that would provide energy efficient upgrades for lighting systems. California recognized the large efficiency gains that would be realized by encompassing lighting controls, occupancy sensors, and luminaries added to any upgrade. Similar efficiency gains can be achieved at the commercial level with industrial and automated controls.

Industry and government both strive to achieve the best performance. But for too long, the hopeful and anticipated approaches of both camps have been belied by the

unintended consequences of mandated standards. Voluntary, consensus-driven codes and standards will achieve the greatest level of cooperation and distribution of energy efficient technology in the marketplace. Already, the marketplace recognizes industry-driven standards to achieve efficient products. In particular, the NEMA Premium™ Motor program recognizes efficient motors above the standards contained in current law. The same can be said for distribution transformer consensus standards represented by NEMA TP-1. Industry believes that industry consensus building codes can be a valuable part of ensuring that cooperative goals are achieved and efficiency gained.

RECOMMENDATIONS TO ENABLE THE GREATER USE OF ENERGY EFFICIENT TECHNOLOGIES

NEMA believes that technological solutions combined with industry consensus and proven results will lead to enhanced energy efficiency. This formula is made even stronger if the cooperative efforts of industry and policymakers are joined. To that end, NEMA proposes the following reforms to further enhance energy efficiency and conservation as part of a comprehensive national energy policy.

Motors

The NEMA Premium™ motor program is a collaborative effort with the Department of Energy, motor manufacturers and electric utilities. It is an excellent model of how voluntary industry standards can improve efficiency thereby providing a benefit to consumers and the environment. It has broad support, as reflected in the recent endorsement from the Consortium for Energy Efficiency.

The NEMA Premium™ motor program expands high efficiency motors standards beyond current requirements. The program covers a broader range of motors than do minimum Federal energy efficiency standards (up to 500 horsepower, whereas Federal standards apply only up to 200 hp), and it is a more exacting standard. In fact, Department of Energy analyses shows that the NEMA Premium™ motor program, including commercial and agricultural applications, would save 5,800 gigawatt hours of electricity and prevent the release of nearly 80 million metric tons of carbon into the atmosphere in the next ten years. Electric-motor-driven equipment consumes about 60% of all the electricity produced in the country, according to the Department of Energy.

The NEMA Premium™ motor program has real-life impact. The Cummins Engine Company's Columbus Engine Plant in Columbus, Indiana retrofitted energy efficient motors on to existing machining and transfer lines and installed the most efficient motors available onto the new lines. Cummins saw a 2.75 percent reduction in total energy costs for the Columbus plant and was hailed by company executives as a significant savings. The Department of Energy's Office of Industrial Technologies indicated that if every plant in the United States integrated motor system upgrades to the extent that Cummins did, American industry would save an estimated one billion dollars annually in energy costs. This would be the equivalent of the amount of electricity supplied to the State of New York for three months.

President Clinton issued Executive Order 13123, which seeks to encourage the acquisition of energy efficient products by the federal government. In addition, programs such as the Federal Procurement Challenge encourage agencies to buy energy efficient products. However, while the Executive Order and the Federal Procurement Challenge have resulted in many efficient upgrades, many agency heads have not had their feet held to the fire to comply with such orders. Many opportunities still exist in Federal agency and Congressional offices to achieve energy efficiency.

NEMA, therefore, recommends that the Federal government be required to purchase motors based on the NEMA Premium™ motor standard. Doing so would enable all new equipment acquisitions to be based on current energy efficiency standards with the dual result of energy savings to the government and widespread market penetration of the most highly efficient technologies in energy-intensive equipment. It would also serve as a valuable demonstration of energy efficient savings to the private sector.

Distribution Transformers

In 1996, the Transformers Products Section of NEMA developed voluntary energy efficiency standards for distribution transformers. Distribution transformers help move electricity on the grid and reduce loss. The basic efficiency standard, known as NEMA TP-1, and the associated test and labeling standards (TP-2. and TP-3, respectively) have gained widespread acceptance as the industry norm for energy efficient transformers.

As another excellent example of industry led consensus standard making, if TP-1 were used nationwide, NEMA estimates an energy savings would be in the range

of 2-3 quads over a 30-year period. This is an average energy savings of between 5 and 10 billion kilowatt-hours per year. By using NEMA Standard TP-1, the energy used by low-voltage transformers can be cut by one-third, and by twenty-five percent for medium voltage transformers. Better yet, the payback period for such transformer investments is relatively short—only three to five years.

With these demonstrated savings in mind, NEMA recommends that the federal government should be required to use NEMA TP-1 transformers in its purchase specifications and be required to replace failed transformers with new units meeting TP-1 efficiencies. Acquisition of distribution transformers that meet the NEMA TP-1 standard will improve distribution transformer efficiency over the low first cost transformers that are typically selected for government procurement. Further, the Department of Energy's current rulemaking to consider energy efficiency standards for distribution transformers should use NEMA TP-1 as a benchmark for standards discussions.

Building Efficiency

Energy efficient buildings achieve some of the greatest cost savings when it comes to energy efficiency. There is, perhaps, no better example to demonstrate these savings than energy efficient lighting systems.

NEMA believes that lighting efficiency can be summed up in the following way: Efficient lighting means turning the lights off when your done, and using lighting at levels to complete the task at hand. NEMA manufacturers make products to do just that from systems and controls to draw the greatest light using the least amount of electricity all the while employing technologies to shut the lights off when no one is around.

The Department of Energy estimates that technologies developed during the past 10 years can help us cut lighting costs 30% to 60%. Lighting accounts for 20% to 25% of all electricity consumed in the United States. The cost savings distinction is even greater when looking at residences and business. An average household dedicates 5% to 10% of its energy budget to lighting, while commercial establishments consume 20% to 40% of their total energy just for lighting.

NEMA advocates a system approach to upgrading lighting efficiency in commercial buildings and, where feasible, residential housing. In a typical residential or commercial lighting installation, 50% or more of the energy is wasted by obsolete equipment, inadequate maintenance, or inefficient use. Where it is feasible, a systems approach is best, but components are just as important. Improved lighting quality makes visual tasks easier and saves 50% or more on energy costs. A dramatic example of how energy use for lighting can be reduced while improving the quality of lighting is the Jefferson Memorial relighting project. The energy use will be reduced from a current 126,000 watts to 16,000 watts, while dramatically improving the visual impact of this majestic monument, its inscriptions, and the magnificent statute of Thomas Jefferson.

That is why NEMA proposes the Federal government update its federal building energy code to the latest model building code for energy efficiency in commercial and multifamily high rise residential buildings. A new Federal code for energy efficiency in new commercial and multifamily high rise residential buildings will become effective in October of this year. However, this code is based on a 1989 ASHRAE/IESNA Standard. The Department should move expeditiously to update the Federal code to reflect ASHRAE/IESNA Standard 90.1-1999. This would avoid a time consuming regulatory process to adopt the latest ASHRAE/IESNA update, which was itself developed through a consensus process involving a consortium representing the full range of interests in building sector energy efficiency, including the Department of Energy.

For existing buildings, NEMA recommends that all Federal agencies should be required to implement a program to evaluate the building systems of existing facilities constructed prior to 1996, using the whole building approach and Energy Star building evaluation criteria. This evaluation need not be required for facilities which have completed building system energy efficiency upgrades within the preceding 5 years, or which have attained the Energy Star Building Rating. Upon completion of such evaluations, agencies should be required to make all building system upgrades necessary to enable the building to attain the Energy Star Building Rating within 2 years after such upgrades are identified.

Similarly, the Department should move expeditiously to issue a formal determination that the latest revision to ASHRAE/IESNA Standard 90.1 will improve energy efficiency in commercial buildings. The Department of Energy has already performed a quantitative analysis and a detailed textual analysis of the estimated differences between the 1989 and 1999 editions of Standard 90-1. No further analysis should be necessary for the Secretary to determine that the update will improve en-

ergy efficiency in commercial buildings. The issuance of this determination would trigger actions by the states, which have primary building code enforcement responsibility, to update state building codes accordingly. Any acceleration in the upgrading of state building codes to meet ASHRAE/IESNA Standard 90.1-1999 will increase energy savings.

COMMENTS ON LEGISLATIVE PROPOSALS

NEMA offers the following comments for the Committee's consideration with respect to the specific legislative proposals under consideration at this hearing.

Federal Energy Bank (S. 95; Section 1301 of S. 597)

As discussed above, NEMA recognizes the extent to which cost barriers stand in the way of the deployment of energy efficient technologies. The concept of a Federal Energy Bank has been offered as one potential mechanism for making additional resources available to Federal agencies to support energy efficiency projects that might not otherwise be undertaken. While NEMA takes no position at this time on the underlying proposal for a Federal Energy Bank, we are encouraged that S. 597 in subsection 1301(d)((2)(D) recognizes the need to encourage projects with a payback period longer than the three year payback included in S. 95 as introduced.

In many cases, the greatest energy efficiency savings can be obtained through a systems approach, which features upgrades to energy consuming systems rather than mere change out of specific components. A payback period of at least 5 years is important to encourage such conversions, which typically have greater up-front costs, but which will produce increased energy savings over the lifetime of the building. For example, in many cases, lighting change outs are done on a component basis, whereas a systems approach to lighting upgrades can have achieve far greater efficiencies. Deploying electronic ballasts in combination with T8 lamps improves efficiency, but maximum efficiency gains will be achieved if lighting controls are also included. The addition of lighting controls, such as occupancy sensors, can save another 20% to 40% of energy usage. And when making changes designed to increase the energy efficiency of lighting, it often pays to redesign the building's entire lighting system, improving lighting quality, and saving even more on energy costs. But such a valuable project may not be feasible if a strict three year payback period is required.

Incentives for Energy Efficient Schools (Section 1302 of S. 597; Section 602 of S. 388)

As discussed above, while energy efficient devices and controls are available, there is sometimes inadequate recognition of the benefits of a systems approach that integrates advanced controls with energy efficient technologies to achieve the maximum benefits. High performance/energy efficient school buildings should be evaluated on a systems basis, and the enumerated criteria in the legislation for defining a high performance or energy efficient building should explicitly reference the adoption of systems approaches wherever feasible to maximize energy savings.

Voluntary Commitments to Reduce Industrial Energy Intensity (Section 1303 of S. 597)

Greater attention must be focused on the reduction of energy use in the industrial and commercial sectors. The potential for energy savings is significant, but cost barriers and lack of information too often prevent the adoption of new energy efficiency technologies and systems in industrial facilities and businesses of all sizes. NEMA encourages the Committee to explore additional means of supporting the deployment of highly efficient new technologies through programs targeted specifically to the industrial sector. Consideration might be given, for example, to a program modeled on the highly successful Weatherization Assistance Program but targeted to small businesses.

Low Income Home Energy Assistance Program (Section 601 of S. 388, Section 3(a) of S. 352)

NEMA supports the LIHEAP program.

Weatherization Assistance Program (Section 603 of S. 388, Section 3(b) of S. 352)

The Weatherization Assistance Program has been an important element in the nation's effort to assure that the burdens of high energy costs do not fall disproportionately hard on those least able to afford them. Including electricity efficiency retrofits as an element of the Weatherization program would have long term benefits for residents and property owners. For example, the State of California has recently made upgrades to major systems, such as the installation of high efficiency air conditioners and high efficiency water heaters, as well as other efficient technologies, including set-back thermostats, eligible for the State's residential upgrade program.

Taking a similar approach at the Federal level could significantly increase the long term benefits of the Weatherization program. With the likelihood that substantially increased funding will be provided for the Weatherization program in forthcoming fiscal years, the eligibility of more capital-intensive measures should be fully considered.

State Energy Program (Section 604 of S. 388, Section 3(c) of S. 352)

NEMA supports the concept of updating the State energy efficiency goals. As with the Federal government, state energy efficiency plans should not be limited to encouraging certain energy efficient products or components, but rather should focus on promoting the implementation of systems and controls that will enable more efficient energy management. States should also make special outreach to the commercial and industrial sector to reach the untapped energy conservation potential of those sectors.

Energy Saving Performance Contracts (Section 605 of S. 388, Sections 5-7 of S. 352)

As with other efficiency upgrade programs, energy savings performance contracts should emphasize a system approach to achieve maximum energy savings, in lieu of simply providing for the change out of components. NEMA has no specific comments at this time on proposals to amend the authority for Federal energy saving performance contracts.

Federal Energy Efficiency Requirement (Section 606 of S. 388, Section 4 of S. 352)

NEMA agrees that it is time to impose new energy efficiency requirements on Federal buildings, as proposed in section 606 of S. 388. Further, NEMA endorses the principle behind section 4 of S. 352, which would require agencies to undertake a review of all practicable energy and water conservation and renewable energy measures and to implement measures to achieve at least 50% of the potential savings identified by such a review. With respect to both of these proposals, NEMA again urges that the Federal government emphasize the implementation of systems approaches, not merely component replacement, to achieve energy reduction requirements, along with the adoption of new technology, such as NEMA Premium™ motors and distribution transformers that comply with the NEMA TP-1 standard, wherever possible.

S.J. Res. 15, Air Conditioner Standards Rule

NEMA was not involved in the development of the air conditioner standards rule. With respect to the issuance of energy efficiency standards generally, as discussed above, NEMA believes that it is critical that the Department of Energy fully adhere to all aspects of the "Process Improvement Rule" in every standards-related activity.

CONCLUSION

In conclusion, let me reiterate the three points I began with today. A comprehensive electrical energy policy should rely on affordable, proven technology to address energy supply and demand. Second, it is critical to understand that energy efficiency and conservation don't mean sacrifice and reduced access, but rather doing more with existing capacity by achieving reduction in energy usage through the use of more efficient products and systems. Third, market-based solutions should be the primary vehicle to enhance energy efficiency and conservation. I thank the Committee and I am happy to answer your questions.

The CHAIRMAN. Thank you very much, and thank all of you for your testimony. Let me just ask a very few questions here.

Dr. O'Hagan, you recommend that all Federal buildings be upgraded to meet the Energy Star building program requirements. How do these requirements mesh with Executive Order 13123, the requirement there that agencies reduce energy consumption by 30 percent in 2005, by 35 percent in 2010? Is there a meshing of those two requirements on Federal agencies and Federal facilities?

Dr. O'HAGAN. It is my understanding, Mr. Chairman, that the program is based on the old ASHRAE standard, and one of our recommendations is that the code and the standard for Energy Star buildings be upgraded to the 1999 version, which has higher efficiency levels, and using that, the goals would be accomplished.

The CHAIRMAN. I see, so you believe if they upgrade the standards in this Energy Star building program, that these objectives set out in the executive order will be achieved?

Dr. O'HAGAN. Yes, Mr. Chairman.

The CHAIRMAN. I guess, Mr. Parks, what occurred to me in hearing your testimony and reading it here, and trying to compare what you were saying to what Mr. Rees is saying, as Mr. Rees described things, the vast majority of the industry is in favor of the 12 standard rather than the 13 standard and your company—and you have come out strongly in favor of the 13. Do you consider yourself an outsider, or are there other companies with your point of view on this that just are not being heard from, or how do you explain your position relative to the industry position more generally, as Mr. Rees has described it?

Mr. PARKS. I think a couple of things. Mr. Rees did indicate that, as a group, we are all in favor of higher energy efficiency standards. There is no question about that. Ourselves along with two smaller other manufacturers have come out in favor of the 13-SEER simply because we really believe it is the right thing to do.

Our company has had a history, in our opinion, of doing the right things. We have built the business over 20 years to become the second largest in our industry in the United States, and we have done it by providing a value, affordable product to consumers, giving them highly reliable, affordable products that meet their needs.

We sincerely believe that what would happen if the standard were set at 13 SEER, that all manufacturers, as I indicated in my testimony, would step up much as what occurred in 1992, when the standard was set back in 1987, when, in fact, the standard was set at 10. The same arguments were propagated at that point that there would be $700 of price difference on the new, higher efficiency products. However, that simply was not the case.

The CHAIRMAN. Setting the higher standard then causes the volume to increase and the price per unit come down?

Mr. PARKS. That is correct.

The CHAIRMAN. That is your view?

Mr. PARKS. That is correct.

The CHAIRMAN. This is a personal aside here, but we are doing some remodeling on a home we own out in New Mexico, and I told the contractor to be sure and put all compact fluorescent light bulbs in so we could save some energy, and he came back and said, well, that is $40 per light bulb as compared to $3 or $4 if you go with the regular kind.

Now, why hasn't the same thing that you just predict in the air-conditioning area occurred in that area? Why hasn't the price of those come down to some kind of reasonable level?

Mr. PARKS. I think historically, where there are standards that must be met, people will purchase at the minimum standard level. There has been a pattern of that demonstrated and so, given a situation where there is no, essentially, regulatory requirement or mandate to purchase those types of high-efficiency light bulbs, there is not a payback in the consumer's mind. Also, the amount of energy used by a light bulb is minuscule compared to what is used for an air-conditioning product.

The CHAIRMAN. Mr. Nadel, you agree that the price will come down substantially for this higher efficiency air conditioner if it is mandated, is that your view as well?

Mr. NADEL. Yes, it is, and that is based on past experience. Before the SEER-10 standard was set, the ARI members estimated it would cost more than $700 in extra cost. DOE estimated it would cost—I cannot remember the exact figures, something like $340 extra. If you look at the U.S. Census Bureau data, in fact, the cost in 1992 did not go up at all, so when manufacturers sharpen their pencils, when the market share increases from the current roughly 5 percent for SEER-13 up to 100 percent, there will be dramatic cost reductions.

The CHAIRMAN. This Energy Star labeling program that EPA and now DOE are both involved in, how effective is it? Is there something we should be doing to strengthen that program?

Mr. Nadel, do you have a view as to whether there ought to be some statutory change that would strengthen or expand that program, or do you think it is working just the way it ought to?

Mr. NADEL. I think the program is working very well. However, I think it will help some to actually establish a statutory base for the program. Now, there is no official statutory basis. There is general directives to DOE and EPA to improve energy efficiency, reduce pollution, but not a specific directive.

I do know in the bill that the House Energy & Commerce Subcommittee reported out yesterday there are some specific provisions authorizing Energy Star and giving some directives to the programs that I think will be helpful.

The CHAIRMAN. Dr. O'Hagan, did you have a view on that?

Dr. O'HAGAN. Yes, Mr. Chairman. We think that is a very good program as it applies to consumer products, and I think the focus ought to be kept in that area, and also Energy Star buildings. We do not think it is valuable, however, in the industrial area. It has been proposed to be extended, for example, to motors.

We think that the NEMA Premium program which has been launched by the industry and has even higher standards than the Federal standards is a preferred approach, but certainly, as far as consumer products and commercial buildings is concerned, it is an excellent program. It also leads to the point, Mr. Chairman, and also to the question of the light bulbs that you mentioned, the need that we pointed out for education, and for people to understand the economics.

It is very hard for a consumer to pay $15 for a compact fluorescent when they can get an incandescent lamp for 50 cents, and that is a pretty hard sell without a real understanding of the long-term benefits of making that purchase, so it is for that reason that we think a lot of emphasis needs to be put in educating the public as to the benefits of energy-efficient products.

The CHAIRMAN. Well, I think all of this testimony is very useful, and I appreciate you all being here, and we will try to learn from it as we put a bill together.

Thank you very much. The hearing is adjourned.

[Whereupon, at 11:50 a.m., the hearing was recessed, to be reconvened on July 17, 2001.]

NATIONAL ENERGY ISSUES

TUESDAY, JULY 17, 2001

U.S. SENATE,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Washington, DC.

The committee met, pursuant to notice, at 9:38 a.m. in room SD–106, Dirksen Senate Office Building, Hon. Jeff Bingaman, chairman, presiding.

OPENING STATEMENT OF HON. JEFF BINGAMAN, U.S. SENATOR FROM NEW MEXICO

The CHAIRMAN. The purpose of today's hearing is to consider proposals to reduce the demand for petroleum products in the light duty vehicle sector. The committee has held several hearings on the subject of gasoline supply and price. Most recently was a field hearing in South Dakota chaired by Senator Johnson on renewable fuels. Today we are shifting the focus to the demand side of the equation.

Although this committee does not have direct jurisdiction over vehicle fuel efficiency standards, it does have jurisdiction over research and development, over alternative fuels, and over overall energy policy. Several bills which have been referred to this committee propose strategies to reduce gasoline consumption, either through fuel diversification or increased efficiency. We have asked witnesses to review and comment on some of those bills. S. 597, S. 388, S. 883, S. 1053, and S. 1006 are the ones that I currently am aware of.

Witnesses should feel free to comment on any other measures referred to this or any other committee.

The *New York Times* this morning reported on a draft of the National Academy of Sciences report on improving vehicle efficiency. According to that article in the *Times*, the report, which was requested by Congress last year, will find "fuel economy of new vehicles, especially sport utility vehicles and pickup trucks, could be raised by as much as 10 to 11 miles per gallon over the next 6 to 10 years, with the extra cost offset by savings on gasoline."

The panel preparing this report did not include anyone from the environmental community. Yet the findings seem to be fairly consistent with a recent study by the Union of Concerned Scientists. We will have an opportunity this morning to explore the types of technologies that can be deployed in the near term and in the future to achieve greater efficiency.

The *Times* story also follows up on the issue of sales of flexible fuel vehicles that can use either gasoline or ethanol to meet current

fuel economy targets. Close to a million of these vehicles, mostly trucks and SUV's, are currently being manufactured. Yet very few actually burn ethanol.

The committee has been a strong proponent of the use of alternative fuels. In fact, alternative fuel vehicles were a major focus of the Energy Policy Act, the last major legislation, energy legislation, passed by the Congress. Unfortunately, the goals of EPAct with respect to alternative fuels have not been met, in part due to the lack of available refueling infrastructure, but also due to the disincentive to use the alternative fuels inherent in flexible fuel vehicles.

The goals of fuel diversification remain as valid today as they were 10 years ago. We will hear from some of the witnesses this morning on what we can do to increase the use of those fuels. There are numerous reasons we need to be serious about reducing our reliance on petroleum products, from energy security and economics to the global environment, and I hope the hearing will help give the committee guidance on how we can develop policies to both achieve greater efficiency and also greater fuel diversity in the vehicle sector.

Senator Murkowski.

STATEMENT OF HON. FRANK H. MURKOWSKI, U.S. SENATOR FROM ALASKA

Senator MURKOWSKI. Good morning, Senator Bingaman.

Again, I think it is important that we have these continued hearings. Starting off the new week, we have had I think some 21 weeks have gone by since we submitted in general the broad comprehensive energy bills, your bill and my bill before the committee. CAFE standards are high on everybody's agenda and you mentioned the article in the *New York Times.* It is rather misleading in the sense that one can assume it says that the panel urges higher fuel efficiency for automobiles as a final document.

There is a letter that has gone out from Mr. Bill Colgazier, Executive Officer of the National Research Council of the National Academy of Science, July 16, concerning this draft report, and his indication is that: "We believe it is critical for readers to understand that this document is not a final Research Council report. It does not carry the weight of a final peer reviewed study. Further, the study of the National Research Council undergoes significant changes during an anonymous peer review process. Moreover, in the case of this particular study the study committee will be meeting July 17 and 18 to address comments made about the draft. More than 300 comments have been received to date. More are anticipated. Therefore, it is important to understand that the study at this stage is still a work in progress.

"Once the committee has responded to review comments and documented its changes, the Academy's report review committee will determine whether the committee has been responsive to the review's comments. The final work is expected to be issued on July 31."

So I think we should reflect on the reality that this is still a draft, that the *New York Times* report does not necessarily reflect the final comments expected from the National Academy of Sciences on CAFE standards.

You know, we have seen comments of many people that suggest that all we need to do to address our energy crisis is to initiate CAFE standards. We have seen over a period of time the reality that our cars are getting more fuel efficient, but this has not shown up in the faulty measure of automobile performance, that is miles per gallon. We have got a couple of charts here that I would like to have in evidence.

The fact is that manufacturers have maintained fuel economy despite consumers' demand for performance. If you look at the scale, this is EPA's 2000 fuel economy trend reports and it is a rather complicated chart: weight, miles per gallon, manual, and zero to 60, in a time sequence. As shown on the right, the point is if we had kept cars of the 1980's and made the same improvements in vehicle technologies, fuel economy would have been well over 35 miles per gallon. But instead of choosing fuel economy—and I use the word "choosing" because I think it is appropriate—the American people by their own free will seem to have chosen vehicles with improved performance.

It should not be the prerogative of this Congress in my opinion, or any radical environmental groups, the deprive the public of their choice. The automakers simply respond to the needs of their consumers and make the vehicles that people seem to want to buy.

Now, that is the faulty logic of CAFE standards. You cannot regulate consumer behavior without trampling to some extent on individual freedoms and passenger safety. Automakers can make all the fuel efficient vehicles they can, but if no one buys them what have we accomplished? I think the indications are that of the ten most fuel efficient automobiles made in the United States today, they only constitute one-and-one-half of one percent of the automobile sales.

Now, what does that say for America? Well, I think you can draw your own conclusions, but that is not what motivates the purchaser. So the question is at what point do we dictate this? Now, perhaps we should work to produce more vehicles running on alternative fuels or new technologies like fuel cells, vehicles that provide all of the performance characteristics consumers demand in the form that they can recognize, and provide them with tax incentives if that is necessary to choose these new technologies over established vehicle technologies.

The energy bill that we have introduced, S. 389, contains these incentives as put forth by Senator Hatch and a number of others. I think this is the right way to proceed.

Let us not be fooled into thinking that we need only tighten CAFE standards to solve our energy problems. We should instead focus on getting advanced vehicle technologies to market and into the hands of consumers. As we will hear from our third panel, exciting opportunities await us in the area of replacing gasoline with natural gas, ethanol, and electric vehicles. But there is a critical lack of refueling facilities. As we know, you just cannot drive up anywhere and fill up your tank, and there is not a mass market for these vehicles as yet.

Perhaps it is worth asking whether maybe we have been keeping score of the wrong scorecard. The focus on miles per gallon of gasoline puts alternative fuels certainly at a disadvantage and certainly

overlooks and ignores their potential. Perhaps it is time for a new metric that directly addresses the goal of reducing dependence, as an example, on foreign oil, one that would promote finding another alternative to gasoline.

So I hope that our witnesses will also reflect and comment on the negative impact of CAFE standards on alternative fuels and their development, and ask whether there is a better way to provide for fuel diversity in our transportation sector. Reducing our needs for gasoline would reduce our dangerous dependence on imported oil and provide energy security to a greater degree for Americans. Energy security means job security, it means economic security, it means our American standard of living.

We should be careful to foster this fuel diversity in a way which does not stifle innovation and technological development. We look forward to the suggestions on how we might do this as part of a comprehensive energy plan.

Thank you, Mr. Chairman, and thanks for holding the chart so still for so long.

The CHAIRMAN. Thank you very much.

Why don't we start with our first panel. We have Mr. Barry McNutt, who is the Senior Policy Analyst with the Office of Domestic Policy and International Affairs in the U.S. Department of Energy; and Mr. Robert Shelton, who is the Executive Director of the National Highway Traffic Safety Administration. Mr. McNutt, why don't you go right ahead.

STATEMENT OF BARRY D. McNUTT, SENIOR POLICY ANALYST, OFFICE OF DOMESTIC POLICY AND INTERNATIONAL AFFAIRS, DEPARTMENT OF ENERGY

Mr. MCNUTT. Mr. Chairman, members of the committee, good morning. Thank you for the opportunity to be here. As you said, my name is Barry McNutt. I am a Senior Policy Analyst with the Energy Department's Office of Policy and International Affairs. I have a brief oral statement I would like to make and I request that my written testimony be included as part of the record of this hearing.

The topic of this hearing, reducing demand for petroleum products in the light duty vehicle sector, is a problem that we have worked on for a long time, starting with the Energy Policy and Conservation Act in 1975 and running most recently to the President's National Energy Policy and the Department's ongoing vehicle efficiency, alternative fuels, and renewable fuels efforts.

That we have worked on this goal of reducing petroleum demand, almost three-quarters of which is in the transportation sector, for more than 25 years, we have passed numerous pieces of legislation, and we have a variety of ongoing programs I think is certainly telling as to how difficult the problem is.

We have a limited number of options to reduce petroleum demand in any significant way in the light duty vehicle sector. Clearly, improving vehicle fuel economy has to be part of any serious effort to address that goal. We have the technology to make significant progress without sacrificing other attributes that are important to consumers. The challenge we face is getting this technology

into vehicles to deliver increased miles per gallon for consumers at a reasonable price.

With regard to alternative fuels as a pathway to reduce petroleum use in light duty vehicles, the challenge seems to be even greater. We have worked hard for more than a decade since the passage of the Alternative Motor Fuels Act in 1988, followed by the Energy Policy Act as was mentioned in 1992, to implement a variety of programs to increase the use of alternative fuels in highway vehicles. We have done this with both energy and clean air goals in mind.

While a large number of alternative fuel capable vehicles are being produced, little real progress has been made in developing a commercially viable alternative fuels market. There are a lot of reasons for this, but the fundamental reality is that the conventional petroleum fuel system enjoys enormous powers of incumbency, has great and increasing investments in infrastructure, and is making impressive advances in producing cleaner petroleum-based fuels.

If we want the next decade to end differently than the past vis-à-vis a competitive alternative fuels market, significant technology and policy changes would be required.

The expanded use of non-petroleum components in gasoline and potentially diesel fuel is one area where notable progress has been made in the past decade. Oxygenates in gasoline like ethanol and MTBE now represent about 5 percent of the volume of the gasoline pool. While their use is not without controversy, and I am painfully familiar with that controversy, these replacement fuels, as they are characterized in the Energy Policy Act, bring added volume and improved air quality characteristics to the gasoline pool.

Similar replacement fuels such as gas-derived liquids or biofuels for blending with diesel fuel may become available and may become economically competitive. Together all these actions can help reduce the growth in petroleum product demand from light duty vehicle. Nevertheless we are for the foreseeable future likely to see growing gasoline and diesel fuel demand. Addressing this reality requires we focus on increasing our capability to produce cleaner conventional petroleum-based fuels at the same time we work to increase fuel efficiency and increase the use of alternative and renewable fuels.

That is the end of my prepared remarks and I will be glad to address any questions the committee may have. Thank you.

[The prepared statement of Mr. McNutt follows:]

PREPARED STATEMENT OF BARRY D. MCNUTT, SENIOR POLICY ANALYST, OFFICE OF DOMESTIC POLICY AND INTERNATIONAL AFFAIRS, DEPARTMENT OF ENERGY

Mr. Chairman and Members of the Committee, I welcome the opportunity to testify before you today on various legislative proposals currently pending before the Committee: S. 388, S. 597, S. 883, S. 1006, and S. 1053 as they relate to reducing petroleum use in light duty vehicles.

First, I would like to thank the Chairman and Members of the Committee for your leadership and commitment in addressing the nation's energy issues. The Department applauds the Committee's efforts in moving ahead to shape comprehensive long-term energy legislation and look forward to working with you to find areas of common ground between the Congress and President Bush's policy proposals outlined in the National Energy Policy (NEP). Mr. Chairman, we are confident that our best efforts will move us toward a consensus and commitment to action.

Today, the U.S. transportation sector consumes over 13 million barrels a day of petroleum products and almost 60 percent of that is in our light duty vehicles—the passenger cars, light trucks and sport utility vehicles we all drive. Almost all of the fuel used by these vehicles is gasoline and we produce less, even with domestic refineries operating at maximum capacity, than we consume. The imbalance between our gasoline demand and domestic production is made up with imports, which this summer have averaged almost three quarters of a million barrels a day. Light duty vehicle fuel use estimated to increase over one third by the year 2020, despite an assumed 15 percent increase in new vehicle efficiency. Almost all of this fuel will be gasoline and over two million barrels a day of imported gasoline is estimated to be needed in 2020.

We recognize that we need to do more to decrease petroleum product demand in the transportation sector and to increase U.S. refining capacity to make the clean gasoline and diesel fuel that our light duty vehicles will need. However, people who say that the President's energy policy does not focus sufficient attention on conservation simply haven't reviewed the basics of the Policy. It is important to note that more than 50 percent of the National Energy Policy focuses on energy efficiency, encouraging, in the light duty vehicle area, the development of fuel efficient vehicles, consumer attention to energy efficiency and greater use of alternative fuels. However, action on reducing demand alone will not be sufficient. You either have to accept an ever-widening gap between demand and domestic supply, with all the negative consequences that entails, or you also have to begin thinking about how we increase our own supply of clean vehicle fuels.

To address these challenges, the President's National Energy Policy has adopted an approach that is comprehensive and strikes a balance among our priorities.

First, our policy balances the need for increased supplies of energy with the need to accelerate conservation efforts by utilizing cutting edge technology. For example, increased utilization of advanced vehicle materials, hybrid drive-train technology and new, clean direct injection engine designs can provide significant efficiency improvements in light duty vehicle efficiency without sacrificing other attributes. The challenge we face is getting this technology into the vehicles for consumers at a reasonable price. The Administration looks forward to working with Congress to determine the best way to achieve this goal.

Second, we believe energy security dictates more focus on the system that provides the clean petroleum products that serve our transportation needs. We have an enormous and complex transportation fuels refining, distribution and storage system in this country that, while significantly dependent on imported oil, does give us the broad mix of petroleum products needed to meet current demand and support energy security. Unfortunately, that system is having difficulty keeping up with growing demand and a product slate that is shifting towards greater demand for middle distillates. At the same time, new environmental requirements for ever cleaner products will require even greater investment. We need to spend more attention to improving and increasing that clean product capacity, and we need to redress the governmental policies that inhibit that.

Third, our policy appropriately balances our essential requirements for traditional sources of transportation fuels with the need for renewable and alternative fuel sources. It also recommends tax incentives for the use of certain renewables and advanced technology vehicles and more focused research on next-generation sources like hydrogen, through fuel cells.

The President's energy policy also harmonizes growth in domestic energy production with environmental protection. This commitment to conservation and environmental protection is not an afterthought; it is a commitment woven throughout. Transportation fuels production without regard to the environment is simply not an option.

We support this balanced approach with a number of specific recommended actions. The Administration can carry out many of these recommendations on its own, either through executive orders or agency-directed actions. We are moving ahead to implement proposals as quickly as possible. One day after the release of our National Energy Policy, the President issued two executive orders directing Federal agencies to accelerate approval of energy-related projects and directing Federal agencies to consider the effects of proposed regulations on energy supply, distribution or use. Both of these executive orders will affect fuels regulations and refinery operation critical to an adequate supply of transportation fuel.

Moreover, where appropriate, Federal agencies, including the Department of Energy, are directed to take a variety of actions to reduce and diversify vehicle fuel use. Under existing Executive Order 13149, Federal fleets have to reduce petroleum consumption by 20 percent by 2005, using improved efficiency, reduced vehicle use and alternative fuels. This reduction in fuel use is equivalent to increasing the fuel

economy of all the vehicles in the federal fleet by 6 mpg. This is a significantly greater savings than that which would be required by section 704 of S. 597. The Executive Order, however, gives federal fleet managers a choice of how they achieve the savings; they are not limited to buying only higher fuel economy new vehicles.

Some of the recommendations contained in the National Energy Policy report that relate to vehicle fuel use and production require legislative action and we can find several areas for concurrence with proposed legislation. For example, reauthorization of the Spark Matsunaga Hydrogen Research, Development and Demonstration Act of 1990, similar to what is called for by S. 1053, is supported in the NEP. However, we are concerned that legislative proposals that mandate use of specific technologies or fuels on a rigid timetable are not a good way to get us to our goals. Success of the technology development, adequacy of the fuel supply, or cost-effectiveness cannot be assured by legislation. Our goal should be to create the technology base and policy context in which the market can make cost-effective choices that respect our environmental goals and move us towards our energy security goals.

We all recognize energy as a critical challenge. We recognize that the efficiency and fuel diversity of our light duty vehicle fleet can be improved. We also recognize that parts of our petroleum product supply and delivery system need enhancement or modernization. And we all recognize that conservation and stewardship must go hand in hand with achieving these objectives. This Committee has a long and proud tradition of developing bipartisan energy legislation. The Administration recognizes that all major energy bills have been bipartisan in nature and looks forward to working closely together with you to develop bipartisan energy legislation.

In closing, let me say, Mr. Chairman, that I believe the Department of Energy is particularly well suited to make a serious contribution to finding solutions to the energy challenges we will face over the next twenty years. The Department is the single largest supporter of basic research in the physical sciences and manages major programs in basic energy science, high energy and nuclear physics, fusion energy sciences, environmental research, and advanced scientific computing research. In different ways, each of these areas will play a role in providing greater energy security for the American people. As the policy report notes, "The President's goal of reliable, affordable and environmentally sound energy supplies will not be reached overnight. It will call forth innovations in science, research and engineering. It will require time and the best efforts of leaders in both political parties."

Mr. Chairman, this concludes my testimony and I would be happy to answer any questions the Committee may have at this time.

The Chairman Thank you very much.

Mr. Shelton.

STATEMENT OF L. ROBERT SHELTON, EXECUTIVE DIRECTOR, NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION, DEPARTMENT OF TRANSPORTATION

Mr. SHELTON. Thank you, Mr. Chairman. On behalf of the U.S. Department of Transportation, I welcome the opportunity to contribute to the committee's consideration of measures to reduce the demand for petroleum products in the light duty vehicle sector. This is a matter of importance to the economy and to our national energy security.

As its principal contribution to energy conservation in the light duty vehicle fleet, the Department administers the Corporate Average Fuel Economy program. Enacted in 1975 in response to the energy crisis caused by the 1973 to 1974 oil embargo, the CAFE program requires motor vehicle manufacturers to ensure that their new vehicle fleets meet a specified average level of fuel economy in each model year.

The CAFE standard for passenger cars is set by statute at 27.5 miles per gallon, whereas the CAFE standard for light trucks is set by the Department by regulation for each model year. The light truck CAFE standard has been frozen at the model year 1996 level of 20.7 miles per gallon by provisions in the Department's annual appropriations acts.

The early years of the CAFE program were marked by significant improvements in fuel economy as public demand for energy efficient vehicles during the late 1970's and the early 1980's continued to be strong. Since the mid-1980's, however, gasoline prices have typically been stable or declining and consumer demand has tended to favor vehicle utility, safety, and performance over fuel economy, with the result that the fuel efficiency level of the passenger car fleet has leveled off. At the same time, the arrival of new types of passenger vehicles, such as minivans and sport utility vehicles, has attracted buyers away from passenger cars into these less fuel efficient models.

The result is that the average fuel economy for the new light duty vehicle fleet as a whole has declined from an all-time high of 26.2 miles per gallon in model year 1987 to 24.5 miles per gallon for this model year. This decline means that today's fleet is using more petroleum, an increasing percentage of which is imported, than it would have if fuel efficiency had continued to improve beyond the early years of the CAFE program.

It is in this context that we must re-examine the CAFE program and other conservation measures. The Department welcomes lifting the restrictions on CAFE rulemaking Congress has imposed since fiscal 1996 to permit the Department to once again engage in rulemaking that will set the fuel economy standard for the light truck fleet.

In a July 10 letter to the appropriations committees, Secretary Mineta urged them to consider legislation that would remove the restriction before the end of this fiscal year so that the Department would not need to wait until the start of the new fiscal year, but could begin work right away.

Whenever the Department is free the go forward with rulemaking in the CAFE program, our rulemaking will be fully informed by the National Academy of Sciences report expected later this month, despite today's *New York Times* article, and our work will be consistent with the President's national energy policy considerations. We will have to overcome the effects of the 6-year freeze. The Department has not been able to collect data or conduct any analyses that will be needed to establish the statutorily required determination that a specified fuel economy level is a maximum feasible level.

We believe that responsibly crafted CAFE standards under existing law should increase fuel economy without negatively impacting the automobile industry. As you know, the President's national energy policy report recommends the that standards should be based on sound science and should consider passenger safety, economic concerns, and the impacts on both domestic and non-domestic manufacturers.

It is clear that there are many points of view about the best means to improve the fuel economy of the light duty vehicle fleet, as illustrated by the continuing debate in the Congress on whether to legislate higher CAFE standards or to require specific reductions in fuel consumption by certain segments of the fleet, such as light trucks. We are listening to these debates with interest because they offer an opportunity to explore alternative means of conserving petroleum.

To achieve a specified CAFE level, a manufacturer must produce fuel efficient vehicles that the public will buy. If demand for fuel efficient vehicles slackens, whether because fuel prices decline or because consumer preferences change, manufacturers may need to provide incentives, such as rebates or lower prices, to meet required CAFE levels. If other cost effective measures can be devised to increase consumer demand for fuel efficient vehicles, those measures should be examined. In fact, the President's national energy policy report recommends that the Secretary of Transportation evaluate market-based approaches to increasing new motor vehicle fuel economy.

We want to assure the committee that the Department will carry out its responsibilities under the CAFE law to the best of its ability, with the goal of improving fleet fuel economy, producing benefits to the economy, and to our national energy security.

This concludes my statement. I will be pleased to answer your questions.

The CHAIRMAN. Thank you very much.

Let me start and ask a few questions about the process from here on as you see it. You referred to this, Mr. Shelton, in your comments already. But you are currently prohibited, the Department of Transportation is prohibited, from proceeding with any kind of analysis or investigation to determine what an appropriate fuel efficiency standard might be.

Mr. SHELTON. Yes, we are, Mr. Chairman, yes.

The CHAIRMAN. Secretary Mineta has asked the appropriations committees of the two Houses to go ahead and relieve him of that prohibition so that he can get on with developing a new standard, is that right?

Mr. SHELTON. Yes, sir. He sent a letter up last week asking the Department to be relieved of that prohibition.

The CHAIRMAN. So if he were relieved of that in the next couple of weeks, what is the time frame for getting from where we are today to an actual new standard being implemented by the Department of Transportation?

Mr. SHELTON. We have established standards for light trucks through model year 2003. We are required by statute to set standards at least 18 months in advance of a model year. So we have to set standards for model years 2004 and later light trucks and model year 2004 would start approximately October 1, 2003, so we have to set the standard for 2004 18 months earlier, which would be approximately April 1, 2002.

If the freeze were lifted, the Department would start right now on establishing light truck standards for at least 2004. We would need to get a standard in place for model year 2004 light trucks by April 1, so we would proceed to getting that rulemaking done, and that rulemaking might encompass model years also beyond 2004. We have that option.

The CHAIRMAN. Did you see the article this morning in the *New York Times* that both Senator Murkowski and I referred to?

Mr. SHELTON. Yes, sir, I did, Mr. Chairman.

The CHAIRMAN. Did you have any perspective you could give us on this issue of sales of flexible fuel vehicles that can be either gasoline or ethanol? I gather that the draft report, and it is still just

a draft, but that it is critical of the whole notion for what they cite as the fact that very few of these vehicles actually burn ethanol. Even though they may be capable of using either fuel, they do not in fact wind up burning ethanol.

Is that something that your Department has looked at, or do you have any view on that?

Mr. SHELTON. We are looking at that right now, sir. Under the 1988 Alternative Motor Fuels Act, manufacturers are given CAFE incentives to produce vehicles that will run on both gasoline and alcohol, and manufacturers have produced over one million of these vehicles to date. Very few of them actually do operate, though, on the alternative fuels, and a big problem is the infrastructure is not out there. There are very few ethanol refueling stations in this country.

We are actually completing a report to the Congress in conjunction with the Department of Energy and the Environmental Protection Agency which is going to address this program and how it has—and the effects of this program since it has been established.

The CHAIRMAN. Just to sort of finish this line of questions to you, as you see it, given the current authority that the Department of Transportation has to set these standards, if Congress were to back off of the prohibition on you proceeding in this area is there other legislative action that you also think would be useful?

We have various bills pending here in the Senate and in the House which actually set higher vehicle fuel efficiency standards and do not just leave it to your rulemaking to do that. What is your position on those?

Mr. SHELTON. We have not taken any position on the legislative proposals. We have taken the position that we think the National Academy of Sciences report should be completed. We would like an opportunity to review that report before making recommendations as to what policy changes or legislative changes might be necessary to address CAFE.

The CHAIRMAN. You cannot advise Congress as to what to enact or whether to enact anything in this area until you see that final report, is that your position?

Mr. SHELTON. We think it is very important that we all see that final report, Mr. Chairman. The Congress appropriated a million dollars for that report. The report was reported by the Congress and by the Department of Transportation. It is a very significant piece of work, piece of analysis, in looking at the program.

We expect to have that report by the end of July and we think it should be considered very thoughtfully and thoroughly before we take further action.

The CHAIRMAN. My time is up.

Senator Murkowski.

Senator MURKOWSKI. Thank you, Senator Bingaman.

We have been aware that the Department of Transportation was asked to put policies in place to limit fuel use in the light duty vehicle sector, and it is in some of the bills that are before us here. I am curious to know what policies and measures specifically you believe should be considered. I think among them there was the fuel use proposal to have as a goal 5 percent below the 2000 levels

by 2008 or thereabouts, and I think that time frame would be 5 to 7 years to accomplish that.

Could you comment on any of these policies, and also comment on the effect of timeliness, how immediate would some of these likely be, what effect they might have on gasoline supplies, on prices, and so forth?

Mr. SHELTON. As to the first question, Senator, I think we really think it is important to get the National Academy of Sciences report before deciding whether we need legislative authority in this area. With regard to the second part of the question, clearly auto manufacturers face lead times in their product plans and if the goal is to influence those product plans significantly without causing undue negative effects on their plans they would need some lead time before they could start raising vehicle fuel economy.

Senator MURKOWSKI. When we talk about lead time, what are you talking about? Be a little more specific on policies. What policies? I know you are saying let us wait for the National Academy of Sciences, but for the benefit of the committee here can you share a few of the policies here? Are we looking at 5 to 7 years as lead time?

Mr. SHELTON. Typically, sir, it would take 2, 3, 4, probably 3 or 4, model years before a manufacturer could make substantial changes in his product plans other than say restricting sales of planned products. So any legislation or other program which would require a substantial increase in fuel economy, for example, in the near term that was not considered in the manufacturer's product plans could be disruptive to those plans.

Senator MURKOWSKI. Well, how about policy specific recommendations? What policies?

Mr. SHELTON. There are a number of policies that have been proposed, such as the one you mentioned, which is simply to cap gasoline consumption at some level in the future. Typically we would have to work back to figure out what sort of new vehicle CAFE level that implied and then you would have to consider the manufacturer's ability to get to that CAFE level and whether it was achievable in that time frame.

Senator MURKOWSKI. Well, since we are talking about unknown time frames, I am often a little perturbed. We talk about the merits of opening ANWR and the time it would take to make a determination. These things all take time, whether you are talking about changing policies or significant changes in engineering or prospects of opening up an oil field. The bottom line is what the contribution is.

Would the Department of Transportation also consider highway policies, mass transit, alternative fuels?

Mr. SHELTON. Yes, absolutely. We look at energy consumption in its totality that transportation uses to look at effective means to reduce that consumption. For example, we are looking at congestion mitigation as part of the President's national energy policy.

Senator MURKOWSKI. Now, with the development of engineering standards and weight and safety and the buying habits of the public, how do you explain how the ten most fuel efficient cars only constitute 1.5 percent of the automobile sales in this country? I

mean, is there a problem with those cars? Is it buying habit? Is it safety? Is it weight? Is it performance?

Mr. SHELTON. I think clearly when CAFE standards are established you have to consider whether people will buy those vehicles. As you point out, many very fuel efficient vehicles are only sold in very small numbers, which implies that they do not meet the needs of many members of the public. When we set fuel economy standards, we are required by Congress to consider the economic practicability of achieving those levels, which includes the manufacturers' ability to afford to make these changes, but also whether consumers will buy those vehicles in quantities.

Senator MURKOWSKI. Do not leave me hanging there. Technically, you are talking about cost, you are talking about acceptability, you are talking about safety. I assume the higher up you go in demanding an SUV that will achieve what the automobiles currently are set at, what is it, 27 or thereabouts, you are talking about potentially a substantial change in the weight of that vehicle potentially. Are you talking about a significant breakthrough in an engine that will give you that kind of mileage? Then you are talking about potential higher costs as you achieve that squeeze.

Is this just a process of a compromise of all the various considerations that go into achieving higher standards?

Mr. SHELTON. I am not sure it is a compromise, Senator. We have to consider all these factors certainly. In the short run, for example, if you were trying to raise SUV fuel economy by a large amount in a very few model years, the nearest, the most readily available approaches to do that are to sell more smaller SUV's and fewer large ones, which would certainly impact consumers that want larger SUV's, or perhaps they would have to sell less powerful SUV's, which would also have better fuel economy, which again may undermine other consumers' demand for such vehicles.

So they are all certainly considerations when you set CAFE standards. You have to consider whether the manufacturers can sell those vehicles. If you set a CAFE level which demands that manufacturers produce vehicles that are not going to be sold, then there will not be fuel savings.

Senator MURKOWSKI. The last question. Why are not the public buying the most fuel efficient automobiles today? Why do those ten automobiles—either you, Mr. McNutt, or you, Mr. Shelton, tell us why they are not buying them? Clearly there is an incentive to buy them.

Mr. SHELTON. Clearly those vehicles have incentives to buy them, in that they are often inexpensive and they do not use a lot of gas. That is an incentive to buy them. But obviously, for the great majority of consumers those vehicles do not meet their needs. They do not have perhaps sufficient room, sufficient power, whatever else they need when they buy a new vehicle. Those vehicles are not meeting their needs.

Senator MURKOWSKI. That begs the question. If there is a need, fill it. Evidently you cannot fill that need because of technological challenges; is that what you are telling us?

Mr. SHELTON. In the longer term, it is easy to meet that need, because technologies become available to increase fuel economy without affecting the utility of the vehicle.

Senator MURKOWSKI. Mr. McNutt, do you want to try it?

Mr. MCNUTT. We have had a decade of very low gasoline prices up until the last two summers and that has certainly affected consumers' interest in fuel efficiency per se and the tradeoffs they are willing to make. I think as Mr. Shelton says, you can change the fuel economy attributes of both small vehicles, the ones you are referring to, and the larger vehicles over time with technology, and so there is a time tradeoff in terms of how quickly you can do this.

The manufacturers look at consumer demand, look at the competitive playing field that they are operating in, what the other manufacturers are going to do, and they have to operate within that competitive playing field. Today as things now stand, both because of policy and the market, there is not an incentive to make those improvements in the fuel efficiency of the other vehicles.

So over time both the market can change, the policy can change, and the technology can change. We are now at a place where the vehicles that are being offered were designed and brought to market in the end of the 1990's when gasoline was at historic nominal low prices and I think the vehicles being offered are reflective of that. Over time that can change if the framework changes.

I think really that is what we are getting at. The question you were asking is what is that time frame for change, and one has to respect both the design lead times that manufacturers face. I think Mr. Shelton said that 2004 would probably be the first model year you could seriously look at any sort of standard for light trucks, and I think as a practical matter changing the fuel efficiency of those vehicles is really a 2005 or later proposition.

The CHAIRMAN. Thank you.

Senator Johnson.

STATEMENT OF HON. TIM JOHNSON, U.S. SENATOR FROM SOUTH DAKOTA

Senator JOHNSON. Thank you, Mr. Chairman.

I want to ask consent to submit a full opening statement for the record.

The CHAIRMAN. We will include that in the record.

[The prepared statement of Senator Johnson follows:]

PREPARED STATEMENT OF HON. TIM JOHNSON, U.S. SENATOR FROM SOUTH DAKOTA

Mr. Chairman, thank you for holding this important hearing. I am pleased that we are holding a hearing on renewable fuels and fuel efficiency in the light duty vehicle sector. This hearing is timely, since it follows the field hearing that I chaired in Sioux Falls, SD on July 6 on S. 1006, the Rewewable Fuels for Energy Security Act, which I have introduced with my colleague, Sen. Chuck Hagel. S. 1006 is also one of the bills that will be discussed at today's hearing and I am grateful that the Chairman has placed it on the agenda.

As you all know, there has been a great deal of discussion this year about the nation's energy situation. The increasing volatility in gasoline and diesel prices have affected all of us and left us grasping to determine the reasons for the changes. Tightness in oil refining capacity has been a major factor, as has the re-emergence of OPEC as a force in world oil markets. Those factors, in combination with high natural gas prices this past winter and the recent electricity problems in California and the West, have refocused attention on the need for energy policies that ensure long term planning, fuel diversity and a focus on new technologies.

I expect to spend the next few months working with the Chairman and other members of the Committee to develop an energy strategy to mitigate the boom-bust cycles in energy markets. I believe a number of factors have come together to create

a rare opportunity to shift our economy to greater reliance on renewable, domestic energy sources and away from the volatility of the world oil market.

To this end, S. 1006 would ensure future growth for ethanol and biodiesel through the creation of a new, renewable fuels content standard in all motor fuel produced and used in the U.S. Senator Hagel and I will push for our legislation to establish an aggressive growth pattern for ethanol and biodiesel production and use in the United States.

Today, ethanol comprises less than one percent of all transportation fuel in the U.S. My bill would require all motor fuels sold in the U.S. to be comprised of a certain quantity of renewable fuel (ethanol from corn, ethanol from biomass, and biodiesel). By 2008, 2% of all transportation fuel in the U.S. would be from renewable fuels, increasing to 5% by 2016. I believe those are realistic targets.

The Bush Administration recently affirmed its support for ethanol when it denied California's request to evade the oxygen requirement for reformulated gasoline (RFG) as required under the Clean Air Act. The Administration clearly recognizes that ethanol has important clean air benefits, without the dangers of groundwater contamination posed by MTBE. I applaud this decision to enforce the Clean Air Act and ensure clean fuels have a major role in the market.

Based on current projections, construction of new plants will generate $900 million in capital investment and tens of thousand of construction jobs to rural communities. For corn farmers, the price of corn is expected to rise between 20-30 cents per bushel.

Combine this with the provisions of our bill and the potential economic impact for rural economies is tremendous. Today, three ethanol plants in South Dakota produce nearly 30 million gallons per year. The production in South Dakota alone could grow substantially, with at least 3,000 farmers owning ethanol plants and producing 200 million gallons of ethanol per year or more.

An important but under emphasized fuel is biodiesel. We all know that soybean prices are hovering near historic lows. Biodiesel production is small, but has been growing steadily. With the new EPA rules requiring dramatically lower amounts of sulfur in diesel fuel by 2007, the market prospects for biodiesel, an intrinsically low sulfur fuel, are very bright. The increased usage of biodiesel would help to meet the goals of S. 1006 and would be beneficial for the nation.

It is important the Congress take a serious look at these issues beyond just the economic impact for my region of the country. Bio-based fuels offer multiple benefits—from climate change to improving our trade balance. By increasing biofuels production, we can also reduce the need for new refineries and pipelines.

Moreover, we need to find solutions to increase fuel efficiency for vehicles. The energy crisis of the 1970's moved us away from larger, gas-guzzling vehicles, to more efficient, energy-friendly vehicles. Even the SUVs of today get better mileage than many of the vehicles 30 years ago. But the recent swings in gas prices make it clear that we need to take a serious look at new technologies and look at ways to improve the gas efficiency of our vehicles.

The Senate plans to proceed with comprehensive energy legislation this session of Congress. In my view, a substantive bill that improves the nation's energy security can only be enacted if we work in a bipartisan manner. The problems and difficulties that our state and the nation face are too important to be bogged down in partisan rhetoric. I will work together with my colleagues to see that we produce policies to remedy real problems and real energy concerns for the nation. In my view, a viable renewable fuels component would go a long way towards making this happen. With your help and input, I believe we can make that happen.

Senator JOHNSON. And also to thank you for authorizing a field hearing that I chaired in Sioux Falls, South Dakota, July 6 dealing with alternative fuels, with particular focus on S. 1006, the Renewable Fuels for Energy Security Act, which my good friend Senator Hagel and I have co-sponsored. The thrust of our legislation is to create a new renewable fuels content standard in all motor fuel produced and used in the United States. We would move the current consumption of alternative fuel, chiefly ethanol and biodiesel, from less than one percent of all transportation fuel today to an increase to 2 percent by 2008 and 5 percent by 2016.

Now, I believe that one of the issues that needs to be clarified, at least in the mind of the public, is when we talk about consuming ethanol we are not necessarily talking about the dual use tech-

nology changes that were required in Federal legislation. That involves burning 85 percent ethanol, E-85. That does require some technology changes in the vehicles. Unfortunately, the problem has not been with E-85, the problem has been with the access to E-85 and I think the public awareness that these vehicles in fact are able to consume that kind of fuel.

I think E-85 has great promise. But that is a separate issue. The fact is that vehicles manufactured today with no technology changes are capable of burning up to about 10 percent ethanol. Now, Senator Hagel and I are suggesting around a 5 percent use by the year 2016. I believe this is an achievable kind of level.

I would suggest that my friend from Alaska I think made a good point when he talked about CAFE standards, that perhaps we ought to be also focusing a bit on not only mileage, but on displacement of petroleum consumption, which is again a function of greater ethanol and alternative fuel usage. Now, I do not think it is an either/or situation. I think we need to be examining improved CAFE standards, but I think we also need to keep in mind the possibility of significant displacement of petroleum consumption through alternative fuels, particularly when this does not require, necessarily require the kind of major technology changes in the vehicle industry that the E-85 requires.

I think we ought to continue to pursue dual use fuel involving E-85, but clearly we have our work cut out for us in terms of the chicken and egg problem of availability of that fuel throughout the country. That is something that it seems to me that the Department of Transportation is going to have to work on, rather than simply giving up on dual use fuels technology, to keep in mind that the problem is not with the fuel, the problem is with the access to the fuel and the information needed.

The question I would suggest for Mr. Shelton in particular, I would guess, is do you agree that the displacement of petroleum usage is a key policy goal along with better gasoline mileage of American motor vehicles?

Mr. SHELTON. Yes. The idea is to reduce petroleum consumption. You can reduce petroleum consumption by raising fuel economy or you can reduce petroleum consumption by displacing it with alternative fuels.

Senator JOHNSON. Or you can do both.

Mr. SHELTON. Or you can do both.

Senator JOHNSON. That is what I would suggest maybe where we need to end up in this debate.

Mr. SHELTON. Yes. I was not trying to suggest it was an either/or. Absolutely, you should do both.

Senator JOHNSON. One of the benefits, it would seem to me, of increased ramping up—and Senator Hagel and I are certainly looking at a long window of time. We are trying to be realistic about this. But it would seem to me that one of the benefits of increasing displacement of petroleum with alternative fuel is that it is a regime that can be begun now rather than later. It is not something that we have to wait ten years for in order to accomplish.

Would you share that view?

Mr. SHELTON. Yes, sir, it certainly can be achieved in a shorter duration, absolutely.

Senator JOHNSON. Is it your observation that existing automobile technology is very capable of burning blends up to 10 percent ethanol without significant changes?

Mr. SHELTON. I am not entirely current on that, Senator, but that was my understanding based on historical knowledge, that typically a vehicle can burn up to 10 percent ethanol without modification.

Senator JOHNSON. And blends of biodiesel as well, which is a soybean-based fuel?

Mr. SHELTON. I have to defer to Mr. McNutt on that.

Senator JOHNSON. Mr. McNutt.

Mr. MCNUTT. We have very little experience in the biodiesel side. The auto industry's view about ethanol is a proper blended ethanol, which is the language they use, at 10 percent has certainly been acceptable, and it is what we have in the marketplace now.

The question about biodiesel I think, clearly it can be used. At what levels, what kind of equipment modification, if any, I think is something we are learning about now. So it is not a technological obstacle. It is learning how to do it properly.

Senator JOHNSON. I would share with you the testimony from the supervisor of the Black Hills National Forest, of all people, who showed up for our hearing in Sioux Falls, who indicated that they have gone now to biodiesel in their Forest Service vehicles. It is a cleaner burning, easily used fuel, and this again is a technology that exists now, the potential for consumption is here now.

My time is up. I thank the chairman.

The CHAIRMAN. Thank you very much.

Senator Hagel.

STATEMENT OF HON. CHUCK HAGEL, U.S. SENATOR FROM NEBRASKA

Senator HAGEL. Mr. Chairman, thank you. I too have a statement that I would like to ask to be included in the record. Included in that statement, Mr. Chairman, is a thank you to you and to our chairman emeritus for your continued commitment to working on this issue, which I believe energy in itself and the wholeness of it is I believe the most pressing issue facing the future of this country. So thank you.

[The prepared statement of Senator Hagel follows:]

PREPARED STATEMENT OF HON. CHUCK HAGEL, U.S. SENATOR FROM NEBRASKA

I want to thank Chairman Bingaman for continuing these important hearings on energy policy.

Someday, technology will deliver new and diverse sources of energy. But in today's world and for the near future, fossil fuels power America. The 180 million gasoline and diesel-powered vehicles on America's roads are not going to be replaced overnight. With that in mind, the increased use of alternative fuels, including ethanol and biodiesel, can have an immediate and significant impact on reducing our dependence on foreign oil.

The Renewable Fuels for Energy Security Act (S. 1006) that Senator Johnson and I introduced would ensure a one percent market share for fuels derived from renewable resources by 2008, a three percent market share by 2011, and a five percent market share by 2016—a ten-fold increase from today. A three percent market share for U.S. produced renewable fuel would replace between 500,000 to 600,000 barrels of crude oil a day, roughly the amount we now purchase from Iraq.

Renewable fuels like ethanol and biodiesel afford us the opportunity to develop energy, environmental and economic policies that work together. They can help us

improve air quality, strengthen our national security, reduce our trade deficit, and decrease U.S. dependence on foreign oil.

Our nation needs a broader, deeper and more diverse energy portfolio—one that ensures we have clean, reliable and affordable domestic sources of energy. Expanding the market for renewable fuels is only part of the solution, but it is an important part. We must push harder for renewable fuels as a significant addition to any new energy policy that comes out of this Committee.

Thank you, Mr. Chairman.

Senator HAGEL. Picking up on where Senator Johnson was going, his explanation and questions regarding our renewable fuels bill, which we think has some merit. Mr. McNutt, I understand yesterday that a senior representative from the White House, Mr. Melman, who you may or may not know, but just to inform you who he is, he is the Director of the Political Office at the White House, which you might want to get acquainted with him. He probably will have something to do with where all of this eventually winds up.

He told the National Corn Growers that the President was focusing on renewable sources of energy, and I believe that is a quote from Mr. Melman. What do you think he means by that?

Mr. MCNUTT. I will not be presumptuous. I do not know what his remarks were, but I can speak about what the Department is doing. Obviously, renewable energy includes what we are doing today with grain-based alcohols, soy-based diesel fuels, and longer term with cellulosic-based alcohol. All three of those fall into the category, in this light duty fuel context, motor fuel context, of renewables. Obviously, the renewable spectrum when you get to power production is much broader than that.

Senator HAGEL. Do you think he is talking about ethanol, biodiesel, some of the things that Senator Johnson talked about?

Mr. MCNUTT. Again, I do not know——

Senator HAGEL. Hard to tell, is it not?

Mr. MCNUTT [continuing]. What Mr. Melman was talking about, but in terms of when the Department speaks about renewables in the motor fuel area we certainly talk about ethanol from various sources and soy-based material for blending with diesel fuel.

Senator HAGEL. You think that is something we should continue to explore?

Mr. MCNUTT. Yes, we are. We have active programs in those areas. Ethanol use in gasoline is growing. I noticed a press release from the Renewable Fuel Association yesterday reporting the tenth consecutive month of growth in output of ethanol production in the United States to over 100,000 barrels a day. So it is a growing industry, a growing utilization, and we are all pursuing that.

Senator HAGEL. In your testimony as well as Mr. Shelton's, both of you recognized the obvious, that we have talked a bit about this morning, that is the growing dependence on foreign source oil, which I do not think anyone feels particularly comfortable about that. It is something that we do need to address. The President is addressing it. This panel is addressing it. The Congress will continue to address it.

We have not done a very good job with it over the last few years. Many of you remember, as I do, in the 1970's when we were about 36 percent dependent on foreign sources of oil at the height of the Arab oil embargo and we thought essentially our geopolitical, stra-

tegic, economic, energy policy had come apart. Now we are getting close to double that number. So we all have to take some responsibility for deferring the tough decisions in this business.

But the question is, if that is a concern of all of us, how do you best believe we can deal with that? Renewable sources are a part of that. My numbers along with Senator Johnson's show rather conservatively from, as a matter of fact from your Department and others, that if you get to a 3 percent standard of renewable fuels in our transportation fuel inventory that you are now saving at the rate of about 600,000 barrels of foreign source oil a day. I believe that is somewhere in the range of what we import from Iraq.

Now, you may quibble with those numbers, but they are not mine. They are the Department of Energy's and others. But that is beside the point.

So do you believe renewable fuels play a role—can play a more significant role—if we do more than we are doing now to increase those uses and those standards versus other options?

Mr. MCNUTT. The National Energy Policy is looking at a variety of ways of reducing the foreign oil dependence, including obviously greater domestic production of oil. How the various things play against each other depends on your assessment of them. You talked about 3 percent of motor fuels pool, which on a direct calculation is like 300,000 barrels a day. I understand we do not need to quibble about whether it is 300,000 or 600,000 barrels a day.

I think renewables' real advantage does not lie in oil displacement per se, but lies in the very fact that, one, it is renewable and has benefits in other areas. More specifically, as I mentioned in my opening statement, we have had success, as Senator Johnson was noting, in bringing what I call blend stocks into the gasoline stream because we do not have an infrastructure limitation. So that is a second advantage of pursuing that route, which is you do not have to build infrastructure, you can use more of them tomorrow, as we are seeing.

So you have certain expanded environmental advantages for renewables as they are being used now in gasoline. You have blending advantages and the lack of infrastructure. You also add to the quality of the gasoline pool if they are blended correctly. So to me, I think we have to look at the full value of those renewables, not just their displacement value, because in the end game we are using, will be using in the time you are talking about, 20 million barrels a day of oil, and whether 300,000 or 500,000 is the important number, the important thing about renewables is their ultimate benefits.

Senator HAGEL. Thank you.

Mr. Chairman, thank you.

The CHAIRMAN. Thank you.

Senator Feinstein.

STATEMENT OF HON. DIANNE FEINSTEIN, U.S. SENATOR FROM CALIFORNIA

Senator FEINSTEIN. Thanks very much, Mr. Chairman.

Mr. McNutt and Mr. Shelton, welcome. For the last three Congresses I have been trying to work on fuel efficiency standards. I joined Senator Dick Bryan of Nevada and Senator Gorton of Wash-

ington to try to move fuel efficiency standards for SUV's and light trucks, and I saw how very difficult it was. We finally got the study from the National Academy of Sciences, which was a kind of big deal, if you will.

Well, to make a long story short, in this Congress Senator Olympia Snowe, Senator Schumer, Senator Collins and I have introduced legislation which over the next 6 years would bring the fuel efficiency standards for light trucks and SUV's in compliance with sedans. So it would be a third every 2 years for 6 years. This saves about a million barrels of oil a day. It prevents 240 million tons of carbon dioxide, the largest global warming gas, from entering the atmosphere a year, and it cuts down on oil imports about 10 percent.

Additionally, it would save the consumer anywhere from $300 to $600 a year buying gasoline. To me, it sounds like a no-brainer.

Now, the one question was is it really doable. I went and had the opportunity to speak to the National Academy of Sciences when they were meeting here and then afterwards some representatives from the automobile companies talked to me and said: Oh, we cannot do this, we are very resistant to it, etcetera, etcetera. Then I got very worried because I heard that the National Academy's panel had no environmentalists, was apt to be very pro-automobile company.

Well, this morning I saw the *New York Times* and my heart just jumped with delight, because what the draft report apparently said was that these standards are eminently doable, they are eminently meetable, and they probably can be done by different uses of existing technology. So I was just delighted. If that is the draft report, hopefully the Academy will back the draft report. I do not know whether they will or they will not.

As you know, the House has taken some minimum baby steps forward. So as I look at this issue and as I watch the administration and Secretary—excuse me—Vice President Cheney's comments, I see the administration changing. As a matter of fact, I asked them whether they would support increased fuel efficiency standards—I do not mean to make you gentlemen uncomfortable—increased fuel efficiency standards and the response I got was: Well, we want to see the Academy's report first.

Hopefully that report will be forthcoming very shortly, and hopefully we will be able to move this legislation. But what I wanted to ask you about was, as part of this legislation Federal fleets would have to reduce petroleum consumption and we would increase the fuel economy of new vehicles in the Federal fleet on the following schedule. Two years after the enactment of the bill, the average fuel economy of the new vehicles comprising the Federal fleet must be 3 miles higher than the baseline average fuel economy for that class, and 2 years after the enactment the average fuel economy after that must be 6 miles per gallon higher than the baseline.

My question to you is that, since the Federal Government purchases about 1 percent of all new vehicles, State vehicles make up another .65 percent and usually follow Federal standards, this can make a big difference. Would your Department be supportive of moving the Federal fleet in this direction?

Mr. SHELTON. Thank you, Senator. As you noted, the administration has taken the position that it wants to wait until the National Academy of Sciences study is completed before making policy recommendations on whether we need to change CAFE or pursue legislative changes. We, like you, are eagerly awaiting that report, which we expect to have by the end of this month.

So at this point I honestly do not know the answer to your question. I do not know what the average fuel economy is of the Federal fleet. I have to check with the General Services Administration. So I am not sure how feasible they view it as to substantially increase the fuel economy of those vehicles.

Senator FEINSTEIN. I got my answer. Thank you very much.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you very much.

We have two additional panels here and I would propose that we go ahead and proceed to the second panel. In fact, it is just suggested that we combine the next two panels and just ask all six witnesses to come forward, please.

Thank you both very much for your testimony.

Mr. MCNUTT. Thank you.

The CHAIRMAN. Well, thank you all very much for coming today. Let me just introduce the witnesses just starting on the left-hand side here going across. I do not know if that is the logical way to do it, but let me just do it that way. From the left, Mr. Charles Gibbens, who is automotive fleet manager, on behalf of National Association of Fleet Administrators; next is Mr. McCormick, Byron McCormick, the director of Global Alternative Propulsion Center, the Global Alternative Propulsion Center, General Motors Corporation. Thank you for being here.

Next, Mr. Greg Dana, who is the vice president for environmental affairs with the Alliance of Automobile Manufacturers. Mr. Rich Kolodziej—is that about right?

Mr. KOLODZIEJ. Fairly close.

The CHAIRMAN. Why do you not tell me what is right.

Mr. KOLODZIEJ. It is "KOE-Loe-JAY."

The CHAIRMAN. "KOE-Loe-JAY."

Who is president of the Natural Gas Vehicle Coalition. Mr. Gary Marshall, who is vice president of the National Ethanol Vehicle Coalition; Mr. Eugene Zeltmann, who is the co-chairman of the Electric Vehicle Association of the Americas. Thank you all very much. Why do we not just start and each of you take 5 or 6 minutes and summarize your testimony. We will include in the record your full testimony and then we will have some questions.

Mr. Gibbens.

STATEMENT OF CHARLES GIBBENS, AUTOMOTIVE FLEET MANAGER, ON BEHALF OF NATIONAL ASSOCIATION OF FLEET ADMINISTRATORS

Mr. GIBBENS. Thank you, Mr. Chairman. The National Association of Fleet Administrators, or NAFA, appreciates the opportunity to testify at this hearing and share with the committee the perspective of fleet managers on strategies that you might consider for reducing demand for petroleum products in the light duty vehicle sector. NAFA is the association of professional fleet managers. Our

2,000 members manage more than 3 million cars, vans, and trucks for corporations and government agencies.

As already noted, I am Charles Gibbens, the automotive fleet manager for the county of Henrico, Virginia, and I manage a diverse fleet of about 2,500 vehicles.

Reducing petroleum demand in the light duty vehicle sector was a goal of the Energy Policy Act of 1992 and one of the objectives of EPAct was that fleet mandates would jump-start the market for alternative fuel vehicles, stimulate AFE use by the general public, and result in a 10 percent replacement of petroleum by 2000 and 30 percent by 2010. Federal, State and fuel provider fleets are mandated to purchase AFVs when replacing light duty vehicles.

The law provides for an exemption process if either vehicles or refueling facilities are not available. Since 1992 fleet managers have faced the challenge of how to comply with the EPAct mandate. Fleet managers have been consistent in their message that any plan to move vehicles to alternative fuels will not be successful until the costs and operational issues are comparable with gasoline and diesel vehicles.

Despite the optimism of many, AFVs are still costly, are not available in sufficient model lines, lack the requisite refueling infrastructure, and do not meet the operating needs of most fleets. At this moment, despite the best efforts and limited accomplishments, the economic and the operational situation is not promising for the majority of fleets or for the general public. These very practical real world conditions may explain why even the Federal Government has so consistently failed to meet its own mandate for AFV acquisition and operation.

It seems clear from the experiences of the Federal fleet, fuel provider fleets and State fleets that fleets by themselves will not make any significant reduction in the Nation's use of fossil fuels. This is in part because of inherent limitations in existing AFV models, alternative fuels, refueling infrastructure, technology and costs.

Mandates, however, were only part of the EPAct strategy. It was anticipated that the mandated fleets would provide the critical mass for the vehicle manufacturers and the fuel providers. In turn, the vehicle manufacturers and fuel providers would reach economies of scale necessary for substantial penetration of the light duty vehicle sector. It is important to point out that EPAct mandated AFV purchases, but only if the appropriate vehicles and fuels were readily available. It was of course never the intent that the mandated fleet would either build its own vehicles or build its own refueling facilities. In fact, the act provided specific exemptions if either the vehicles or the fuel were not available.

It was assumed that AFVs would generate the refueling infrastructure because the alternative fuel would be more cost effective. Unfortunately, this is not always the case. Just last week, the fleet manager for the city of St. Louis, Missouri, refueled his dedicated CNG pickup at a cost of about $1.38 per gallon gasoline equivalent, when the city was only paying 98 cents per gallon for a gallon of gasoline after exemption for State and Federal tax.

As a viable public policy, EPAct has failed. The marketplace has not risen to the challenge to address the economic barriers. Some are blaming fleet managers for EPAct's failure. The blame the fleet

manager for failing to convince a mayor, a governor, a CEO that sound economics would be to acquire vehicles that cost more, are more expensive to operate, travel fewer miles, have limited cargo space, and can easily be refueled.

The General Accounting Office has identified the real reasons for the failure of EPAct. In a February 2000 report, GAO found that the goals of the act were not being met "principally because alternative fuel vehicles have significant economic disadvantages compared to conventional gasoline vehicles." The report continues: "Fundamental economic impediments, such as the relatively low price of gasoline, the lack of refueling stations for alternative fuels, and the additional cost to purchase these vehicles, explain much of why both mandated fleets and the general public are disinclined to acquire alternative fuel vehicles and use alternative fuels."

The Department of Energy concurs with this GAO assessment. According to DOE's section 506 technical policy analysis: "Fleet AFV use by itself will be insufficient to achieve large alternative fuel market share. Alternative fuel use by EPAct-covered fleets, even with the contingent mandates for private and local government fleets, is unlikely to provide more than about 1.5 percent replacement fuel use."

The committee has an unenviable task. The simplest option would be to fix EPAct, declare victory, and revisit the failures in another 9 years. This simple option responds to those who would urge you to focus on the mandates without real concern for petroleum reduction. The alternative is to think outside of the box and consider a bolder strategy that includes efficiency, conservation, and use of both alternative fuels and alternative technologies.

The Nation's energy situation seems to dictate a bold public policy. Accordingly, fleet managers recommend the following: One, amend EPAct to allow additional compliance options. This would include full credit for use of biodiesel, hybrid electric vehicles, and neighborhood electric vehicles. This fall 75 percent of new State vehicles and 90 percent of fuel provider vehicles must be AFVs, but these fleets may not get credit for hybrid electric vehicles or full credit for the use of biodiesel.

Two, amend EPAct to provide credit for installing refueling infrastructure as included in S. 388.

Three, strengthen voluntary programs such as DOE's Clean Cities program that focus on niche markets where fuels such as natural gas are most efficient.

Four, encourage the use of and remove obstacles to the use of other renewable energy-based fuels and fuel blends, such as biodiesel and blends of biodiesel.

Five, resist any further mandates on State fleets or fuel provider fleets. Again, as noted, squeezing every drop of petroleum from these fleets by the year 2010 would result in only about a 1 percent reduction in petroleum use.

Six, because refueling infrastructure is such a problem, focus on those strategies that take advantage of the existing liquid refueling infrastructure. Specifically, grant incentives for the development of hybrid electric vehicles and the use of renewable fuels.

Seven, provide significant economic incentives via grant programs and tax incentives. For example, pass and fund section 705

of S. 388, which establishes a grant program for local governments for covering the incremental costs of qualified alternative fuel vehicles. It authorizes $100 million for each fiscal year 2002 through 2006 and limits individual grant awards to no more than $1 million.

Also, many fleet managers support the intent of S. 760, the CLEAR ACT, which is a tax issue and is outside the jurisdiction of this committee. The CLEAR ACT would potentially help overcome the economic barriers facing vehicles, fuels, and refueling infrastructure. The CLEAR ACT, however, in its present form is of little benefit to government or nonprofit fleets. We are hopeful that this can be corrected before any House or Senate markup. If not corrected, NAFA questions whether Congress should pass the legislation.

In closing, the challenge for the Senate Energy Committee is to think outside the box. Some will urge you to take the easy course of action, that is to force government agencies and companies to buy AFVs and use the fuels regardless of cost and regardless of the public policy benefit. Mandates have proven to be counterproductive. Too much time and resources have been spent by DOE, other Federal and State agencies, fleets, fuel providers, and manufacturers to make mandates work, all hoping that mandates will be the silver bullet. Too much has been spent for too little gain.

Thank you again for this opportunity to participate and I would be most happy to answer any of your questions.

[The prepared statement of Mr. Gibbens follows:]

PREPARED STATEMENT OF CHARLES GIBBENS, AUTOMOTIVE FLEET MANAGER, ON BEHALF OF NATIONAL ASSOCIATION OF FLEET ADMINISTRATORS

The National Association of Fleet Administrators, Inc. (NAFA) appreciates the opportunity to testify at this hearing and share with the Committee the perspective of fleet managers on strategies that you might consider for reducing demand for petroleum products in the light-duty vehicle sector.

NAFA is the association of professional fleet managers. Our 2,000 members manage more than 3 million cars, vans, and trucks for corporations and government agencies.

I am Charles Gibbens, the Automotive Fleet Manager for the County of Henrico Virginia. I manage a diverse fleet of about 2,500 vehicles.

Reducing petroleum demand in the light-duty vehicle sector was a goal of the Energy Policy Act of 1992 (EPACT). One of the objectives of EPACT was that fleet mandates would jump-start the market for alternative fuel vehicles (AFVs), stimulate AFV use by the general public and result in a 10 percent replacement of petroleum by 2000 and 30 percent by 2010.

Federal, state, and fuel provider fleets are mandated to purchase AFVs when replacing light-duty vehicles. For model year 2002, the acquisition for state and fuel provider fleets is 75 percent and 90 percent, respectively. The law applies to fleets in metropolitan areas with populations of more than 250,000. The law provides for an exemption process if either vehicles or refueling facilities are not available.

Since 1992, fleet managers have faced the challenge of how to comply with the EPACT mandates. Fleet managers have been consistent in their message that any plan to move vehicles to alternative fuels will not be successful until the costs and operational issues are comparable with gasoline and diesel vehicles. Despite the optimism of many—AFVs are still costly, are not available in sufficient model lines, lack the requisite refueling infrastructure and do not meet the operating needs of most fleets.

There has been some progress. There have been anecdotal successes attributed to fleet use of AFVs. Unfortunately, for every anecdote of success there are also anecdotes of dissatisfaction, frustration and failure. Many fleet managers, who are successfully using AFVs today in a specific niche segment of their fleets, have clearly stated that they will not be able to expand AFV use in other segments of their fleets because of overriding operational or expense barriers.

On the positive side, vehicle manufacturers are beginning to make AFVs in a wider variety of vehicle types. On the negative side, however, many fuels are much less available than had been predicted and promised. Since 1992, methanol has disappeared from the marketplace and the natural gas industry has abandoned plans to build a public refueling infrastructure. Some of the more promising projects, such as CNG in Atlanta for the Olympics and CNG and propane on the Pennsylvania Turnpike, have failed.

At this moment, despite the best efforts and limited accomplishments, the economic and the operational situation is not promising for the majority of fleets or for the general public. These very practical, real—world conditions may explain why even the Federal Government has so consistently failed to meet its own mandate for AFV acquisition and operation.

It seems clear from the experiences of the federal fleet, fuel provider fleets, and state fleets that fleets by themselves will not make any significant reduction in the nation's use of fossil fuels. This is in part because of inherent limitations in existing AFV models, alternative fuels, refueling infrastructure, technology and costs.

Mandates, however, were only part of the EPACT strategy. It was anticipated that mandated fleets would provide the critical mass for the vehicle manufacturers and the fuel providers. In turn, the vehicle manufacturers and fuel providers would reach economies of scale necessary for a substantial penetration of the light-duty vehicle sector.

It is important to point out that AFV purchases were mandated by EPACT, but only if the appropriate vehicles and fuels were available. It was, of course, never the intent that a mandated fleet would either build its own vehicles or build its own fueling facilities. In fact, the Act provided specific exemptions if either the vehicles or the fuel were not available.

It was assumed that AFVs would generate the refueling infrastructure because the alternative fuel would be more cost effective. Unfortunately, this is not always the case. Just last week, the fleet manager for the city of St. Louis refueled his dedicated CNG pickup at $1.38/GGE when the City was only paying $0.98 for a gallon of gasoline after exemption for Federal and State taxes.

St. Louis is a good example. The city is not currently subject to any mandate, but the fleet manager has been an alternative fuel advocate for many years. Yet, as he says, "We've tried almost everything and can't find any vehicle-fuel combination that comes close to break even on cost or on a lifecycle-cost basis not to mention the range/cargo space hits."

As a viable public policy, EPACT has failed. The marketplace has not risen to the challenge to address the economic barriers. Some are blaming fleet mangers for EPACT's failure. They blame the fleet manager for failing to convince a Mayor, a Governor, or a CEO that sound economics would be to acquire vehicles that cost more, are more expensive to operate, travel fewer miles, have limited cargo space, and can't be easily be refueled.

The General Accounting Office has identified the real reasons for the failure of EPACT. In a February 2000 report, GAO found that the goals of the Act were not being met "principally because alternative fuel vehicles have significant economic disadvantages compared to conventional gasoline vehicles." The report continued, "Fundamental economic impediments—such as the relatively low price of gasoline, the lack of refueling stations for alternative fuels, and the additional cost to purchase these vehicles—explain much of why both mandated fleets and the general public are disinclined to acquire alternative fuel vehicles and use alternative fuels."

More importantly the GAO told the Senate Finance Committee just last week that "alternative fuels and vehicles have not made much of a dent in the conventional fuel and vehicle dominance in the U.S. vehicle fleet." According to GAO's February 2000 report, "If federal agencies, state governments, and alternative fuel providers fully complied with the act's mandates, the vehicles in their fleets would replace less than 1 percent of petroleum fuels in 2010."

The Department of Energy concurs with the GAO assessment. According to DOE's Section 506 Technical Policy Analysis: "Fleet AFV use by itself will be insufficient to achieve large alternative fuel market share. Alternative fuel use by EPACT covered fleets, even with the contingent mandates for private and local government fleets, is unlikely to provide no more than about 1.5 percent replacement fuel use . . ."

RECOMMENDATION FOR REDUCING PETROLEUM USE IN THE LIGHT-DUTY SECTOR

The Committee has an unenviable task. The simplest option would be to "fix" EPACT, declare victory, and revisit the failures in another nine years. This simple

option responds to those who would urge you to focus on the mandates without real concern for petroleum reduction.

The alternative is to think outside of the box and consider a bolder strategy that includes efficiency, conservation and use of both alternative fuels and alternative technologies. The nation's energy situation seems to dictate a bold public policy.

Fleet managers recommend the following:

Amend EPACT to allow additional compliance options. This would include full credit for use of biodiesel, hybrid electric vehicles and neighborhood electric vehicles. This fall 75% of new state vehicles and 90% of fuel provider vehicles must be AFVs, but fleets may not get credit for hybrid electric vehicles or full credit for the use of biodiesel.

Amend EPACT to provide credit for installing refueling infrastructure, as included in Senate Bill 388.

Strengthen voluntary programs, such as DOE's Clean Cities Program, that focus on niche markets where fuels such as natural gas are most efficient.

Encourage the use of and remove obstacles to the use of other renewable energy-based fuels and fuel blends such as biodiesel and blends of biodiesel.

Resist any further mandates on state fleets or fuel provider fleets. Again, as GAO noted squeezing every drop of petroleum from these fleets by 2010 would result in only a 1% reduction in petroleum use.

Because refueling infrastructure is such a problem, focus on strategies that take advantage of the existing liquid fuel refueling infrastructure. Specifically, grant incentives for the development of hybrid electric vehicles and use of renewable fuels.

Provide significant economic incentives via grant programs and tax incentives.

For example, pass and fund SEC. 705 of Senate Bill 388, which establishes a grant program for local governments for covering the incremental cost of qualified alternative fuel vehicles. It authorizes $100 million for each of fiscal years 2002 through 2006, and limits individual grant awards to no more than $1 million.

Also, many fleet managers support the intent of Senate Bill 760, the CLEAR Act which is a tax issue and outside the jurisdiction of this Committee. The CLEAR Act could potentially help overcome the economic barriers facing vehicles, fuels and refueling infrastructure. The CLEAR Act, however, in its present form, is of little benefit to government or nonprofit fleets. We are hopeful that this can be corrected before any House or Senate markup. If not corrected, NAFA questions whether Congress should pass the legislation.

The challenge for the Senate Energy Committee will be to think outside the box. Some will urge you to take the easiest course of action, that is to force government agencies and companies to buy AFVs and use the fuels regardless of cost and regardless of the public policy benefit. Mandates have proven to be counterproductive. Too much time and resources have been spent by DOE, other federal and state agencies, fleets, fuel providers and manufacturers to make mandates work, all hoping that mandates will be the silver bullet. Too much has been spent for too little gain.

Thank you again for the opportunity to participate. I will be happy to answer any questions.

The CHAIRMAN. Thank you.

Dr. McCormick, why don't you go right ahead.

STATEMENT OF DR. J. BYRON McCORMICK, PH.D., DIRECTOR, GLOBAL ALTERNATIVE PROPULSION CENTER, GENERAL MOTORS CORPORATION

Dr. MCCORMICK. I want to thank the members of the committee for the opportunity today to speak about General Motors' fuel cell initiative. I am Byron McCormick and I am responsible for GM's fuel cell program.

Based on the recent rate of progress in fuel cell technology, we are on the threshold of an historic opportunity. Instead of the historical evolution of technology by incremental improvements, we

now see our way to bold technology advances that will fundamentally change personal transportation for the new century.

Fuel cell vehicles running on hydrogen fuel are the ultimate environmentally friendly vehicles because the only emission is water. Fuel cell vehicles are more than twice as efficient as internal combustion engines, have no pollutant emissions, and are quiet.

Fuel cell vehicles promise two additional benefits; First, fuel cell vehicles will be supported by a broadly available, cost effective hydrogen refueling infrastructure. Such an infrastructure by its very nature would provide a single enduring framework for the evolutionary shift for personal transportation from petroleum to a mix of energy sources including renewables.

Secondly, the development of this technology will create more environmentally compatible distributed power generation possibilities. Power on today's electric grid could be supplemented by the generating capacity of cars in every driveway. For example, if only one out of 25 cars in California today was a fuel cell vehicle their generating capacity would exceed that of the electric grid in place today.

Recognizing the potential of fuel cells, approximately 4 years ago GM leadership decided to take some rather bold action and consolidated our programs and accelerated them greatly. We did this based on the notion that there are over six billion people in the world today, most of these people are young, they are globally aware, web-connected, and residing in emerging economies.

Secondly, we recognized that only 12 percent of the world's population have access to automobiles today. Therefore, a breakthrough in energy efficiency and emissions would absolutely be required to meet the demands of the future in a sustainable, high quality environment.

So our vision is as follows. We see fuel cells as the automotive power source for the future and we see hydrogen as the long-term fuel. Now, since we have talked a fair amount today about renewables and infrastructure, let me expand on the hydrogen infrastructure for a moment. The creation of a new robust, readily available hydrogen refueling network for these vehicles is clearly necessary.

Hydrogen in the infrastructure could be derived from a mix of sources, including hydrocarbons as well as any source of electricity. In the first case, hydrogen is extracted from petroleum, natural gas, and renewable hydrocarbons such as ethanol via reformers or fuel processors which catalytically decompose the hydrocarbons into hydrogen and carbon dioxide.

Hydrogen can also be extracted from water using electrolysis, which uses electricity to dissociate the water. Electricity could come from conventional powerplants, renewable powerplants such as hydro, solar, wind, and geothermal sources. In this way, hydrogen fuel allows a transition for transportation from a reliance on petroleum to a robust diversity of energy sources including renewable energy.

The blending of these energy sources is seamless to the driver of the vehicle. He sees only hydrogen fuel and not whether it came from petroleum, natural gas, nuclear, or renewable.

To give you an idea of the rate of progress towards that vision, in the last 4 years the size and weight of our fuel cell stack tech-

nology has decreased by approximately a factor of ten. In the past year our gasoline fuel processor technology, which strips hydrogen from gasoline, has decreased by a size factor of three.

Like today's gasoline cars, fuel cell vehicles must be able to handle a tremendous environmental range of conditions. We are now able to start fuel cells from freezing at minus 40 degrees C. in substantially less than a minute and our Hydrogen 1 demonstration fuel cell vehicle covered over 800 miles in one day in the Arizona heat, setting 15 performance and durability records earlier this summer.

This progress is rapid and encouraging, but we are not there yet. We have not yet developed the full automotive performance levels, including reliability, durability, safety, and full compatibility to harsh weather extremes, including the ability to withstand all environmental and in-use abuse that automobiles and trucks are subjected to every day worldwide.

Achieving full automotive performance and affordability targets is key to customer acceptance and enthusiasm. These targets require huge investments that can only be responsibly made if we believe that the hydrogen infrastructure will be there to allow us to introduce fuel cell vehicles to the public. On the other hand, selective demonstration vehicles or captive fleet tests will not suffice to encourage major timely investment by energy producers in that hydrogen infrastructure.

Potential creators of the hydrogen infrastructure will not invest until they see a rapid expansion of hydrogen fuel cell vehicles, and even then there is an economic burden of supporting that infrastructure during the long period of transition from today's gasoline-powered fleets. Stewardship of this transition requires a carefully thought out plan which allows the automotive manufacturers, their materials and component suppliers, and potential hydrogen fuel providers and government regulatory bodies to progress hand in hand. This careful coordination must also take into account the technical, financial, and environmental realities that a successful transition requires.

As a closing thought, I believe that fuel cells and hydrogen-based transportation are the future. The pace of technical progress is accelerating and we cannot be left behind sitting on the sidelines. Now is the time for the U.S. Government and U.S. industry to create a partnership that can lead the world in the change to this vision.

Thank you and I look forward to responding to your questions.

[The prepared statement of Dr. McCormick follows:]

PREPARED STATEMENT OF DR. J. BYRON MCCORMICK, PH.D., DIRECTOR, GLOBAL ALTERNATIVE PROPULSION CENTER, GENERAL MOTORS CORPORATION

I appreciate the opportunity to be here today to testify on behalf of General Motors. I am Byron McCormick, the Director of GM's Global Alternative Propulsion Center. I head the team that is developing fuel cells to power vehicles that people will want to drive and buy.

This is an exciting time in the automotive industry and for General Motors. Technology is clearly changing the way we live our lives for the better, and there's more to come. The subject today is fuel cell technology. This technology, when fully developed and deployed, will not only deliver revolutionary vehicles, but will change the way we think about the automobile and our environment.

We are on the threshold of an historic opportunity. Instead of the historical evolution of technology by incremental improvements, we now see our way to bold technology advances that will fundamentally change personal transportation for the new century. These advances have the potential to lead to the creation of commercially viable zero-emission, fuel-efficient fuel-cell vehicles with the functionality that Americans expect. Not only will fuel cells essentially remove the auto from the environmental equation by reducing tailpipe emissions to only water vapor and potentially shifting vehicles to renewable fuels—they will also offer the performance required for every type of vehicle: heavy duty commercial, sport utilities, trucks, mass transit or cars.

Fuel-cell vehicles running on hydrogen fuel are the ultimate environmentally friendly vehicles because the only emission is water. The fuel cell supplies electricity to an electric motor that powers the wheels. The fuel cell produces electricity by stripping electrons from hydrogen that travels through a membrane to combine with oxygen to form water. Fuel-cell vehicles are more than twice as energy efficient as the internal combustion engine, have no pollutant emissions, and are quiet.

Beyond the advantages for vehicles, fuel cells in vehicles promise two additional benefits. First, once fully integrated into our daily lives, fuel-cell vehicles will be supported by a broadly available, cost-effective hydrogen-refueling infrastructure. Such an infrastructure by its very nature would provide an evolutionary shift of personal transportation from petroleum to a mix of energy sources including renewables.

Secondly, the development of this technology will create new more environmentally compatible distributed electric power generation possibilities. The automobile will have the potential to provide electrical power to homes and worksites. Power on today's electrical grid could be supplemented by the generating capacity of cars in every driveway. For example, if only one out of every 25 cars in California today was a fuel-cell vehicle, their generating capacity would exceed that of the utility grid. A typical mid-size fuel-cell vehicle would produce 50 to 75 kilowatts of electrical power, where a typical household may use 7 to 10 kilowatts at peak load.

Like any advancement that has the promise to completely change the dominant technology, fuel cell development is a major, costly, technical endeavor, which—if aggressively undertaken and sustained—should allow significant implementation in the 10 to 20 year timeframe. Our rate of progress today is very rapid. With an uninterrupted focus, our technological momentum should make this fuel cell vision possible.

It is clear that we are in an intense global competition for leadership in this race to establish and commercialize fuel cell technologies. Toyota, Honda, Daimler, Ford, Volkswagen, Nissan, PSA, Hyndai, GM and others all have large programs. In Japan the Kyogikai, which are companies operating under government auspices, is developing a program for the implementation of fuel cell technology. Now is the time for the U.S. government and U.S. industry to create a partnership that can lead the world in the charge to achieve this vision.

Before I talk specifics, I should note for the record that the opportunity we are discussing today would not be possible without the long-term support of the Senators from New Mexico and the support of ERDA and then the DOE. The fledgling "fuel cells for transportation program" at Los Alamos National Laboratories—which I initiated, then headed from the mid 1970's through the 1980's—along with PEM fuel cell technology provided the technical spark for the recent worldwide explosion of PEM fuel cell activities.

Recognizing this potential, approximately four years ago at General Motors fuel cell activities were consolidated and accelerated. We were given one mandate by our management: Take the automobile out of the environmental debate. Regardless of whether the environmental debate is focused on air quality, climate, or overall sustainability, GM leadership recognizes that global conditions inspire bold, thoughtful action.

1. There are over 6 billion people in the world today with over 10 billion expected later this century. Most of these people are young, globally aware, web-connected, and residing in emerging economies with escalating demand for personal transportation.

2. Only 12 percent of the world's population has automobiles today. Therefore a breakthrough in energy efficiency and emissions will be required to meet the demands of the future in a sustainable high-quality environment.

Our vision is as follows:

1. We see fuel cells as the long-term power source. The GM global fuel cell program seeks to create affordable, full-performance, fuel-cell-powered vehicles that meet customer preferences and demands and emit only water vapor from their tail-

pipes. Such vehicles would be 50 to 100 percent more energy efficient than today's vehicles depending on design and drive cycle.

2. We see hydrogen as the long-term fuel. The creation of a robust, readily available hydrogen-refueling network for those vehicles will be accessible through refueling stations, as gasoline is dispensed today. Hydrogen in the infrastructure could be derived from a mix of sources including: 1) hydrocarbons; and 2) from any source of electricity.

In the first case, hydrogen is extracted from petroleum, natural gas and renewable hydrocarbons, such as ethanol, via "reformers" or fuel processors, which catalytically decompose the hydrocarbons into hydrogen and carbon dioxide.

Hydrogen can also be extracted from water using electrolysis, which uses electricity to dissociate water. Electricity would come from conventional power plants or renewable power such as hydro, solar, wind and geothermal sources. In this way hydrogen fuel allows a transition of transportation from reliance on petroleum to a robust diversity of energy sources including renewable energy. The blending of these energy sources is seamless to the driver of a vehicle; he sees only hydrogen fuel, not whether it came from petroleum, natural gas, nuclear or renewable energy.

There are three major challenges that we need to overcome to make this hydrogen economy a reality:

First, we need continued significant development in on-board hydrogen storage. Using hydrogen in a vehicle requires a completely new type of fuel tank. The challenge is to find a lightweight, compact tank that stores enough hydrogen at modest pressure for a lengthy drive.

Last month we took a major step toward clearing this hurdle. GM is acquiring a substantial minority ownership in QUANTUM Technologies. They are the industry leader in automotive hydrogen storage. QUANTUM Technologies has achieved performance that could allow us to introduce a fuel-cell vehicle in the future that will have a range equal to today's vehicles.

But we should not limit ourselves to partnerships between private companies. We need the government to partner with us on fundamental, long-term research and development as well. And not just on storage of hydrogen, but a full portfolio of technologies.

And that includes our second major challenge to a hydrogen economy developing clean and efficient methods of producing hydrogen. There are many substances from which hydrogen can be released, but it takes energy to do it. Eventually, we want to use a method that is renewable, and that has no adverse environmental impact. We're working closely with energy suppliers to investigate the best solutions.

The third challenge we have to overcome is developing business models for the deployment of a hydrogen infrastructure, and piloting technologies to support it. To address this GM joined with General Hydrogen's Geoffrey Ballard to announce last month a 25-year alliance between our companies.

As for the reality of this vision, we at GM have invested aggressively in what are called "enabling" technologies: fuel cells, reformers, electrolyzers and automotive electric propulsion. Our commitment is clear in the significance of our investment—over $100 million annually for several years to date, and growing. The acceleration has been spurred on by rapid technical progress.

To give you an idea of that rate of progress, in the last 4 years the size and weight of our fuel cell stack for a given power has decreased by a factor of 10. In the past year, our gasoline fuel processor has decreased in size by a factor of 3.

Like today's gasoline cars, fuel-cell vehicles must be able to handle a tremendous range of environmental conditions. We are now able to start fuel cells from freezing—minus 40°C—in substantially less than a minute, and our Hydrogen One demonstration fuel-cell vehicle covered over 800 miles in one day in the Arizona heat, setting 15 performance and durability records earlier this summer.

These milestones represent remarkable progress. Our rate of progress encourages us, but it is crucial to recognize that the race for fuel cell development is a marathon, not a sprint. No one should overlook that there remain major technical obstacles that must be conquered before these vehicles can be brought to market and can become commercially successful.

Let me be clear about the progress represented by fuel cell demonstration vehicles. The progress is rapid and encouraging, but we are not there yet. No one has achieved full automotive performance levels including reliability, durability, safety and full capability in harsh weather extremes including the ability to withstand all environment and in-use abuse that automobiles and trucks worldwide are subjected to every day. We must achieve these goals and affordability before this technology will be considered an option by our customers.

Achieving full automotive performance and affordability targets is key to customer acceptance and enthusiasm. These targets require huge investments that can only

be responsibly made if we believe the infrastructure will be there to allow us to introduce fuel-cell vehicles to the public. Government policy today must drive the development of the hydrogen economy by accelerated R&D in hydrogen storage, pilot scale distribution networks and refueling stations and incentives for their proliferation.

Selective demonstration vehicles or captive fleet tests will not suffice to encourage major timely investment by the energy producers and the full automotive supply base before a hydrogen infrastructure is seen to be evolving. Nor will potential creators of the hydrogen infrastructure invest until they see a rapid expansion of hydrogen fuel-cell vehicles and even then, there is the economic burden of supporting that infrastructure during the long period of transition from today's gasoline-powered fleet.

Stewardship of this transition requires a carefully thought out plan which allows the automotive manufacturers, their material and component suppliers, the hydrogen fuel providers and governmental regulatory bodies to progress hand-in-hand. This careful coordination must also take into account the technical, financial and environmental realities that a successful transition requires.

This is the basis on which a government-industry partnership must be based.

In General Motors, the magnitude of our fuel cell investment creates an intense business dilemma—the choice between using our resources to meet the expanding funding needs to achieve a revolutionary vision at the expense of short-term focused initiatives, or to fund the aggressive pursuit of more incrementally focused initiatives.

To a large degree, the outcome of that internal debate will depend on the development of a long-term, stable set of governmental policies and initiatives upon which we can properly balance the investment of our finite financial and technical resources.

As a closing thought, I believe that fuel cells and hydrogen-based transportation are the future. The pace of technical progress is accelerating. We cannot be left behind or sitting on the sidelines. Now is the time for the U.S. government and U.S. industry to create a partnership that can lead the world in the charge to achieve this vision.

Thank you.

I look forward to responding to your questions.

The CHAIRMAN. Thank you very much.

Mr. Dana, why don't you go right ahead.

STATEMENT OF GREGORY DANA, VICE PRESIDENT, ENVIRONMENTAL AFFAIRS, ALLIANCE OF AUTOMOBILE MANUFACTURERS

Mr. DANA. Mr. Chairman and members of the committee: On behalf of the 13 members of the Alliance of Automobile Manufacturers, it is a pleasure to be here today to provide the committee with our position on the role of cars and light trucks in our national energy policy.

Today I would like to make three basic points: First, existing energy policies are not delivering anticipated results. That is why we are sitting here today.

Second, to be successful we must maintain consumer focus, because consumers determine fuel economy every day through their purchasing decisions on dealers' lots.

Third, with your help, we can increase the fuel economy of the fleet and meet consumer demands by accelerating the introduction of advanced technology fuel efficient vehicles.

Let me expand on these points. We are a mobile society. Today transportation accounts for nearly two-thirds of all oil consumption and it is almost 97 percent dependent on petroleum.

Automakers are working to increase fuel efficiency. Auto manufacturers have consistently increased the fuel efficiency of their models since the 1970's. According to EPA data, fuel efficiency has

increased steadily at nearly 2 percent a year on average from 1975 to 2001 for both cars and light trucks. This fuel efficiency is a measure of how effectively a vehicle uses energy from fuel.

While car and light truck fuel efficiency continue to increase, their combined fuel economy has stabilized, for one reason: Consumers are in the driver's seat when it comes to determining fuel economy. This is the demand side of the equation.

Today, you are in the role of policymakers, but you are also consumers. Like millions of consumers nationwide, you may also value advanced safety features, passenger room, towing capacity, cargo carrying capacity, utility, comfort and performance. In fact, most consumers want it all. In surveys, consumers indicate they want greater fuel economy, but in their purchases they do not want to sacrifice size, safety, cargo room, acceleration, or other vehicle attributes to get it.

Today, manufacturers offer more than 50 models with fuel efficiency ratings above 30 miles per gallon. We also offer vehicles that achieve 40 miles per gallon or greater, but these highly fuel efficient vehicles account for less than 2 percent of sales.

The auto industry strongly believes that technology will allow us to address energy conservation goals and still provide consumers with vehicles that meet their family and business needs. That is why we support the alternative fuel and advanced technology provisions in Vice President Cheney's national energy policy.

We also support the tax credit provisions in Senator Hatch's bill, S. 760, the Clean, Efficient Automobiles Resulting from Advanced Car Technologies, or the CLEAR ACT of 2001. The CLEAR ACT would provide tax incentives for fuel cells, hybrid electric vehicles, battery electric vehicles, and dedicated alternative fuel vehicles, along with alternative fuel and alternative fuel infrastructure tax incentives.

We are working on slight modifications to the hybrid electric vehicle tax credits and we would like to see the tax credits for the introduction of advanced lean burn technology.

The CLEAR ACT is timely legislation. New technologies have set the stage for transforming the auto industry. Today you can purchase alternative fuel vehicles from subcompacts to SUV's to pickups. Alliance members are developing and introducing hybrid electric cars, SUV's and pickups that can increase city fuel economy by up to 200 percent. Automakers are working on the next generation of lean burn technology to ensure compliance with new, more stringent emission standards, and major manufacturers are investing hundreds of millions of dollars in research and development to bring fuel cell vehicles to market within 5 to 10 years.

Mr. Chairman, we support consumer tax credits for a limited time, 6 years, and we support extending the tax credit for fuel cells to 10 years. These credits will accelerate the market penetration of highly fuel efficient vehicles. As a result, manufacturers can increase production and lower costs for consumers. Consumers will have more fuel efficient vehicles with the attributes they desire and policymakers will see increases in fuel economy.

In conclusion, as we go forward we must maintain consumer focus and tax credits will accelerate the market penetration of highly fuel efficient vehicles that consumers will buy.

Thank you, Mr. Chairman. I would be happy to answer any questions.

[The prepared statement of Mr. Dana follows:]

PREPARED STATEMENT OF GREGORY DANA, VICE PRESIDENT, ENVIRONMENTAL AFFAIRS, ALLIANCE OF AUTOMOBILE MANUFACTURERS

Mr. Chairman, thank you for the opportunity to testify before your Committee regarding energy policy issues. My name is Gregory Dana and I am Vice President, Environmental Affairs of the Alliance of Automobile Manufacturers, a trade association of 13 car and light-truck manufacturers. Our member companies include BMW of North America, Inc., DaimlerChrysler Corporation, Fiat, Ford Motor Company, General Motors Corporation, Isuzu Motors of America, Mazda, Mitsubishi, Nissan North America, Porsche, Toyota Motor North America, Volkswagen of America, and Volvo.

Alliance member companies have more than 620,000 employees in the United States, with more than 250 manufacturing facilities in 35 states. Overall, a recent University of Michigan study found that the entire automobile industry creates more than 6.6 million direct and spin-off jobs in all 50 states and produces almost $243 billion in payroll compensation annually.

The Alliance supports efforts to create an effective energy policy based on broad, market-oriented principles. Policies that promote research development and deployment of advanced technologies and provide customer based incentives to accelerate demand of these advanced technologies set the foundation. This focus on bringing advanced technologies to market leverages the intense competition of the automobile manufacturers worldwide. Incentives will help consumers overcome the initial cost barriers of advanced technologies during early market introduction and increase demand, bringing more energy efficient vehicles into the marketplace.

Congress needs to consider new approaches for the 21st century. The Alliance and its 13 member companies believe that the best approach for improved fuel efficiency is to aggressively promote the development of advanced technologies—through cooperative, public/private research programs and competitive development—and incentives to help pull the technologies into the marketplace as rapidly as possible. We know that advanced technologies with the potential for major fuel economy gains are possible. As a nation, we need to get these technologies on the road as soon as possible in an effort to reach the national energy goals as fast and as efficiently as we can.

The Alliance is pleased that Vice President Cheney's National Energy Policy report recommends and supports a tax credit for advanced technology vehicles (ATVs). Specifically, it proposes a tax credit for consumers who purchase a new hybrid or fuel cell vehicle between 2002 and 2007. In addition, the report supported the broader use of alternative fuel and alternative vehicles. This is consistent with the Alliance's position of supporting enactment of tax credits for consumers to help offset the initial higher costs of advanced technology and alternative fuel vehicles until more advancements and greater volumes make them less expensive to produce and purchase.

Senate legislation that has been crafted to spur the sale of advanced technology fuel-efficient vehicles is included in S. 389, introduced by Senator Murkowski. This legislation would (1) provide tax credits for the purchase of alternative fuel and hybrid vehicles, (2) modify the existing tax credit for electric vehicles, (3) extend the dual fuel CAFE credit, (4) provide a business tax credit for alternative fuels sold at retail, (5) extend for three years the tax deduction for alternative fuel refueling property and add a new deduction for this property, (6) allow states to open HOV lanes to alternative fuel vehicles, (7) allow DOE to provide equivalent alternative fuel vehicle credits to fleets or persons that invest in alternative fuel refueling infrastructure, (8) establish a federal grant program for local governments addressing the incremental cots of qualified alternative fuel vehicles, and (9) require federal agencies to increase the fuel efficiency of newly purchased federal vehicles.

Many of the provisions in S. 389 are included in S. 760 introduced by Senator Hatch and others. The Alliance is in general support of S. 760, but would like to see some minor, technical changes made to the hybrid-electric vehicle section of the bill and would also support the inclusion of tax credits for advanced lean burn technology. The Alliance believes that the overall concepts and provisions found in S. 760 are the right approach and would benefit American consumers.

The bill would ensure that advanced technology is used to improve fuel economy. Performance incentives tied to improved fuel economy are incorporated into the legislation in order for a vehicle to be eligible for the tax credits. These performance

incentives are added to a base credit that is provided for introducing the technologies into the marketplace.

Specifically, S. 760 has a number of important provisions addressing various types of advanced technologies. These include:

Fuel Cell Vehicles

The most promising long-term technology offers breakthrough fuel economy improvements, zero emissions and a shift away from petroleum-based fuels. A $4,000 base credit is included along with performance based fuel economy incentives of up to an additional $4,000. The credit is available for 10 years to accelerate introduction—extremely low volume production is expected to begin in the 2005-2007 timeframe.

Hybrid Vehicles

Electronics that integrate electric drive with an internal combustion engine offer near term improvements in fuel economy. A credit of up to $1,000 for the amount of electric drive power is included along with up to $3,000 depending upon fuel economy performance. The credit is available for 6 years to accelerate consumer demand as these vehicles become available in the market and set the stage for sustainable growth. To be eligible for the credit, hybrid vehicles must meet or beat the average emission level for light duty vehicles.

Dedicated Alternative Fuel Vehicles

Vehicles capable of running solely on alternative fuels, such as natural gas, LPG, and LNG, promote energy diversity and significant emission reductions. A base credit of up to $2,500 is included with an additional $1,500 for vehicles certified to "Super Ultra Low Emission" standards (SULEV).

Battery Electric Vehicles

Vehicles that utilize stored energy from "plug-in" rechargeable batteries offer zero emissions. A base credit of $4,000 is included (similar to the fuel cell—both have full electric drive systems) and an incremental $2,000 is available for vehicles with extended range or payload capabilities.

Alternative Fuel Incentives

Alternative fuels such as natural gas, LNG, LPG, hydrogen, B100 (biomass) and methanol are primarily used in alternative fueled vehicles and fuel cell vehicles. To encourage the installation of distribution points to support these vehicle applications, a credit of $0.50 for every gallon of gas equivalent is provided to the retail distributor. This credit is available for 6 years and will support the distribution of these fuels as vehicle volume grows and may be passed on to the consumer by the retail outlet. Note that ethanol is not included in these provisions due to the existing ethanol credit.

Alternative Fuel Infrastructure

Complementary to the credit for the fuel itself, the existing $100,000 tax deduction for infrastructure is extended for 10 years and a credit for actual costs up to $30,000 for the installation cost of alternative fuel sites available to the public is included. One of the key hurdles to overcome in commercializing alternative fuel vehicles is the lack of fueling infrastructure. For nearly a century, infrastructure has focused primarily on gasoline and diesel products. These infrastructure and fuel incentives will help the distributors overcome the costs to establish the alternative fuel outlets and support distributors during initial lower sales volumes as the number of alternative fuel vehicles increases.

To reiterate, the way to improve vehicle and fleet fuel economy, one that is in tune with consumer preferences, is to encourage the development and purchase of advanced technology vehicles (ATVs). Consumers are in the driver's seat and most independent surveys show that Americans place a high priority on performance, safety, space and other issues with fuel economy ranking much lower even with today's gas prices. ATVs hold great promise for increases in fuel efficiency without sacrificing the other vehicle attributes consumers desire. Just as important, the technology is transparent to the customer.

Member companies of the Alliance have invested billions of dollars in research and development of more fuel-efficient vehicles. Automobile companies around the globe have dedicated substantial resources to bringing cutting-edge technologies—electric, fuel cell, and hybrid electric vehicles as well as alternative fuel vehicles and powertrain improvements—to the marketplace. These investments will play a huge role in meeting our nation's energy and environmental goals.

These advanced technology vehicles are more expensive than their gasoline counterparts during early market introduction. As I mentioned earlier, the Alliance is supportive of Congressional legislation that would provide for personal and business end-user tax incentives for the purchase of advanced technology and alternative fuel vehicles. Make no mistake: across the board, tax credits will not completely cover the incremental costs of new advanced technology. However, it will make consumers more comfortable with accepting the technology and begin to change purchasing behavior. In short, tax credits will help bridge the gap towards winning broad acceptance among the public leading to greater volume and sales figures throughout the entire vehicle fleet. This type of incentive will help "jump start" market penetration and support broad energy efficiency and diversity goals.

Some of the discussion today has centered on the vehicles of the automobile manufacturers. But it is important not to forget about a vital component for any vehicle—the fuel upon which it operates. As automakers looking at the competing regulatory challenges for our products—fuel efficiency, safety and emissions—and attempting to move forward with advanced technologies, we must have the best possible and cleanest fuels. EPA has begun to address gasoline quality but it needs to get even cleaner. This is important because gasoline will remain the prevalent fuel for years to come and may eventually be used for fuel cell technology.

Beyond gasoline, the auto industry is working with a variety of suppliers of alternative fuels. In fact, the industry already offers more than 25 vehicles powered by alternative fuels. More than 1 million of these vehicles are on the road today and more are coming. Today, we find vehicles that use:

- Natural gas, which reduces carbon monoxide emissions by 65 to 90 percent;
- Ethanol, which produces fewer organic and toxic emissions than gasoline with the longer term potential to substantially reduce greenhouse gases;
- Liquefied petroleum gas (propane), the most prevalent of the alternative fuels, which saves about 60% VOC emissions; and
- For the future, hydrogen, which has the potential to emit nearly zero pollutants.

The Alliance has submitted comments to the DOT in support of an extension of the dual fuel vehicle incentives through 2008. Current law provides CAFE credits—up to 1.2 mpg—for manufacturers that produce vehicles with dual fuel capability. These vehicles can operate on either gasoline or domestically produced alternative and renewable fuels, such as ethanol. However, the dual fuel credits end in model year 2004 unless extended via rulemaking by the National Highway Traffic Safety Administration. The Alliance believes an extension is important so that these vehicles continue to be produced in high volume to help encourage the expansion of the refueling infrastructure and giving consumers an alternative to gasoline.

In addition to alternative fuels, companies are constantly evaluating fuel-efficient technologies used in other countries to see if they can be made to comply with regulatory requirements in the United States. One such technology is diesel engines, using lean-burn technology, which have gained wide acceptance in Europe and other countries. Automakers have been developing a new generation of highly fuel-efficient clean diesel vehicles using turbocharged direct injection engines as a way to significantly increase fuel economy and reduce greenhouse gas emissions. However, their use in the U.S. must be enabled by significantly cleaner diesel fuel.

Earlier this year, EPA promulgated its heavy-duty diesel rule that the Alliance supports, as far as it goes. The rule reduces the amount of sulfur in the fuel. Low sulfur diesel fuel is necessary to enable the new clean diesel technology to be used in future cars and light trucks. Providing cleaner fuels, including lowering sulfur levels in gasoline and diesel fuel, will provide emission benefits in existing on-road vehicles. Sulfur contaminates emissions control equipment, such as catalytic converters. Efforts to reduce sulfur content will provide environmental benefits and allow vehicles to operate more efficiently. Unless there are assurances that fuels will be available, companies will not invest in new clean diesel technologies.

As you can tell, the automobile companies—from the top executives to the lab engineers—are constantly competing for the next breakthrough innovation. If I can leave one message with the Committee today, it is to stress that all manufacturers have advanced technology programs to improve vehicle fuel efficiency, lower emissions and increase motor vehicle safety. These are not "pie in the sky" concepts on a drawing board. In fact, many companies have advanced technology vehicles in the marketplace right now or have announced production plans for the near future. That's why now is the perfect time for the enactment of tax credits to help spur consumers to purchase these new vehicles which years of research and development have made possible.

Thank you for the opportunity to testify before the Committee today. I would be happy to answer any questions you may have.

The CHAIRMAN. Thank you very much.

Mr. Kolodziej.

STATEMENT OF RICHARD R. KOLODZIEJ, PRESIDENT, NATURAL GAS VEHICLE COALITION

Mr. KOLODZIEJ. Excellent.

The Natural Gas Vehicle Coalition appreciates the opportunity to be here this morning to discuss our views on the actions that Congress can and should take to reduce America's use of foreign oil by accelerating the purchase and use of alternative fuel vehicles. The Natural Gas Vehicle Coalition is a national organization with more than 180 member companies ranging from natural gas utilities to major automobile manufacturers to other equipment and service providers to environmental organizations and government organizations.

Mr. Chairman, it is vitally important that we increase the use of non-petroleum alternative motor fuels, especially natural gas, because doing so would help address at least two important national public policy priorities simultaneously. First is the issue that we have already talked about, dependence on foreign oil. Natural gas vehicles contribute directly to reducing our dependence on foreign oil. The U.S. imports significantly more petroleum today than it did in 1992 when the Energy Policy Act was passed, and that is just not good public policy. It is not good for the country.

The only way to break free of that reliance on petroleum fuels is to increase the use of non-petroleum alternative fuels. Efforts to increase fuel efficiency, while laudable and important and we have got to do that, will not by themselves improve energy security. A gasoline or diesel vehicle that gets 60 or even 80 miles per gallon is still 100 percent dependent on petroleum.

The second way America benefits from increased use of NGVs is the environment. Compared to similar gasoline vehicles, NGVs produce far less carbon monoxide and volatile organic compounds and nitrogen oxides. They even produce 20 percent less greenhouse gases. Meanwhile, heavy duty vehicles are not necessarily the focus of this session today, but heavy duty vehicles produce far less NO_X and up to 90 percent less particulates than a comparable diesel vehicle. In fact, heavy duty natural gas vehicles already meet the particulate levels called for in EPA's emissions standards that do not even go into effect until 2007. They also produce significantly less air toxics, which may in fact become the air quality issue of this decade.

Today, there are over 100,000 natural gas vehicles on America's roads. There are over a million and a half worldwide, and the vehicles in America displace more than 100 million gallons of gasoline a year. The United States produces the best and the cleanest NGVs in the world and right now we have more alternative fuel vehicle models available than ever before. We have made great progress, but we have a long way to go.

Consumers continue, as you have heard, to be hesitant to buy these vehicles because of the additional costs involved and the lack of a fueling infrastructure. Both these problems would be resolved if vehicle demand reached a critical mass. If we reach the critical mass, we get economies of scale for the manufacturers. If we get

economies of scale for the manufacturers, we would come down on our costs.

Because of the substantial public benefits that NGVs offer, Congress could and should take steps to make this overall improvement happen, and in our written testimony we have indicated a number of recommendations. The single most important step would be the passage of the CLEAR ACT, S. 760. I loved hearing all those positive things earlier about S. 760. The CLEAR ACT would be a meaningful tax program, tax incentive program, that would provide a market-driven, non-regulatory approach to the purchase and use of alternative fuel vehicles.

Now, we recognize that the CLEAR ACT is not within the jurisdiction of this committee. However, we believe that it is crucial that the energy policymakers on this committee send a clear and unambiguous message that enactment into law of the provisions of the CLEAR ACT is a critical part of our national energy strategy and is in the best interest of the country.

The NGV Coalition also believes that the Energy Policy Act must be restructured. While that law has had a big impact on getting automakers to produce alternative fuel vehicle models, as was mentioned earlier, it has not achieved anywhere near the petroleum replacement goals envisioned. In our written testimony we indicate a program, a number of specific recommendations that would build on the positive achievements of EPAct, increase the amount of alternative fuel used and therefore foreign oil displaced, and increase the amount of flexibility available to the covered fleets to help them more effectively comply with the law.

A third area is R&D. Federally sponsored NGV R&D has been critical to the NGV industry's technical advancements, and the industry has worked closely with the Department of Energy to develop a comprehensive 5-year NGV R&D strategic plan. Unfortunately, the Department has never requested sufficient funds to implement the Federal Government's part of that plan, instead focusing, we believe disproportionately, on funding diesel and gasoline projects.

We urge the committee to instruct DOE to substantially expand the NGV program to bring it into line with the 5-year plan we have jointly developed, especially with respect to natural gas as a fuel for hybrid vehicles and as a hydrogen source for fuel cells.

Mr. Chairman, that concludes my remarks. Our written comments include other recommendations concerning programs that would help further the use of alternative motor fuels and I look forward to working with you and the committee on implementing this program.

[The prepared statement of Mr. Kolodziej follows:]

PREPARED STATEMENT OF RICHARD R. KOLODZIEJ, PRESIDENT, NATURAL GAS VEHICLE COALITION

INTRODUCTION

Mr. Chairman and Members of the Committee, the Natural Gas Vehicle Coalition (NGVC) appreciates the opportunity to discuss our views on the actions Congress can and should take to reduce America's use of foreign oil by accelerating the purchase and use of alternative fuel vehicles. My name is Rich Kolodziej, and I am President of the NGVC. The NGVC is a national organization dedicated to the development of a growing, sustainable and profitable natural gas vehicle market. The

NGVC represents more than 180 natural gas companies, equipment manufacturers and service providers, as well as environmental groups and government organizations.

Reducing the use of petroleum by increasing the use of non-petroleum alternative motor fuels should be among the highest policy priorities of the federal government for at least two fundamental reasons. First, the lack of stability and competition in oil markets and the continued growth in oil imports demonstrate beyond doubt that it is time to get serious about reducing our reliance on oil imports. The oil producing nations are in a monopoly position, and we are held hostage to their decisions about production levels. American consumers must be provided a choice.

Second, too many Americans live in urban areas with poor air quality. It is estimated that more than 100 million Americans live in areas that are not in compliance with national ambient air quality standards. The result has been an alarming increase in the incidence of asthma and other respiratory ailments in children and the elderly. Increasing the use of alternative fuel vehicles—especially natural gas vehicles—helps address both these policy priorities simultaneously.

Now is the time to take action. Today, there are more alternative fuel vehicles (AFVs) in operation and models available than at any time before. Domestic natural gas is readily available. State and local governments across the country are adopting legislative incentives that will help pave the way toward more AFVs. In addition to the introduction of these vehicles, federal, state and local incentives also have encouraged increased investment in alternative fuel infrastructure. However, no one state or group of states alone can significantly alter the direction of any major national industry, such as the motor vehicle industry.

Therefore, while the future for alternative fuel transportation technologies appears bright, much more must be done at the national level if we are to significantly reduce this country's reliance on imported oil, improve our air quality and develop profitable alternative fuel vehicle markets. Since consumers continue to be hesitant to buy many AFVs because of the costs involved and the lack of infrastructure, Congress needs to expand incentives for all alternative fuels, including measures that will bring down the cost of acquiring AFVs and purchasing alternative fuels. Congress also should adopt incentives that support the expansion of the alternative fuel infrastructure and reduce the incremental costs involved.

1. THE NEED TO REDUCE OUR DEPENDENCE ON FOREIGN OIL IS GREATER THAN EVER

The U.S. imports significantly more petroleum today than it did in 1992 when the Energy Policy Act (EPAct) was enacted. Net imports are up more than 2.8 million barrels a day while domestic production has declined by nearly 1.3 million barrels a day. The combination of lower domestic production and increased demand means that oil imports also make up a larger share of total oil consumed in the US. In 1992, crude oil imports made up approximately 45 percent of domestic supply. Last year, crude oil imports accounted for 59 percent of total supply. The Energy Information Administration's (EIA) 2001 Annual Energy Outlook forecasts that oil imports will approach 61 percent of total supply this year. EIA's long-term forecast has oil imports making up 69 percent of U.S. supply by 2010, and more than 71 percent by 2020.

Persian Gulf and OPEC member countries supply an important part of U.S. crude oil and petroleum imports. The EIA reports that in 1999 the U.S. relied on OPEC members to provide approximately 46 percent of imported petroleum; Persian Gulf states alone provided approximately 23 percent of total imports. While EIA's long-term forecast shows OPEC continuing to provide about 46 percent of U.S. petroleum demand in 2020, the forecast shows Persian Gulf exports becoming a much more significant part of OPEC exports to the US, rising from 39 percent to 50 percent.

OPEC and Persian Gulf exports also make up a major component of world oil supply. OPEC members currently provide about 40 percent of worldwide supply. OPEC's share of the world oil market is expected to reach 51 percent by 2020, according to EIA's forecast. Persian Gulf oil is even more key to world oil supplies. Persian Gulf exports in particular are of concern since this region has generally been unstable and continues to be the source of geopolitical conflicts.

Of particular concern is Iraq, which continues to be the wild card in international oil markets. Iraqi currently has an oil production capacity of 3.0 million barrels of oil per day. This represents nearly four percent of world oil production. This is a significant volume of oil and its removal from international markets at a time when reserve stocks are low could significantly affect world oil prices. Over the next two decades, the EIA projects that Iraq will more than double its oil production, ensuring that it continues to be an important player in international oil markets.

The recent curtailment of world oil production by OPEC members demonstrates the serious consequences of even small disruptions in the supply of oil to international markets, and proves that OPEC is capable of acting cohesively to control international oil markets. It is precisely because of their growing market power that they have been able to affect world oil prices. As recent events demonstrate, the economic effect of supply disruptions is not limited to any one region but rather reverberates across international commodity markets. The notion that the U.S. can increase its energy security by reducing its overall reliance on OPEC oil simply is not true. Disruptions of oil supplies from the Persian Gulf and from OPEC members will still result in much higher prices being paid for oil imports regardless of their country of origin. In addition, while the market share for petroleum in the America's residential, commercial, industrial and power generation markets has declined substantially over the past 25 years, petroleum still has a virtual monopoly in our transportation sector.

An additional concern is the growing demand for oil by developing nations. It is estimated that by 2020 demand for oil worldwide will increase by over 50 percent. Much of this will occur because of economic expansion and growing vehicle populations in developing nations, especially China. This increased demand is expected to place significant upward pressure on world oil prices.

U.S. reliance on foreign oil has a significant impact on our economy. Petroleum imports result in fewer dollars spent at home and more sent overseas. Payments for imported petroleum jumped from $60 billion in 1999 to more than $100 billion in 2000, according to EIA.

2. EPACT'S PETROLEUM DISPLACEMENT GOALS HAVE NOT BEEN ACHIEVED

To combat our reliance on oil imports, EPAct set a national goal of replacing 10 and 30 percent of the petroleum used in light duty vehicles with non-petroleum alternative fuels by 2000 and 2010, respectively. EPAct was intended to create a viable alternative fuels market. Its goal was to reduce U.S. petroleum and crude oil imports and increase energy security by promoting reliance on domestic fuels.

A report released last year by the U.S. General Accounting (GAO) indicates that unfortunately today, even after almost nine years of EPAct implementation, alternative fuel use accounts for a very small amount of overall motor fuel demand. According to the 1998 figures compiled by the GAO, total alternative fuel use—including the oxygenated blending stocks for gasoline—accounts for less than 4 percent of all highway gasoline use. This is far short of the EPAct goal of 10 percent displacement by 2000. The amount of alternative fuel that is used in AFVs is even less. GAO reports that alternative fuel use in AFVs displaced only about 334 million gallons of gasoline or less than 0.3 percent of total gasoline consumption. The vast majority of the remaining amounts of non-petroleum fuel used in the country are comprised of MTBE or ethanol that is added to gasoline to meet the reformulated gasoline requirements of the Clean Air Act.

3. THE TRANSPORTATION SECTOR: THE KEY TO ENERGY SECURITY

Concerns about energy security and the transportation sector's reliance on petroleum motor fuels led to the passage of EPAct. While the effort to increase alternative fuel use and to reduce the transportation sector's reliance on petroleum motor fuels has been disappointing, EPAct has nevertheless resulted in a number of positive developments. Today, the type and number of alternative fuel vehicles being sold, as well as the number of alternative fuel stations, has grown. The U.S. is the world leader in the field of alternative fuel vehicles and fueling infrastructure. The U.S. automakers should be commended for their impressive array of low polluting, AFVs. Yet, still more must be done.

Since the 1970s, all major energy-consuming sectors other than transportation have significantly reduced their dependence on petroleum. Today, the transportation sector remains almost totally dependent on petroleum motor fuels. The U.S. transportation sector is responsible for more than two-thirds of all petroleum consumption and an astonishing 15 percent of world oil demand. The only way to break free of the reliance on petroleum fuels is to increase the use of alternative fuels. Efforts to increase fuel efficiency in gasoline and diesel vehicles are laudable and must be a continuing part of a national energy strategy. However, increased fuel efficiency for gasoline and diesel vehicles alone will not improve our country's energy security. Improving fuel efficiency will simply slow-down the current growth in oil consumption. Fuel efficiency does not provide energy consumers with options for fueling their vehicles. A gasoline or diesel vehicle that gets 60 or even 80 miles per gallon is still 100 percent reliant on petroleum supplies.

Increasing the use of alternative fuels will provide consumers with real options when it comes to supply disruptions or price hikes. We cannot wait for the next supply disruption or price spike to create the necessary fueling infrastructure. Those efforts must begin now. Given the significant amount of energy consumed by the domestic transportation sector, a strong U.S. market for alternative fuels would put downward pressure on international oil prices. In addition, exports of U.S. alternative fuels technologies would not only bolster our own economy but would further reduce world-wide dependence on foreign oil, further lessening the market power of certain oil exporting nations. News of growing international interest in alternative fuels increases daily. Countries such as Argentina, China, Chile, Egypt, India and Mexico increasingly are looking at alternative fuels to combat air pollution and reduce oil imports.

4. THE CURRENT NATURAL GAS VEHICLE MARKET

There are more than 100,000 natural gas vehicles in-use today. These vehicles are owned and operated by the federal government, local and state governments, and, increasingly, private fleets. These vehicles include passenger cars, light duty trucks, school buses, transit buses, refuse haulers, and many other types of vehicles. It is important to note that nearly all of the new NGVs placed in-service today are produced by original equipment manufacturers (OEMs). Such well-known companies as DaimlerChrysler, Ford Motor Company, General Motors, Honda, Toyota, Blue Bird, and Freightliner are manufacturing these vehicles. Nearly every manufacturer of transit buses now offers a line-up of natural gas buses. In addition, heavy-duty natural gas engines are now available from Caterpillar, Cummins, Detroit Diesel, John Deere and Mack.

While the number of NGVs in-use is still small in terms of the overall vehicle population, it is growing. Since 1992, the number of NGVs in-use has increased four-fold. More impressive, the total amount of fuel consumed by these vehicles has increased more than six-fold. Today, NGVs displace more than 100 million gallons of gasoline a year, representing about 27 percent of all alternative fuel that is consumed in alternative fuel vehicles.

5. THE ENVIRONMENTAL BENEFITS OF NATURAL GAS VEHICLES

Natural gas is one of the cleanest alternative fuels. When compared to average petroleum vehicles, NGVs reduce exhaust emissions of carbon monoxide (CO) by 50%, non-methane organic gas (NMHC) by 88% and nitrogen oxides (NO_X) by 66%, and produce 20% fewer greenhouse gases. NGVs have been certified to be substantially cleaner than traditionally fueled vehicles. Several models already meet or exceed California's ultra-low emissions vehicle (ULEV) and super ultra-low emissions vehicle (SULEV) standards.

Heavy-duty vehicles powered by natural gas generally reduce emissions of particulate matter by 90 percent and NO_X by more than 50 percent. Natural gas engines also produce significantly less air toxic emissions. Regulatory agencies across the country increasingly are looking to natural gas engines to displace diesel engines as an effective strategy for reducing pollution. For example, officials in California have decided that natural gas or other alternative fuels should power most new government-owned heavy-duty vehicles. In addition, many transit agencies around the country have decided to exclusively rely on natural gas buses when purchasing new buses for their fleets.

The Honda Civic GX illustrates the excellent emissions attributes that natural gas has as a vehicle fuel. Even though they have been working with natural gas for only a few years, Honda has been able to achieve truly remarkable results with the Civic GX. In fact, the natural gas Honda GX, which is certified as SULEV, is the cleanest internal combustion engine powered vehicle ever commercially produced, producing far less pollution than Honda's other low-polluting vehicles, including their hybrid electric vehicle. Initially, regulators had difficulty even measuring the emissions from the Honda GX. A gasoline vehicle certified to just the minimum current federal standards emits nearly 194 times more pollution than the dedicated natural gas Honda Civic GX. Vehicles produced by the DaimlerChrysler, Ford and General Motors also have met some of the most demanding emission standards in existence. For example, a one-mile trip to the corner grocery store and back in an average pickup truck emits as much smog forming hydrocarbons as is emitted by the Ford F-250 NGV in a 247 mile trip.

More immediately, natural gas vehicles can provide critical emission reductions today. The recently announced EPA heavy-duty emission standards will not be fully implemented until 2010. Natural gas heavy-duty vehicles already meet the particulate matter levels called for in the proposed rules and are years ahead of diesel en-

gines in terms of reducing NO_X emissions. In addition, there are many uncertainties concerning the timing of EPA's proposed rules. Industry has indicated that they intend to fight the standards, especially the sulfur reductions for diesel fuel. It is possible that the emission benefits of the proposed rule will not be available until some time after 2010. In the meantime, natural gas vehicles are available now and they can deliver superior emissions performance with the added advantage of petroleum displacement.

6. THE FUTURE OF THE NATURAL GAS VEHICLE MARKET

The prospects for increased natural gas use for centrally fueled and other high fuel use fleet operations, such as taxicabs, refuse haulers, school and transit buses, airport shuttles and over-the-road trucks, are very good. The NGV industry has generally chosen to focus on high fuel use fleets and heavy-duty vehicles because their fuel consumption and refueling patterns make them the best choice for early introduction of alternative fuels. Initially, suppliers of natural gas are looking for customers that will use sufficient amounts of fuel to justify the capital investment in retail and private fueling. Another advantage of focusing on high fuel use fleets and operators of heavy-duty vehicles is that replacing these vehicles with alternative fuels provides the greatest amount of emission reductions.

While NGVs are commercially available, they generally cost more than their gasoline or petroleum counterparts. Light-duty NGVs for example, generally cost $3,500 to $5,000 more; heavy-duty NGVs cost from $25,000-$50,000 more. However, as more vehicles are sold, economies of scale will lower the incremental cost of NGVs. The Department of Energy estimates that light-duty NGVs will cost approximately $800 more than comparable gasoline models when mass-produced. Unfortunately, we are still far from seeing the economies of scale that will result from mass production. For example, Ford Motor Company produced over 100,000 Crown Victoria Sedans last year. Of these, only 1,000 were natural gas-powered.

Some people have questioned the continued need for alternative fuel vehicles, particularly since the U.S. EPA announced plans to make gasoline and diesel fueled vehicles of all sizes much cleaner. While there is no question that conventionally fueled vehicles have gotten cleaner and will continue to do so, natural gas vehicles too can continue to become cleaner. Alternative fuel vehicles will continue to be necessary to offset the increased number of vehicles and increased growth in vehicle miles traveled projected by the U.S. Department of Transportation.

Many experts also believe that eventually hydrogen-based fuel cell vehicles will replace the internal combustion engine. It is important to understand that natural gas provides an excellent pathway to a hydrogen transportation future since natural gas can be used to supply the needed hydrogen for fuel cell vehicles. (In fact, almost all stationary fuel cells currently in commercial use derive their hydrogen from natural gas.) As the demand for hydrogen grows, natural gas could be converted into hydrogen at distribution centers or at refueling stations and supplied to hydrogen vehicles. The natural gas infrastructure that is in place today (including the existing pipelines, fueling stations, fuel storage systems and garages and maintenance facilities retrofitted to safely handle a gaseous fuel like natural gas) can be used to support the hydrogen future. In addition, because of the growing NGV market, there are an increasing number of mechanics, inspectors and other transportation professionals that are becoming familiar with servicing gaseous fuel vehicles. It is difficult to imagine how the nation could transition from a petroleum-based transportation system directly to a hydrogen system. Therefore, natural gas is not just an excellent pathway to a hydrogen transportation future; it may just be the only way to transition to that future.

It also should be kept in mind that it will be decades before fuel cell vehicles could become a substantial percentage of the U.S. vehicle population. Internal combustion engines, whether used in traditional vehicles or hybrid electric vehicles, will continue to power most vehicles for the foreseeable future. Natural gas vehicles will always be cleaner than comparable gasoline or diesel vehicles using the same technology, including hybrid electric technology.

RECOMMENDATIONS

There are a number of policies and programs that the federal government could and should put in place to accelerate the purchase and use of alternative fuel vehicles. Some are refinements of existing programs; some are new. Many fall within the purview of the U.S. Department of Energy or Environmental Protection Agency. However, all require congressional leadership in terms of continued authorizations and/or appropriations. The NGVC recommends that Congress support the following policies and programs:

a. Financial Incentives

Support the CLEAR ACT. In April, Senators Hatch and Rockefeller introduced S. 760, a bipartisan bill titled Clean Efficient Automobiles Resulting from Advanced Car Technologies (CLEAR ACT). That bill currently has 11 cosponsors. A companion bill, H.R. 1864, was introduced in the House in May. S. 760 would provide meaningful tax incentives for the purchase of alternative fuel and advanced technology (fuel cell and hybrid) vehicles, the use of alternative fuels, and investments in alternative fuel infrastructure. These proposals are market-driven non-regulatory approaches to promoting AFVs and their use. A credit against income taxes is provided for individuals and businesses for the acquisition of alternative fuel vehicles. The amount of the credit depends on the environmental benefits the vehicle provides. A credit against income taxes also is provided to retail sellers nationwide for the sale of alternative motor fuels. We recognize that the CLEAR ACT is not in the jurisdiction of this Committee. However, we believe that it is critical that the energy policymakers on the Energy Committee send a clear and unambiguous message that enactment into law of the provisions the CLEAR ACT is a critical part of a national energy strategy and in the best interest of the country.

Provide More Funding to State and Local Government Fleets. State and local government fleets are increasingly turning to alternative fuel vehicles as a strategy to help bring their communities into compliance with National Ambient Air Quality Standards. (Indeed, 75 percent of covered state government fleets are required by EPAct to be capable of operating on alternative fuels.) Because of the financial pressure of other priorities, this transition to AFVs is proceeding slower than it could or should be. Congress should provide state and local governments matching funds for AFV acquisition for their fleets, with a higher level of matching for states that commit to a higher percentage of AFVs in the state's fleet than required by EPAct.

Congress also should increase funding for the Department of Energy's Clean Cities Initiative. Over 80 cities across the country have established Clean Cities coalitions, which are public/private partnerships dedicated to in the increased use of AFVs. The Clean Cities program has been extraordinarily successful, and its efforts should be recognized and encouraged.

Fund Local Government Model AFV Demonstration Projects. Last month, Rep. Sherwood Boehlert (R-NY), chairman of the House Science Committee, introduced the "Alternative Fuel Vehicle Acceleration Act" (H.R. 2326). The bill would establish a nationwide alternative fuel vehicle energy demonstration and commercial application competitive grant program by providing $200 million in federal grants to up to 15 communities. The grants could be used to deploy AFVs and connect them to existing transportation systems to help create AFV intermodal networks. Rep. Boehlert plans to include H.R. 2326 in the energy package being developed by the House Science Committee. The Energy Committee should consider similar legislation.

Support the Green School Bus Program. Recent studies indicate that children riding on older school buses are exposed to potentially dangerous levels of emissions. We join with the Union of Concerned Scientists to urge passage of legislation to provide school districts with funding to replace diesel school buses with alternative fuel buses, especially older school buses that may not meet today's safety standards.

b. Research, Development and Demonstration (RD&D)

Expand Funding for NGV RD&D. NGVs are good, but they can be made better. Significant R&D is still needed to (1) improve engine efficiency, (2) further reduce engine emissions, (3) reduce the cost and improve the reliability of fueling infrastructure, and (4) demonstrate natural gas systems in new applications. The Energy Committee should direct DOE to substantially expand its NGV RD&D program to bring it in line with the new Five-Year NGV RD&D Plan developed jointly by the NGV industry and DOE.

Include NGVs in Advanced Automotive Technology R&D. As discussed above, from the perspective of energy security and the environment, natural gas is a superior fuel to gasoline and diesel for hybrids and fuel cells. Therefore, natural gas could and should play a very important role in the deployment of advanced automotive technologies such as hybrid electric and fuel cell vehicles. Existing federal advanced vehicle programs, however, have focused on liquid (primarily, petroleum-based) fuels for these vehicles. The Energy Committee should instruct DOE to include gaseous fuels in its advanced technology vehicle program.

c. Restructure EPAct

EPAct includes specific goals for petroleum reduction through the use of non-petroleum alternative motor fuels. To help achieve these goals, the Act requires alternative fuel provider fleets, the federal fleet and state government-owned fleets to

acquire light duty AFVs. The law allows these fleets to meet up to one-half of their AFV purchase requirements through the use of biodiesel. Each 450 gallons of biodiesel used (2,250 gallons of B-20) by a fleet equals one AFV. As discussed above, EPAct's success in encouraging OEMs to bring AFVs to the market stands in stark contrast, however, to its success in actually helping to displace petroleum with alternative fuels. Fuel provider fleets and the federal fleet are required to operate their AFVs on alternative fuel, but only if such fuel is reasonably available. Many fleets have met their EPAct requirements by acquiring flex-fuel vehicles (vehicles that can operate either on alternative fuel or conventional petroleum fuel), and then operating them on gasoline. Consequently, according to the recent General Accounting Office study discussed above, very little petroleum actually has been displaced through the use of alternative fuels in AFVs owned by these fleets. Congress should make the following modifications to EPAct to increase its effectiveness in reducing the use of petroleum:

i. Create an Optional EPAct Compliance Alternative. Some state government and fuel provider fleets have expressed a desire for greater flexibility in meeting the AFV acquisition requirements. Congress should modify EPAct to provide state government and fuel provider fleets with an optional approach to meeting their EPAct requirements that offers them substantially greater flexibility. In exchange, the program would ask them to accept a voluntary commitment to actually reducing their use of petroleum fuel. Under this program, state government and fuel provider fleets would have the option to continue to meet EPAct requirements as they have in the past (i.e., by acquiring AFVs, meeting up to one-half their requirements through the use of biodiesel and, for fuel provider fleets, using alternative fuel where available). However, this proposal also would provide them the option of opting out of the vehicle acquisition and fuel use requirements by agreeing to reduce a percentage of the petroleum they use in their fleet operations. This percentage would be equal to the amount of petroleum that would be displaced if all AFVs they own and would be required to acquire under EPAct if they remained subject to the vehicle acquisition requirements operated on alternative fuel exclusively. The Department of Energy would be required to issue rules regarding the calculation of this amount.

If a fleet elects this option, all actions it takes to reduce petroleum consumption would be counted under the rules DOE must issue. These actions could include:

- the use of biodiesel (every gallon of biodiesel used would count),
- the use of hybrid electric vehicles and neighborhood electric vehicles (based on the amount of petroleum displaced compared to a conventional vehicle in the same weight class),
- the actual use of alternative fuel in all their vehicles, including light-, medium- and heavy duty vehicles and
- the amount of fuel displaced as a result of substantial contributions they make to getting other fleets or persons to reduce petroleum consumption.

This flexible approach would result in meaningful petroleum displacement, provide incentives for acquisition of AFVs, hybrid vehicles and neighborhood electric vehicles and encourage increased use of biodiesel. Since the option is voluntary, it would not constitute an unfunded mandate.

ii. Credit for the acquisition of heavy-duty vehicles. Congress should permit fleets covered by EPAct to count dedicated medium and heavy-duty vehicles they acquire toward their EPAct requirements.

iii. Enforcement. Congress should direct DOE to send a report to the Senate Energy and Natural Resources and House Energy and Commerce Committees within 90 days of the date of enactment regarding compliance with EPAct requirements by federal, state and fuel provider fleets. DOE should be instructed to detail the efforts it has made to enforce the requirements of the Act, as well as to promote the use of alternative fuels by these fleets. DOE also should be required to publish the report in the Federal Register as well as to publish enforcement actions under EPAct.

d. Other

Accelerate Mobile-to-Stationary Credit Trading. Under current Environmental Protection Agency (EPA) regulations (open market trading guidance and the Federal NO_X Budget Trading program), the use of mobile emission credits to offset stationary source emissions is either prohibited or discouraged by overly bureaucratic requirements. Where used, the process has been extremely burdensome. Congress should direct EPA to develop regulations to encourage and facilitate mobile to stationary source emissions trading, and to update its Mobile Emissions Model to include natural gas vehicles and other low-polluting technologies. EPA should be instructed to develop methodologies for ensuring that mobile source emission reduc-

tions are real and verifiable, and move expeditiously to ensure that mobile reduction credits are part of its regulatory programs.

CONCLUSION

On behalf of the Natural Gas Vehicle Coalition, I appreciate the opportunity to provide our views on these critical issues. It is clear that the U.S. must take steps to lessen its dependence on foreign oil. Natural gas vehicles can help to significantly reduce dependence on foreign oil. It also is clear that America's urban areas must reduce their levels of air pollution. Natural gas vehicles are the cleanest vehicles commercially available today and will continue to be tomorrow. The U.S. currently has the best technology in the world for using alternative transportation fuels. It is critical for the U.S. to capitalize on this technological edge and begin to move alternative fuels into the marketplace. Government incentives continue to be necessary to make this happen. With government incentives and leadership, the private sector can greatly expand the market for alternative transportation fuels.

The CHAIRMAN. Thank you very much.

Mr. Marshall.

STATEMENT OF GARY MARSHALL, VICE CHAIRMAN, NATIONAL ETHANOL VEHICLE COALITION

Mr. MARSHALL. Good morning, Mr. Chairman.

The CHAIRMAN. Good morning.

Mr. MARSHALL. Glad to be here today. I want to talk with you a little bit about the National Ethanol Vehicle Coalition, which is the primary advocacy group for the use of E-85, or 85 percent ethanol, as a form of alternative transportation fuel. The NEVC is comprised of a number of different members, including the 26 members of the Governors Ethanol Coalition, the National Corn Growers Association, several State corn growers associations, which I actually work for the Missouri Corn Growers Association, as well as several automobile manufacturers, ethanol companies, and others.

We are primarily interested in E-85 as an alternative fuel source, but we are obviously very supportive of the use of ethanol as E-10. We have other advocacy groups out there working on E-10 and certainly we are very supportive of efforts such as S. 1006, the Renewable Fuels Act. But we are going to focus our remarks today on E-85, and obviously the biggest challenge that we have had, as people have been talking about all morning, has been the development of infrastructure to fuel automobiles with E-85, 85 percent ethanol. We are hoping that we can help today to integrate E-85 into a broad-based national energy strategy.

Today, most of the ethanol produced in the United States comes from corn. But as ethanol demand increases, we are going to see ethanol produced from a number of different feedstocks, including agricultural wastes, wood waste, and even municipal solid waste. We support and advocate all of these different forms of feedstocks, including biomass, agricultural waste, and feed grains.

Briefly, the automakers have made significant investments to bring E-85 compatible vehicles to the marketplace at no additional cost to consumers. By the conclusion of market year 2001 there will be approximately 1.9 million flexible fuel vehicles on the Nation's highways capable of consuming more than 1.5 billion gallons of ethanol annually if the infrastructure was available. The number of these vehicles continues to increase. We are going to see more this year, more introduced next year.

Different styles of vehicles will be compatible to use alternative fuels, like E-85. These vehicles can run on 85 percent ethanol, they can run on 10 percent ethanol, they can run on conventional gasoline. So if you do not have access to the 85 percent ethanol, you can use something else if you are traveling away.

Again, the problem has been finding the infrastructure, putting the infrastructure together to produce E-85. We can use the existing infrastructure to deliver it. The gasoline tanks, we have to have a dedicated tank for the E-85, but the pumps, just like we see in many of the filling stations across the country today, we can utilize those directly for E-85. So there is an additional cost of putting in the different tanks and so forth, but the infrastructure could be made available relatively easily. It just has not been completed to this point in time.

Now, just for a couple of brief interesting comments. If these 1.9 million flexible fuel vehicles were able to use E-85 as its primary fuel source, we would displace 34 million barrels of imported petroleum, use an additional 530 million bushels of corn, generate an additional $3 billion in farm income, develop a marketplace for the production of ethanol from biomass and waste materials, significantly reduce the emissions of non-methane hydrocarbons, carbon monoxide, and air toxics, implement a reduction of more than 4.3 million tons per year of greenhouse gas emissions, and help establish a long-term sustainable alternative domestic transportation fuel.

As more of these automobiles come on line, obviously we believe there is no other form of transportation fuel that provides the broad range of environmental and economic benefits to the Nation as does E-85. But as I have been saying, obviously there are impediments to achieving those results. Lack of infrastructure—today we have only about 200 public E-85 fueling stations in the United States.

Ethanol contains less energy on a Btu basis than does gasoline and even with the existing blenders tax credit a gallon of gasoline equivalent E-85 often exceeds the cost of unleaded gasoline.

The automakers have been criticized for producing flexible fuel vehicles that do not operate on alternative fuels, but we can change that with help. The Alternative Motor Fuel Act of 1988 provided credits to the automakers to encourage the production of these alternative fuel vehicles and these credits, while limited, have assisted the automakers in achieving the corporate average fuel economy standards proposed and provided for by law.

They have been criticized, again, for not taking advantage, or for taking advantage of the CAFE credits provided by Congress and that little of the alternative fuels have been used. The automakers have only been doing what has been available to them. The incentives were there for the production of the vehicles. The incentives have not been there for the use of the fuels. Congress obviously intended that these incentives be used to initiate and promote the production of the vehicles. Now we need these same types of things for the fuel.

I would like to offer a very general set of conclusions and recommendations that the committee might want to consider. No. 1,

all forms of alternative fuels be products produced in North America and promote national energy security.

No. 2, E-85 and biodiesel are the only alternative fuels that can significantly reduce emissions of greenhouse gases.

No. 3, E-85 and biodiesel are the only forms of renewable transportation fuels available in a liquid form that could use the Nation's existing fuel delivery system.

No. 4, renewable fuel production can be a cornerstone for important economic development and job creation across the country.

We do support the development of a national energy strategy. You may want to consider a couple of other ideas. It might be appropriate to establish something like a national alternative fuel trust fund, where we could help provide incentives for the use of alternative fuels. The development of a financial mechanism that would provide gasoline gallon equivalency to all forms of alternative transportation fuels, so that the motoring public would not be faced with reductions in fuel mileage when utilizing alternative fuels. The establishment of new incentives or the extension of existing incentives available to the automakers to assist in offsetting the cost of producing the alternative fuel vehicles. Implementation of incentives to fuel providers across the Nation that would potentially change their existing paradigm from being a petroleum-based company to an energy-based company or a transportation fuel-based company.

So with that, Mr. Chairman, I would like to thank you for the opportunity to provide these remarks. I would be happy to answer any questions that you might have.

[The prepared statement of Mr. Marshall follows:]

PREPARED STATEMENT OF GARY MARSHALL, VICE CHAIRMAN, NATIONAL ETHANOL VEHICLE COALITION

Good morning Mr. Chairman, members of the Committee, ladies and gentlemen. My name is Gary Marshall and I serve as the CEO of the Missouri Corn Growers Association, which has offices in Jefferson City, MO. I am here today representing the National Ethanol Vehicle Coalition in which I also serve as the Vice-Chairman of the organization. Thank you for the opportunity to appear before the Committee and discuss the use of 85 % ethanol or E85, as a form of alternative transportation fuel. My comments will be very brief to allow the Committee an opportunity to ask any questions that you may have.

The National Ethanol Vehicle Coalition is composed of state and local organizations, state and local elected officials, third-part stakeholders, ethanol producers, vehicle manufacturers, and agricultural interests. Our members include:

- The 26 members of the Governors' Ethanol Coalition
- National Corn Growers Association and several state affiliates including:
  - Missouri Corn Growers Association
  - Colorado Corn Growers Association
  - Kansas Corn Growers Association
  - Maryland Corn Growers Association
  - General Motors Corporation
  - Ford Motor Company
  - DaimlerChrysler
  - Ethanol Management Corporation
  - Corn Plus
  - Nebraska Ethanol Board
  - BC International, and others

The National Ethanol Vehicle Coalition (NEVC) is the nation's primary advocacy group promoting the use of 85% ethanol as a form of alternative transportation fuel. We do not engage in the debate and discussions regarding the use of ethanol as a form of oxygenate or fuel blend, however, it is important to note that we do support

and advocate all uses of ethanol. Our focus is on high-level blends of ethanol and the opportunity that E85 has to supplement the existing use of ethanol and not supplant the use of E10.

The NEVC and a broad range of project partners have been involved with the establishment of the E85 fueling infrastructure for the past several years, and are seeking to integrate E85 into a broad based national energy strategy. Today, most ethanol is produced from corn and other agricultural crops. As ethanol demand increases, future production will expand from grain based feedstocks to the use of agricultural wastes, wood wastes and even municipal solid waste. It is important to note that the NEVC supports and advocates the production of ethanol from all forms of feedstock's, including biomass, agricultural waste, and feed grains.

U.S. automakers have made significant investments to bring E85-compatible vehicles to the marketplace at no additional cost to the consumer. By the conclusion of Model Year 2001, there will be approximately 1.9 million flexible fuel vehicles on the nation's highways—capable of consuming more than 1.5 billion gallons of ethanol annually-if the infrastructure were available. The number of these vehicles will continue to increase as production of new E85 flexible fuel vehicle models are introduced. A flexible fuel vehicle is designed to operate on either gasoline or E85. There are no separate fueling tanks, no switches to flip, and if E85 is unavailable and fuel is needed, gasoline is introduced into the same filling tube and mixed into the same tank.

Please allow me a moment to outline the impact that the use of an additional 1.5 billion gallons of ethanol would have beyond today's 1.8 billion gallons of ethanol being utilized as a fuel oxygenate and octane enhancer.

If each of these 1.9 million flexible fuel vehicles would use E85 as its primary fuel, the impact would be to:

- Displace approximately 34 million barrels of imported petroleum;
- Use of an additional 528 million bushels of corn to produce ethanol (from the 2 billion bushel surplus);
- Generation of an additional $3 billion in farm income;
- Development of a marketplace for the production of ethanol from biomass and waste materials;
- Significantly reduce the emissions of non-methane hydrocarbons, carbon monoxide, and air toxics;
- Implement a reduction of more than 4.3 million tons per year of greenhouse gas emissions; and,
- The establishment of a long-term sustainable, alternative domestic transportation fuel.

The source materials for the preceding calculations will be provided to your staff.

These benefits could be realized today as the technology is available, the vehicles are on the street, and more vehicle models are being offered annually. There is no form of transportation fuel that provides the broad range of environmental and economic benefits to the nation, as does the use of E85.

Clearly there are impediments to achieving the aforementioned results, including:

- A lack of infrastructure to fuel the vehicles. Approximately 200 public E85 fueling stations are currently in place across the nation.
- Ethanol contains less energy on a BTU basis than does gasoline, and even with the existing blenders credit, the cost of a "gasoline gallon equivalent" of E85 exceeds unleaded gasoline.
- The automakers are being criticized for producing flexible fuel vehicles that do not operate on alternative fuels and debate is pending to reduce or eliminate the CAFE Credits provided for the production of these vehicles.

The Alternative Motor Fuel Act of 1988 provided credits to automakers to encourage the production of alternative fuel vehicles. These credits, while limited, can assist an automaker in achieving the Corporate Average Fuel Economy standards provided by law. The automakers have been criticized by both the press and the environmental community for taking advantage of these CAFE Credits that were provided by the Congress, in that little alternative fuels are being used. I submit that the automakers have only used an incentive that was provided and promoted the United States Congress, which clearly intended these incentives to be used to initiate and promote the production of alternative fuel vehicles. The weakness of the Alternative Motor Fuel Act of 1988 was that the Act did not address the infrastructure needed to fuel these vehicles. It is our position that the automakers are being unfairly targeted and that it is appropriate to remember that General Motors, DaimlerChrysler, and Ford Motor Company are in the business of manufacturing motor vehicles, not selling or marketing transportation fuels.

In order to allow adequate opportunity for questions, I will close by offering only a short and very general set of conclusions and recommendations that the Committee may wish to consider to bring alternative fuels into the nation's mainstream.

The Committee may wish to consider that:

- All forms of alternative fuels are products of North America and they will all promote national energy security.
- E85 and biodiesel are the only alternative fuels that can significantly reduce the emissions of greenhouse gases.
- E85 and biodiesel are the only forms of "renewable transportation fuels" available in a liquid form that could use the nation's existing fuel delivery system.
- Renewable fuel production can be a cornerstone for important economic development and job creation across the nation.

Many, many legislative proposal have been and are being considered in this session of Congress. While time does not allow for us to comment on the details of these numerous bills, the NEVC does support the development of a national energy strategy. As you and the Congress deliberate, you may wish to consider the following options to implement a national energy strategy.

- It may be appropriate to establish a "National Alternative Fuel Trust Fund" that is used to promote the use of all forms of alternative transportation fuels. Such trust fund could potentially be financed by major emitters of greenhouse gases that could contribute to this fund in lieu of making costly and inefficient modifications to manufacturing processes that would otherwise reduce such emissions.
- Development of a financial mechanism that would provide "gasoline gallon equivalency" to all forms of alternative transportation fuels so that the motoring public would not be faced with reductions in fuel mileage when using alternative fuels.
- Establishment of new incentives or the extension of existing incentives available to the automakers to assist in offsetting the cost of producing alternative fuel vehicles.
- Implementation of incentives to fuel providers across the nation that would potentially change their existing paradigm from that of a "petroleum company" to that of a "transportation fuel" company.

Thank you for allowing the National Ethanol Vehicle Coalition to provide these comments today. We would like to ensure the Committee that we are available to provide assistance at your convenience and we look forward to working with the Committee and Congress in development of programs to promote all forms of alternative transportation fuels.

The CHAIRMAN. Thank you very much.

Mr. Zeltmann, why don't you go ahead.

STATEMENT OF EUGENE ZELTMANN, CO-CHAIRMAN, ELECTRIC VEHICLE ASSOCIATION OF THE AMERICAS

Mr. ZELTMANN. Good morning, Mr. Chairman and members of the committee. I am Gene Zeltmann, President and Chief Operating Officer of the New York Power Authority. The Power Authority is America's largest State-owned public power enterprise, operating ten generating facilities and more than 1400 circuit miles of transmission lines in New York State.

I appear today as co-chairman of the Electric Vehicles Association of the Americas, whose membership includes international vehicle and component manufacturers, energy providers, and technology developers. I thank you for this opportunity to discuss the role of the Federal Government in reducing the use of petroleum in the light duty vehicle sector.

EVAA believes that reducing dependence on foreign oil demands that we transition the country's biggest consumer of this commodity, the transportation sector, to use of other fuels. Electricity is an attractive alternative. It is clean, efficient, relatively affordable, and is produced domestically from a variety of feedstocks. Use of

electricity can greatly enhance our energy security since today the U.S. electric generation base is about 3 percent oil.

EVAA encourages the development and use of several electric transportation modes, including vehicles powered solely by batteries, fuel cell vehicles, where the electricity of course is generated on board, and finally hybrid electric vehicles that rely upon a small internal combustion engine operating in conjunction with an electric motor.

Mr. Chairman, my written statement details the benefits of using electric transportation and describes the challenges we face in commercializing these technologies. I will use my time this morning to highlight actions that the Government might take to assist in the transition of our transportation network to alternative fuels.

New York State has moved boldly to promote electric and other means of clean fuel transportation, exemplifying the role that EVAA and its members believe that government should fill. Under the leadership of Governor George Pitaki, generous State incentives for purchase of vehicles have been enacted. A State environmental bond is providing financial support for clean fuel buses and fleet vehicles. The Governor has directed the State fleet, which already includes some 700 clean fuel vehicles, to operate solely on such fuels by the end of this decade.

The Power Authority is assisting in this paradigm shift by deploying more than 200 electric vehicles for use by our customers and employees. We have initiated all-electric commuter programs and supported the acquisition of several hundred hybrid electric buses. Importantly, we are facilitating the conversion of 500 U.S. postal vans to electricity.

With respect to the Federal Government's role, let me say first that EVAA supports tax incentives as the single most effective means of jump starting the market for ethanol and other clean fuel vehicles. EVAA supports the inclusion of such incentives as a critical component to an effective national energy policy.

With respect to other matters within the jurisdiction of this committee, EVAA supports and urges the inclusion of several specific items in comprehensive energy legislation. First, a primary factor in the current high price of electric vehicles is the battery. Advanced batteries used to power hybrid electric vehicles are expensive, due largely to the materials, like nickel, cadmium, perhaps lithium, used in their manufacture. Increasing volume will assist somewhat in lowering the price, but automotive manufacturers believe the batteries will remain too expensive to allow for an affordable EV even at mass production.

A second use subsequent to service in the vehicle is feasible because EV electric battery packs retain about 80 percent of their rated capacity at the end of the useful life in a vehicle. Studies indicate that such batteries could be used effectively in stationary applications, like electricity storage and load leveling. We ask that the committee authorize a 3-year program so that electric utilities and other interested parties could cost-share with DOE in demonstrating the effectiveness and benefits of using spent EV battery packs in stationary applications.

Second, the chairman of the House Sciences Committee, Sherwood Boehlert, has introduced legislation to create a program that would demonstrate a variety of electric and other alternative fuel technologies in cities across the country. This forward-thinking proposal will assist in creating seamless intermodal transportation systems in urban environments that are fueled exclusively by clean alternatives like electricity. Chairman Boehlert plans to include his bill as part of the Science Committee's energy package and we urge this committee to consider incorporating this proposal in comprehensive energy legislation as well.

Third, we ask that you examine the Energy Policy Act of 1992, those provisions that require governments and so-called fuel provider fleets, like electric and natural gas utilities to acquire clean fuel vehicles. The current program failed to meet the EPAct goal of reducing transportation sector petroleum use by 10 percent by the year 2000. EVAA has been working with other alternate fuel groups as well as representatives of government and commercial fleets to identify modifications to existing law.

We seek flexibility in meeting the requirements of existing law in order to better ensure that EPAct's future petroleum displacement goal is indeed achieved.

Finally, as we have heard this morning, hydrogen could become the fuel of choice in this century. Our interest in hydrogen is simple. It is the fuel required to power fuel cell vehicles. The committee will consider the reauthorization of existing hydrogen R&D legislation. As the committee considers questions about hydrogen, about fuel cell development, about the energy needed to power our mobile society, we urge you to find ways to establish public and private partnerships to jointly address these technological changes. The Federal Government can play a significant role in assuring that the vast amounts of human, technical, and financial resources now being spent on hydrogen and fuel cell development is optimized through integrated, cooperative programs and policies.

As you examine existing law and create a new energy policy, we urge you to include the programs, policies, and incentives that I have outlined today to encourage the development and use of electric modes of transportation.

That concludes my remarks, Mr. Chairman. I thank you again for the opportunity to appear and I will be happy to try to answer any questions.

[The prepared statement of Mr. Zeltmann follows:]

PREPARED STATEMENT OF EUGENE ZELTMANN, CO-CHAIRMAN, ELECTRIC VEHICLE ASSOCIATION OF THE AMERICAS

INTRODUCTION AND OVERVIEW OF STATEMENT

This testimony is submitted on behalf of the Electric Vehicle Association of the Americas (EVAA), a national non-profit organization that advocates the use of electric transportation technologies, including battery, hybrid and fuel cell electric vehicles, as a means of addressing national energy security, energy efficiency and air quality goals. Members of the organization include international automotive and other equipment manufacturers, energy providers, national associations and government entities. (A complete membership roster is attached to, and made a part of, this testimony.)

EVAA applauds the Energy Committee's investigation to determine means by which the federal government might cause, or help to cause, a reduction in the use of petroleum by the light duty vehicle sector. A critical key to reducing U.S. depend-

ence on foreign oil is to transition the transportation sector—particularly the light duty vehicle segment—to use of alternatives to gasoline and diesel fuels, like electricity and/or hydrogen. U.S. petroleum demand is projected to grow from 19.5 million barrels per day in 1999 to 25.8 million in 2020—led by growth in the transportation sector, which accounts for about 70 percent of current U.S. petroleum consumption. And the consumption of energy by the transportation sector is growing at an alarming rate. By 2020, the Energy Information Administration (EIA) predicts that total energy demand for transportation in the U.S. will be 38.5 quadrillion Btu, compared with only 26.4 quadrillion Btu in 1999.

Electric transportation technologies present our nation with an important means for reducing our dependency on foreign petroleum and increasing the diversity of fuels relied upon in the transportation sector. This testimony highlights:

- the important national benefits accruing from the widespread adoption of electric transportation technologies into our transportation network;
- discusses the current technological, market-entry and infrastructure challenges to such widespread deployment of electric transportation technologies; and
- outlines federal policies and programs that EVAA's members believe are critical to assuring that electric transportation technologies can be a significant segment of the U.S. transportation sector in the 21st century.

BENEFITS OF ELECTRIC TRANSPORTATION TECHNOLOGIES

There is a family of electric transportation technologies being developed and/or commercialized. EVAA defines an electric vehicle as any technology that employs an electric drive system to power the vehicles. Electric transportation technologies under development and/or commercially available today include battery electric vehicles (BEVs), hybrid electric vehicles (HEVs) that use both an electric motor and an internal combustion engine, and fuel cell electric vehicles (FCEVs). Each of these technology categories offer significant energy security and environmental benefits, and together represent the cleanest, most advanced alternatives to conventional vehicles on the road or under development.

Battery Electric Vehicles

Battery electric vehicles (BEVs) charged off the Nation's electric utility grid use "fuel" created from a variety of feedstocks, from wind to nuclear. Importantly, petroleum represents a diminimus fuel feedstock for electricity production in the U.S. Less than 3% of the current U.S. generation base relies on petroleum. Electricity is a domestically produced, relatively stably priced fuel that affords us "fuel diversity" for the transportation sector. Further, the primary charging for BEVs is expected to occur overnight, when electricity demand is at its lowest, allowing for widespread adoption of the technology without adding new capacity.

In addition to significant energy security benefits, BEVs offer the opportunity for continued personal mobility without degradation to the environment. Nearly 100 cities across the U.S. fail to meet federal air quality standards, and approximately 62 million people live in counties where monitored data show unhealthy air for one or more of the six principal pollutants [carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM), and sulfur dioxide (SO_2)]. For many urban areas, electric transportation can be a particularly important means to substantially reduce emissions of mobile source pollutants, including volatile organic compounds and oxides of nitrogen that are the precursors of smog. Battery electric cars and buses are truly "zero emission" transportation modes. They produce no tailpipe emissions and generate insignificant, ancillary emissions during operations. They also have the added benefit of mitigating noise pollution and using energy more efficiently than conventional modes.

Hybrid Electric Vehicles

Hybrid electric vehicles, which combine the benefits of electric power with conventional gas-powered engines, can significantly improve the efficiency and environmental performance of vehicles, thereby reducing fuel use and contributing to improved air quality. HEVs on America's roadways today evidence the tremendous advantages that this technology provides. The Toyota Prius has a stated fuel economy of 67 mpg, and a California environmental rating of "SULEV", or "Super Ultra Low Emission Vehicle," with only about 1/2 of the carbon dioxide and 1/10 of the nitrogen oxide emissions associated with a comparable, gasoline powered vehicles; the Honda Insight is rated at 70+ mpg and meets California's "ULEV" emissions rating. All international auto manufacturers have announced plans to bring hybrid electric vehicles to the market place in the coming years.

Fuel Cell Electric Vehicles

Fuel cell electric vehicles (FCEVs), which harness the chemical energy of hydrogen and oxygen to generate electricity, have the potential to change the way we think about energy. Fuel cells are more efficient than other technologies that rely on direct combustion, and they produce zero, or near zero emissions. When fueled directly by hydrogen, the only by-product of a fuel cell electric vehicle is water.

Like electricity, hydrogen does not occur naturally in a usable form on Earth; it must be generated or produced by consuming fuels or other forms of energy. Yet, also like electricity, multiple feed stocks can be used, creating fuel diversity and thereby enhancing national energy security. Fuel processors "on-board" a vehicle can produce hydrogen from natural gas, methanol, ethanol, gasoline, or diesel. "Off-board" processors can use all of these feedstocks and can also make hydrogen from the electrolysis of water.

CHALLENGES TO WIDESPREAD ADOPTION OF ELECTRIC TRANSPORTATION TECHNOLOGIES

Despite the significant societal benefits accruing from their use, years of research and development by companies and governments across the globe, and mandates for commercialization of such vehicles, electric transportation technologies have not yet become a meaningful part of the U.S. transportation network. Since 1996, a total of only 4,339 battery electric vehicles have been leased and/or sold in the U.S. And, while sales of HEVs are growing quickly, there still have been only 17,773 put into service to date. In addition to these light duty automotive offerings, there have been about 200 electric and hybrid-electric buses and over 6,000 low-speed, battery electric vehicles placed into service.

While the sum of all of these vehicles—which is less than 30,000 as compared to 1999 vehicle sales in the U.S. of 16.5 million—may be insignificant statistically, they represent an enormous step toward development of a long-term and sustainable market for such vehicles in the U.S. The technology—with respect to battery and hybrid electric vehicles—is proven and maturing; customer reception to the vehicles has been tremendous and sales have been constrained more by product availability than by demand; and incentives to encourage consumer purchase are in place and/or being considered by government at all levels. However, more must be done if these vehicles are to become an integral part of our transportation network.

Costs for immature and low-volume technologies will be higher than those of comparable, conventional vehicles. Until a supplier base can be built, the technology matured and volume production established, the incremental costs of electric transportation technologies must be addressed in order to assure consumer acceptance. Fortunately, battery, hybrid and fuel cell vehicles share a number of subsystems (e.g., power electronics, motors, regenerative brakes). Therefore establishing a supplier base for battery electric vehicles, for example, can help to lower the costs of early commercial fuel cell vehicles when they are brought forward.

Infrastructure support systems, from re-fueling and charging to service and maintenance, must be put in place to support the convenient and safe operation of electric transportation technologies. Deploying the infrastructure systems—particularly those to support a hydrogen-based economy represents a vast and expensive undertaking.

Building markets for electric transportation will require consumer awareness and experience with the technology to establish confidence in the products.

Finally, with respect to fuel cell electric vehicles, there is a continuing need for research and development of the subsystems and components that will allow industry to bring forward a consumer-attractive FCEV.

ROLE FOR GOVERNMENT IN OVERCOMING THE TECHNOLOGY AND MARKET CHALLENGES TO ELECTRIC TRANSPORTATION TECHNOLOGIES

Consumer Tax Incentives

Targeted tax incentives can be an effective means by which government can help assure that electric drive technologies are successfully introduced into the marketplace. EVAA members believe that such incentives should be limited in their scope and duration, and available now and in the immediate future as these new and dramatically different technologies are introduced to consumers.

EVAA supports the inclusion of tax incentives for electric and other alternative fuel vehicles (AFVs) as part of any national energy plan. Such incentives can help drive the biggest consumer of petroleum—the transportation sector—toward use of cleaner, domestically produced alternatives. We recommend that the Committee consider incorporating the principles of the "Clean Efficient Automobiles Resulting from Advanced Car Technologies Act" ("CLEAR ACT"), S. 760, in any comprehensive energy bill that it may report. The CLEAR ACT, introduced by Senators Jeffords,

Hatch, Rockefeller and others, would set the stage for a consumer-based and technology driven transformation of the transportation sector. All major vehicle manufacturers are poised to bring battery, hybrid and/or fuel cell electric cars and buses to the market. Federal tax incentives, as called for in the CLEAR ACT, would allow the technology to spread quickly by lowering purchases prices and encouraging deployment of supporting infrastructure.

We believe a very important feature of the CLEAR ACT is its recognition that vehicles which provide the greatest societal benefits in terms of environmental and efficiency performance are deserving of the most generous benefits. Also, the CLEAR ACT recognizes that fuel cell electric vehicles will be entering, the market later than other electric and alternative fuel vehicles, and has provided for incentives for this category of technology to continue for a longer period of time to ensure that the market has matured sufficiently before the incentives expire.

Federal Program to Introduce Advanced Vehicle Technologies to U.S. Cities

Cities and communities plagued with poor air quality and traffic congestion stand to be the greatest beneficiaries of the successful commercialization of electric and other alternative fuel vehicles; yet, to date, the technologies are largely unknown and "untried". Deploying electric transportation technologies, from battery-powered bikes to fuel cell electric buses, can result in the clean and efficient transport of people and goods in the urban environment.

Legislation that has been introduced in the House of Representatives and is being considered for inclusion in that chamber's national energy plan creates a federal program to support the introduction of electric and other alternative fuel vehicles in linked transportation systems in up to 15 cities in the U.S. Introduced by the Chairman of the House Science Committee, Sherwood Boehlert (R-NY), H.R. 2326, the "AFV Acceleration Act of 2001," provides $200 million in federal cost-share funding to help communities deploy clean, efficient modes of transportation and to build the infrastructure that can assure the subsequent widespread adoption of these technologies. Creating these models of efficient and clean transportation will allow for transit operators, public officials and the citizens who experience the benefits of the technology in their daily lives to gain the experience and confidence necessary to transition to these radically new technologies.

EVAA encourages this Committee to consider including the AFV Acceleration program, as envisioned in H.R. 2326, in any national energy package it may develop. Forming partnerships and alliances between governments at the local, state and federal levels, and leveraging federal dollars with those of industry and other levels of government, is an effective means of introducing and deploying alternative fuel vehicles to communities and citizens across the country.

Federal Program to Assist in Making Advanced EV Batteries Economically Viable

In addition to consumers' lack of familiarity with electric vehicles, other challenges to market penetration of the initial series of electric vehicles are high purchase prices and limited range. Manufacturers currently are not producing greater numbers of EVs, having reached conclusions that the costs are too high and the market too limited. The cycle of high costs and limited sales is broken only if costs are reduced and/or volume is increased dramatically. One of the primary contributors to the high costs of EVs is the advanced battery necessary to provide the minimum range deemed acceptable to consumers. While it is estimated that prices for batteries begin to fall when the volume reaches 10,000 packs (i.e., enough to power 10,000 EVs) per year, auto manufacturers believe that volume alone cannot address the prohibitive costs of advanced technology batteries necessary to create consumer demand for EVs because the materials needed for such batteries (e.g., nickel) are expensive.

To assure volume sales of EVs, a dramatic reduction in the cost of batteries is required. An innovative approach to addressing this issue may be to "extend" the life—or value—of the batteries beyond vehicular use. Once the batteries have been "used" in a vehicle, there is an opportunity to refurbish, then "re-use" the batteries in a stationary application. For example, electric utilities could "re-use" EV battery packs in peak shaving, transmission deferral, back-up power and transmission quality improvement applications. If successfully demonstrated for secondary, stationary-use applications, the effective price of battery systems are projected to make EVs more competitive.

Preliminary studies have shown that if a secondary market is created that pays $100 to $200/kWh for EV batteries, the costs of such batteries for use in the first application (i.e., the vehicle) could be reduced to $100 to $150/kWh—the price point where auto manufacturers believe is necessary to assure an affordable EV. Combining the value for using the battery in both a vehicle and then later a stationary ap-

plication likely would cover the cost of producing the battery pack, even at low volume (estimated at $400/kWh).

EVAA encourages this Committee to consider establishing a program within the Department of Energy to assist industry in demonstrating that "spent" EV batteries can be cost-effective and high-performing in secondary, stationary applications as part of any national energy package it develops. The program should be designed to demonstrate up to 1,000 kWh of "used" batteries (approximately 33 vehicle battery packs) in a minimum of 10 stationary use applications. These "used" batteries would demonstrate electric utility stand-by, peak-shaving and transmission quality improvements and would help to validate the value of "used" batteries as a means to store electricity for purposes beyond use in EVs.

Providing Flexibility in Compliance with EPACT Fleet Requirements

EVAA requests that this Committee examine the existing provisions of the Energy Policy Act of 1992 (EPACT), P.L. 102-486, that require state and federal governments and the providers of alternative fuels (e.g., electric utilities, natural gas utilities, and other producers/suppliers of fuels defined as alternatives to gasoline under the Act) to convert their vehicle fleets to alternative fuel vehicles. The rationale of building volume and market demand through government fleets and the fleets of those in the business of producing, supplying and/or selling alternative fuels is sound, though the execution of the program to date has not achieved the goals of the ACT, namely to replace 10% of the petroleum used in the light duty vehicle sector by 2000, and fully 30% by the year 2010.

While committed to building a long-term, self-sustaining market for electric vehicles, EVAA's electric utility members have found compliance with the existing EPACT alternative fuel providers' program difficult given the limited availability, high initial purchase price and limited performance of electric vehicles. These alternative fuel providers, as well as others struggling to meet the dictates of the DOE-administered program, are looking for flexibility in the program and recognition for actions taken that can help to develop the markets for electric and alternative fuel vehicles. For example, some electric utilities who are unable to incorporate so-called "full function" EVs due to limited availability, have begun to purchase and deploy low-speed electric vehicles to replace the duty cycle of a conventional vehicle; others have made investments in EV charging infrastructure to help encourage the market; and still others have begun to deploy hybrid-electric vehicles to help build demand in that segment and thereby "drive-down" the costs of components that are shared with battery and fuel cell electric vehicles. These actions, EVAA believes, should be recognized under the EPACT alternative fuel providers' program.

EVAA is working in partnership with other alternative fuel interest groups, representatives of the federal government, and commercial fleet representatives to craft a set of modifications to the EPACT alternative fuel vehicle programs that will create flexibility in meeting the goals of the law, while assuring that the goals of the existing law, i.e., displacement of petroleum use in the transportation sector, can be achieved. It is the hope of the working group that agreement might be reached, and that we might provide this Committee with a set of suggested modifications to EPACT for consideration as part of any comprehensive energy legislation that may be developed.

Integrating Federal Hydrogen and Fuel Cell Development Efforts

The world's major automobile and heavy duty vehicle manufacturers who are engaged in efforts to commercialize fuel cell vehicles all face the same technically challenging issue: How can hydrogen be provided to the fuel cell that will power the vehicles? Whether hydrogen is produced elsewhere and then stored onboard the fuel cell vehicle or is produced on the vehicle by use of an onboard fuel processor, hydrogen is a key enabler to the success of these vehicles. And, not only can hydrogen fuel much of tomorrow's transportation systems, but its versatility could provide the clean energy needed to satisfy our electric as well as our mechanical and thermal energy needs—powering office buildings, homes, industrial complexes and shopping malls.

The reality of the marketplace is that the role of hydrogen in the transportation sector, and to a large extent in the stationary applications sector, is coupled closely with fuel cell development. While hydrogen R&D is essential in its own right, the success of fuel cells is very dependent upon the success of hydrogen production, storage, transportation and use. The recently released report of the National Energy Policy Development Group, led by Vice President Cheney, specifically recommended that the President direct the Secretary of Energy to focus R&D efforts on integrating current programs regarding hydrogen, fuel cells and distributed energy.

As this Committee considers reauthorization of the Hydrogen Future Act of 1996—separately or as part of a comprehensive energy package—EVAA asks that the reauthorizing legislation recognize the need to integrate on-going hydrogen, fuel cell and distributed energy research and development programs and to consider specific mechanisms and programs to insure that coordination is achieved in government and industry efforts to pursue both hydrogen and fuel cell development. One means for organizing public and private partnerships to address the technical challenges might be to undertake a very significant, large-scale demonstration that invites, under one tent, today's leading fuel cell and hydrogen participants to focus on maturing the technologies and deploying the infrastructure that will allow us to move to this renewable and clean energy resource as quickly as possible. An example of such a collaborative undertaking can be found in the California Fuel Cell Partnership (CaFCP), which includes participation by the federal government, and is organized to comprehend the infrastructure requirements within the state of California to support use of fuel cell electric vehicles.

Conclusion

Electric transportation technologies, whether powered by batteries, fuel cells or a combination of batteries and an internal combustion engine, collectively represent our transportation future. Transitioning to electric drive systems ensures continued mobility without reliance on insecure and often costly sources of foreign oil, and importantly, without degradation to the environment. Federal partnerships—whether in the form of consumer tax incentives, cost-share for research, development and demonstration, and/or assistance in deployment—to assist industry in bringing electric transportation technologies to the marketplace is a wise and cost-effective investment in our future energy security and in our citizens' quality of life. EVAA encourages this Committee to consider the industry's recommendations for programs and policies made within this statement as national energy legislation is crafted.

The CHAIRMAN. Well, thank you very much.

Let me ask a few questions, first about the hybrid electric vehicles that are now on the market and that everyone indicates, each of the manufacturers indicate, they are developing for sale in the next few years. Is there something inherent in the construction of a hybrid electric vehicle that requires it to be more, significantly more expensive than a regular internal combustion engine-driven vehicle, or is it just a question of getting the volume up to a sufficient level that the price comes down? What is the answer to that?

Mr. DANA. Mr. Chairman, in a hybrid electric vehicle what you have is a conventional engine along with electric motors to drive the wheels and a small battery pack. So you are essentially running two propulsion systems, which is why you have an added cost for a hybrid electric vehicle. Some of those parts in volume production we think can be thrifted somewhat. We do not know if we can ever get completely down to a conventional vehicle, even at volume, with a hybrid, but certainly there are some cost economies that will come.

The CHAIRMAN. When will there be U.S. manufacturer-produced hybrid vehicles on the market other than the Toyota and the Honda vehicle that are already on the market?

Mr. DANA. I believe Ford has announced that their Escape SUV will have a hybrid system in the 2003 model year. I know that GM is working on a Silverado pickup with a hybrid system, and Daimler Chrysler has announced a Durango that would be a hybrid. I believe those are 2004 model year, if I remember correctly.

The CHAIRMAN. Am I right that hydrogen-powered automobiles also all contain an electric motor, that the hydrogen powers the electric motor, so it is essentially a hybrid electric vehicle driven by hydrogen instead of by gasoline? Is that an accurate description or not, Mr. McCormick?

Dr. MCCORMICK. You can certainly run hydrogen through internal combustion engines and some companies are looking at that, as are we. But the solution we are talking about with fuel cells allows us to get rid of the engine and transmission and replace it with a fuel cell that produces the electricity, and then you have the electric motors to drive the car.

The CHAIRMAN. But the electric motor has to be there in any fuel cell-driven vehicle?

Dr. MCCORMICK. Absolutely, yes. So it is basically an electric vehicle with a fuel cell instead of batteries.

The CHAIRMAN. It seems to me that whether the source of the power, the fuel used, is hydrogen through a fuel cell or is gasoline through an internal combustion engine or natural gas through a natural gas-powered combustion, adding the electric engine or the electric motor dramatically improves the efficiency of the vehicle. Am I right about that? Any of you have thoughts about that?

Mr. DANA. Well, in a couple of ways. As Dr. McCormick says, they are seeing efficiencies twice as great in a fuel cell vehicle as a conventional vehicle just from the type of system that is used to drive it. In the hybrids that are being developed today, you get much greater efficiencies, mainly because you actually turn the engine off at idle and actually not use the engine at some times while the batteries and motors run the vehicle. So that is part of the greater efficiency of the hybrids. Actually, at idle you most of the time shut the engine off and do not use it.

The CHAIRMAN. Mr. Zeltmann, you had a comment?

Mr. ZELTMANN. I had a thought, if I may. The beauty of what we are talking about with the hydrogen is it is a way to capture perhaps alternate forms of power generation such as solar or wind power or hydrogen power, because as you electrolyze the water and then capture the hydrogen and then use that to power the fuel cell-operated vehicle, for example, you in fact are able to get yourself away from dependence upon petroleum products imported from overseas.

Now, that gets to the point that we have heard earlier this morning about the need for infrastructure for the hydrogen storage and transportation and the safety that is required with it. But the facts are that you have the ability to use green power generation forms in producing the hydrogen, which is an attractive alternative that might be considered as you go forward in these deliberations.

The CHAIRMAN. Mr. Kolodziej.

Mr. KOLODZIEJ. Mr. Chairman, one of the confusions out there is that people refer to hybrid electric vehicles, they frequently just assume that means a gasoline or diesel engine that is driving it. If the focus is on displacing foreign oil, then I think we need to also look at alternative fuel engines to drive the hybrid vehicle in which you get 100 percent displacement.

There is a lot, right now a lot of work being done through DOE and also in the private sector on large-scale buses, trucks, hybrid, natural gas engines and vehicles. With respect to hydrogen, the key is where do you get the hydrogen from. It is great to have a vehicle, but if you do not have a hydrogen source where do you go?

Right now all the stationary fuel cells in the world as far as I know of that are in commercial operation get their hydrogen from

natural gas. In addition most of the hydrogen that is commercially available is produced from natural gas and then shipped around in containers. Our strong belief is that a natural gas vehicle system now is blazing the trail and setting the stage for a hydrogen infrastructure. You have natural gas going to the filling station and then converted at the filling station into hydrogen and put on the vehicle. What you need for hydrogen is gaseous fuel storage, gaseous metering, gaseous dispensing. We are doing all that. You need mechanics that understand how to deal with gaseous fuel. You need buildings that are instrumented with sensors and whatever to handle gaseous fuel since it is lighter than air and it does not sit in the air, as opposed to petroleum fuels. We are doing that. You need a public that is comfortable dealing with gaseous fuels in their vehicle. We are doing that.

So the more we are successful, the easier it will be to transition to a hydrogen future. We strongly believe that the only way you get there, to a hydrogen future, is through another gaseous fuel, in this case natural gas.

The CHAIRMAN. Thank you.

My time is up. Senator Hagel.

Senator HAGEL. Mr. Chairman, thank you. I am going to have to leave to get to another meeting, but I wanted to say that, first, I very much appreciate this panel coming before us this morning. This panel represents the future for our energy transportation technologies, fuels, vehicles, and our questions and concerns and problems that we have regarding this universe are going to be found in your testimony.

There are pieces of that that you have all in your organizations you represent have put a lot of time into, and we will continue to work through the developments of each of your technologies and thoughts and ideas and innovations.

So, Mr. Chairman, I want to thank you again and this panel in particular for sharing your thoughts and expertise.

The CHAIRMAN. Thank you very much.

Senator Akaka, you came and left. Did you want to go, or should Senator Carper, either one of you?

STATEMENT OF HON. DANIEL K. AKAKA, U.S. SENATOR FROM HAWAII

Senator AKAKA. Thank you very much, Mr. Chairman. Thank you, and at this time I want to add my welcome to the panel before the committee.

I would like to comment on S. 1053, a bill that reauthorizes the Hydrogen Future Act enacted in 1986. It directs the Department of Energy to continue to research and develop hydrogen technologies. The bill is important to the Nation because hydrogen has the potential to free our Nation from imported oil and provide a clean and abundant energy source.

I have had an abiding interest in hydrogen as an energy source and have championed its advancement for a long time. The Hydrogen Future Act is a legacy of my friend and predecessor in the Senate, Senator Sparky Matsunaga. He was the first to focus attention on hydrogen by sponsoring hydrogen research legislation. The Mat-

sunaga Hydrogen Act, as the legislation became known, was designed to accelerate development of hydrogen technologies.

As a result of Senator Matsunaga's vision, the Department of Energy has been conducting research that will advance technologies for cost effective production, storage, and utilization of hydrogen. I am convinced that in the next few decades, hydrogen will join electricity as one of our Nation's primary energy carriers, and hydrogen will ultimately be produced from renewable sources.

Technical and institutional challenges and barriers to wider use of hydrogen are being surmounted at an accelerating pace on a global scale. Iceland is making a strong bid to become the world's first hydrogen-based economy. In the United States, I am pleased that the State of Hawaii has enacted legislation that would facilitate a public-private partnership for promoting hydrogen as an energy source. In California, the State's zero emissions vehicle requirements favor early introduction of hydrogen-powered vehicle.

Despite the progress, many challenges remain for hydrogen. Production costs remain high. Attractive low-cost storage technologies are not available and the infrastructure is inadequate. We need to address these barriers if we are to enjoy the fruits of an efficient and environmentally friendly energy source. An aggressive research, development, and demonstration program can help overcome many of these problems.

Mr. Chairman, I hope the committee will move quickly on this bill and I look forward to asking questions to the panel. Hydrogen storage—this is my question—storage, transport, and distribution systems are critical to advancing widespread use of hydrogen for energy. Currently, the infrastructure needed for this purpose does not exist. Dr. McCormick smiles.

Any of the panel members may respond to this. I have a three-part question for you. Is there a role for the Federal sector to help speed infrastructure development? What is the general time frame envisioned for the Nation to have a substantial hydrogen infrastructure? Third, what are the most critical barriers to the development of the hydrogen infrastructure for vehicular applications?

As I mentioned his name, maybe I should ask Dr. McCormick first.

Dr. MCCORMICK. Thank you, Senator. First of all, as I noted in my written comments, both fuel cells and hydrogen storage and the reason we are here today really derive from previous investments and previous support by members of this committee for the Department of Energy programs. So I think that clearly as the first element of it we should continue the basic research on advanced hydrogen storage technologies and basic fuel cell technologies.

The second role for the Federal sector, and it is one that will have to evolve over some time, and it really relates to the barriers, and that is that in order for people to place a hydrogen infrastructure in place there needs to be a consistent set of policies over an extended period of time to allow it to happen. I would ask you to recall that 60 percent of the gasoline dealers, the dispensers of gasoline to our cars, are small business people. They cannot afford to be flip-flopped around, nor can they afford to do five or six different options. Their economics just purely will not allow it.

So consequently, I think there is a role in the Federal sector for developing consistent long-term policies that focus towards and direct us towards the hydrogen solution and fuel cells as well, because I think our payoff, as we have talked about earlier today, is huge. We have the payoff of displacing petroleum, and the really nice thing about the hydrogen economy—and I really like your notion of energy carriers. I believe there will be two, electricity and hydrogen. The advantage of both of them is they can be made from any source, and hydrogen is the logical one for cars. So I think it is a very logical approach.

With respect to storage, we are making tremendous progress. We are working with technologies now in the compressed area which will put the vehicles out and have compatible range with the current generation of vehicles. We are working on electrolyzer technology, which I alluded to earlier today, which will decompose water from electricity to make hydrogen, but it will deliver that hydrogen directly at pressure. That is very important because if you need an efficient system you do not want to put an extra compressor in there cost and efficiency-wise.

I think we are making tremendous progress, but I believe that we would like a breakthrough. We would like something beyond compressed, we would like something beyond liquid. We are investing worldwide in a number of different technologies, but I think it is one that could yield to some good fundamental science. So I would urge again very solid funding at national laboratories, universities, research organizations to do that.

Relative to the time frame, that is a tough one because from our viewpoint we believe that we are going to break down the technical barriers for the fuel cell hydrogen vehicle within this decade. Our rate of progress is astounding, and I say that as somebody who has tracked the technology for a long time and I cannot believe how it is moving worldwide.

But the time frame then really becomes one of dealing with the barriers to put in the infrastructure, and there it does become economic and policy-driven. So from my viewpoint, I think we have the opportunity to begin to see a major transition by the end of this decade. I think in order to do that we have to start getting consistent policies and consistent themes that focus around that issue so there is not confusion and then start working in an orderly fashion to do large demonstrations where we can understand what the flaws are and move it forward and demonstrate the safety, and ultimately put in place tax incentives, etcetera, for all of the people that have to be involved in doing this. That is, the small business people who have to put in the distributors, the people who would generate the hydrogen from a multiplicity of sources, as we heard today.

So I think that the real barrier is going to be that infrastructure, and there we need policy.

The CHAIRMAN. Thank you very much.

Senator Carper.

STATEMENT OF HON. THOMAS R. CARPER, U.S. SENATOR FROM DELAWARE

Senator CARPER. Mr. Gibbens, I missed your testimony. I apologize for arriving late. Take just a minute and hit me with some of the most important things you said, please.

Mr. GIBBENS. Well, I think the most important thing is that any of the mandates, either on the current mandated fleets or on the proposed government or private fleet, simply will not give you the petroleum reduction that was envisioned in EPAct. Studies have indicated that all those fleets, if they fully complied, would only give about a 1.5 percent reduction. As much as we would like to comply, there are significant barriers, cost barriers in the acquisition of the vehicles, disposal of the vehicles, the kinds of vehicles, alternative fuel vehicles that might be available to meet our operational needs, and probably most significant, as everybody has mentioned here, is if I choose a particular alternative fuel type vehicle where do I get the fuel? In other words, where is the fuel infrastructure? Unless I choose to fund that, which is very expensive, the marketplace is just simply not there for us to pick any particular type of alternative fuel vehicle and then be guaranteed a place that I can go refuel that vehicle.

So those are the major points in my presentation.

Senator CARPER. Thank you.

Dr. McCormick, about a year and a half ago I was in Michigan for a wedding and I happened to spend some time visiting with Rick Wagner. He said: We are having an auto show in Detroit right about now. It was January 2000. He said: If you want to go, we will try to arrange it to get you in. I had about an hour or so and I went to the auto show.

Among the things I saw there was a GM concept vehicle. I am trying to remember the name of it. I think it started with a "P".

Dr. MCCORMICK. Precept.

Senator CARPER. Precept, yes. Precept, which I think was expected to be available for purchase maybe in 2004. I seem to recall that it is expected to realize 70 or 80 miles a gallon. It was a hybrid. I was excited about it at the time, thought about it often since then. Whatever happened to Precept?

Dr. MCCORMICK. Well, let us go through the history of Precept. It is a derivative of our PNGV program and it did achieve those remarkable mileages. I might add that we did a mockup fuel cell version which had fuel economies of over 100 miles per gallon as well. That was not intended to be a for-sale vehicle. It had a lot of very advanced technologies in it, many, many patents. But I think very rapidly you will see those begin to transition into more conventional cars. I agree with you it was an astounding car, and now we are trying to move the technologies as quickly as we can into our base vehicles.

Senator CARPER. You might be right, and a year and a half ago maybe there was no notion or interest at all in making that a vehicle widely available for distribution. That sure was not my understanding at the time, it really was not.

Let me just ask—I am a guy who believes in buying domestic cars. We buy Ford, Chryslers, GM in our home. A little over a year ago a woman pulled up to my office, when I was Governor of Dela-

ware, pulled up to our office and said: I bought a new car. I said: What did you get? She said: I bought a Toyota. After I chastised her, she said: Well, it is a Toyota, it gets exceptional gas mileage. She said: Come take a look at it.

I did. It is their hybrid, and I was struck by the fact that it is actually a reasonably attractive vehicle, that the size of the battery pack was not all that great, it is four-door and reasonable trunk space. The cost was I think maybe $20,000, which I am told that Toyota takes about a $10,000 loss on each vehicle they sell. I think they are building about 20,000 of them this year. What I am told, they are selling basically all that they make.

I think Honda has a hybrid out as well. But I am concerned. Here we are, the United States, leader of the free world, leader of the world, and we have got Toyota and Honda out there not just building these cars, but actually taking them to market and selling them in numbers which I think with Honda, I think they are going to expand their hybrids to not only go into the—what is their hybrid called?

Mr. ZELTMANN. Honda Insight.

Senator CARPER. Yes, Honda Insight. I hear they may be taking it to the Civic, putting it as a powerplant in some of the Civics, within a year or so. I am just troubled by the fact that—this goes back to my excitement with the Precept. I said, well, 2004 is a lot of time to wait for the Precept, but it is better than not at all. Yet we have got the folks from Honda and the people from Toyota with vehicles on the road, not in huge numbers but significant numbers, but in numbers that are going to grow rather substantially, getting 50, 60 miles per gallon, and we are looking forward to a vehicle in model year 2003, maybe 2004.

Why are they ahead of us? I do not mean to be argumentative. It is just troubling to me.

Dr. MCCORMICK. I feel I need to respond. I do not believe they are ahead of us. First of all, we did the EV-1 and drove the electric propulsion. We were the people that really broke the ground for a lot of this, and from that we learned a lot, one of which is for these vehicles to sell you have to bring them in at a very reasonable price. Also, we learned from the electric vehicle that we needed something other than an electric battery or we would not be able to sell them in quantity.

We are developing the technology very aggressively and are bringing out a variety of vehicles in the 2004 time frame. They are focused particularly on the heavy duty vehicles, the trucks, because those are the vehicles that consume the most fuel and that is the place where we can get the most benefit in terms of imported petroleum.

You correctly noted—and I would note that we have a deep partnership with Toyota, so we understand propulsion with them—that both of those two vehicle types are subsidized. So it is a matter of how much do you want to lose in putting those vehicles out there versus what you can learn. We actually believe that our 2004 pickup truck is actually a sound financial and business plan and will actually make money, and that is the key to these things. If you want them to be sustainable, you have to have the right product that consumers will buy and actually make money.

So I think you will see these vehicles out there. We also have our Paradigm system coming about at that time, which will go across mid-sized vehicles. So I think we are right report with them. These early vehicles are matters of how much money are you willing to lose.

Mr. DANA. Senator, may I make one point also?

Senator CARPER. Yes, please.

Mr. DANA. The Precept, which is one of, as Dr. McCormick said, of the PNGV program, the manufacturers of PNGV focused on diesel hybrids. Right now EPA has put out a final rule that would clean up diesel fuel by 2006. That rule is in litigation, and there are also emissions standards——

Senator CARPER. What are you saying, that rule is in litigation?

Mr. DANA. Yes, it is. EPA has also set emissions standards for 2004 and later vehicles where the ability of a diesel engine to meet those standards is somewhat questionable. It really depends upon this clean fuel that is being put out there. So in some ways I think it is fair to say that manufacturers who are looking at diesel have some roadblocks in the future years in terms of do you really want to commit to large volume production until these things are cleared up and what is going to happen in that future.

Senator CARPER. Thank you.

Is my understanding about Honda putting the hybrid propulsion system in Civics, is that correct? Are they going to do that?

Mr. DANA. That has been announced in the press.

Senator CARPER. Do you think they are doing it to lose money?

Dr. MCCORMICK. Well, at the end of the day let us see what they price it at and how many of them they sell. Again, we did not do the EV-1 to lose money either, but it is a tough proposition. You have got to see what the consumer is willing to pay.

Mr. KOLODZIEJ. Senator.

Senator CARPER. Yes, please.

Mr. KOLODZIEJ. Honda is a very smart company and it makes sense for them to do whatever they are doing. So if they are putting it in the Civic it makes sense somehow economically for them.

The other important point for you is to keep in mind that the cleanest internal combustion vehicle ever commercially produced is being made right now in Ohio. It is a Honda. It is a Honda Civic GX natural gas vehicle. But every one of them are made in Ohio.

Senator CARPER. Marysville?

Mr. KOLODZIEJ. I believe it is Marysville.

Senator CARPER. Dr. McCormick, you talked about the truck that they are going to introduce the hybrid in. That was model year 2004. Any idea what the gas mileage would be without the hybrid?

Dr. MCCORMICK. I do not remember the exact numbers. That is about, over the drive cycles that we look at, that is about a 15 percent improvement in the fuel economy of that vehicle.

Senator CARPER. Roughly what would its fuel economy be without the hybrid?

Dr. MCCORMICK. I do not know that I remember that off the top of my head.

Senator CARPER. Well, let us just say it is 16 miles per gallon. Let us say it is 20, let us say it is 20. 15 percent would go from 20 to 23 miles per gallon, right. I know there is a good explanation

as to why that is better, to make that 3 miles per gallon jump in a vehicle. What would you sell, half a million of them, 250,000?

Dr. MCCORMICK. We are expecting the number to be somewhat smaller because of the premium.

Senator CARPER. Because of?

Dr. MCCORMICK. We are expecting the number of vehicles to be sold to be smaller than that because of the premium price for it. We are going to find out.

Senator CARPER. Just refresh me again on why are we better off as a country to realize a 3 miles per gallon increase in the efficiency of that pickup truck as opposed to a Precept that would get twice the gas mileage?

Dr. MCCORMICK. I do not think we are. I think we want to get to twice the gas mileage, which is again why I am advocating fuel cells.

Senator CARPER. But in the near term. We realize and I applaud what you are doing in fuel cells and I think it is exciting, I am anxious to get there, anxious for us to adopt a policy that is supportive. But in the meantime, we are stuck with what we have. In the meantime, we have the potential for some of the alternative vehicles and fuels that we have talked about, and in the meantime we have this hybrid technology.

I am intrigued to see somebody out there, Honda, thinks that they are onto something, and they are going to start expanding, not just into that one vehicle, but into maybe others. What I am having a hard time understanding—and I certainly do not mean to be picking on you, but I am having a hard time understanding why we are better off increasing the efficiency and one vehicle go from 20 to 23—and I have had the same conversation with my friends from Daimler Chrysler about the Durango, which is built in my State.

Why are we better off going from 20 to 23 and why do we not find some vehicles that we could come closer to the Precept as well? Is it the fear that nobody will buy them?

Dr. MCCORMICK. Well, two comments. First of all, I want to make sure that you are clear that we are also bringing out a mid-sized car using the Paradigm system in that time frame. So it is not just the truck that we are looking at.

But when you look at where the fuel is actually used, it turns out when you do the mathematics, actually sit down and do the calculation, a similar improvement on a high fuel usage car net gives you less fuel imported than a similar improvement on a higher mileage car percentage-wise.

Senator CARPER. I asked you earlier how many pickups you thought you would make with the hybrid system in them and I think you said probably fewer than 250,000 per year.

Dr. MCCORMICK. We are not sure quite what that number is, but we are being conservative going forward to make the business case for it.

Senator CARPER. Let us just assume for the moment that it is 200,000. Let me see if I can do any math in my head still at this advanced age. But if you have 200,000 vehicles that you sell and you get an increase in mileage of 3 miles per gallon, that would be what, 600,000. If you could sell, gosh, 20,000 vehicles that got an

extra 30 miles per gallon, the savings would be the same. Am I missing something there?

Dr. MCCORMICK. Yes. You have to look at miles driven and total miles used per year. So across a 10,000 mile annual drive something that gets 20 miles per gallon uses a lot more fuel and so consequently a small improvement in that really affects the bottom line amount of fuel. Remember, the people drive the same number of miles per year and so you get a disproportionate gain in the total fuel used.

Senator CARPER. Let me just carry out my example earlier. The same situation, 200,000 pickup trucks, 3 miles, increased miles per gallon. If we were able to—let us see. If you were able to build and sell 40,000 vehicles, 40,000 vehicles like a Precept, but even not nearly as good as a Precept, but if you were able to sell 40,000 vehicles that were only driven half as much, only half as much, but got an extra 30 miles per gallon, you would be at a break-even.

Is part of what is not being said here that the reason why it makes sense to put them on the SUV's and the trucks is because that is where we make money when we build vehicles? We do not make money, if you are Chrysler, they do not make money selling Neons. They make money selling Jeeps.

I do not know if you folks make much money on your Cavalier. You make money on your Tahoe. In terms of being able to do this in a way that makes sense for your company, trying to understand the logic and rationale for going with the trucks and the SUV's is in order for the free enterprise system to work and for you to make money doing this stuff you have got to put it into vehicles, because there is extra cost, you vehicle got to put them into vehicles that you can sell at a markup and will cover your costs.

Is that part of it?

Mr. KOLODZIEJ. Senator, this is not my area, but I just cannot keep my mouth shut. The issue is fuel displacement. If you have got a vehicle that is getting 30 miles per gallon and mom and pop buys them, mom and pop is driving 12,000 miles a year using, what, 400 gallons, 400 gallons. Now, you have got a duty cycle on a pickup truck, you might be putting 60,000 miles on that vehicle at 20 miles to the gallon. That vehicle is using 3,000 gallons.

If you can increase the fuel efficiency on that vehicle 15 percent, you have got an increase of a lot. If you doubled it from mom and pop—you are actually getting more fuel displacement by going after the heavier duty vehicles. Even though it looks like a smaller number, because of the duty cycles you can get a bigger impact. A class A truck might go 120,000 miles a year at 6 miles or 4 miles a gallon. So if you can get a small percentage increase improvement there, you can have a big impact on the total fuel use.

As to the financial strategy, Byron, you want to answer your financial strategy?

Dr. MCCORMICK. Let me expand on that. Actually we have introduced hybrid buses and it turns out that if you did 13,000, a very small number, 13,000 hybrid bus propulsion systems in the United States, that would be equivalent to a half a million Prius's in terms of fuel displaced. So I think the calculation that Rich talked about is very key and what you want to do is calculate how many gallons of fuel does a vehicle use per year and then how much can I im-

prove that, and you find out that the average consumer driving an SUV, a bigger truck, consumes so much fuel that a percentage improvement there is very, very, very effective.

Senator CARPER. What I want to do is sit down with pen and paper and my calculator and run some numbers, not at a hearing but afterwards. Tom Davis was by, who runs your truck operation, last week and I spent some time with him. He talked about the buses. It is very promising, very promising, and I am encouraged by what you are doing there and hope that maybe in a later round of questioning if we have that that I can pursue that with you. Thank you.

The CHAIRMAN. If you had another question, why do you not go ahead.

Senator CARPER. Mr. Chairman, I have got enough questions here to keep us here for 2 days.

The CHAIRMAN. Well, maybe you should visit with some of the witnesses after the hearing, then, because we are about to adjourn the hearing. I think everyone——

Senator CARPER. Could I ask one more, then?

The CHAIRMAN. Sure.

Senator CARPER. Thanks very much.

In Delaware we raise—we build more cars, trucks, vans, automotive vehicles than any other State per capita. We also raise more chickens per capita than any other State. We raise more soybeans in Sussex County, Delaware, than any county in America, and we are real interested in trying to find ways to take the oil from soybeans and to turn it into a product that can be mixed maybe with diesel fuel and come up with something that is fuel efficient, good for the environment, and that helps commodity prices for soybeans as well.

We are finding when we tested it in our DELDOT vehicles in Delaware for the last year, year and a half or so, and we find it does pretty well with respect to fuel efficiency. We find that it actually smells pretty good. It smells like french fries. But we find that on the emissions side the only area that it lets us down is on NO_X. The NO_X emissions are a little bit higher.

I do not know who was testifying earlier, maybe it was Mr. Marshall, talking about ethanol and trying to encourage people to buy ethanol. But as I listened to you I think I heard you say that for folks to use ethanol to power their vehicles it costs a little bit more, the fuel efficiency is not quite as good, and it is harder to find, it is less convenient for the consumers, which probably explains why we do not use as much of it. If it costs more, it is less efficient, and it is harder to find, that would discourage me from using it, and that is from a guy where we raise a lot of corn and a lot of soybeans.

Mr. MARSHALL. Senator, part of the problem is we can build an automobile that runs on almost any fuel, but the problem is with the infrastructure, the availability of fuel. The different fuels that are out there, none of them are quite as easily available as gasoline, which we have used for many, many years. That is part of the problem we have been talking about, all of us, about the infrastructure development that is necessary.

Senator CARPER. Go ahead, Mr. Marshall. Go ahead and make a comment, and then I will jump in.

Mr. MARSHALL. You hit on a number of points. The key point is providing the incentives to utilize the product. Ethanol can compete very well with compressed natural gas, propane, or anything else provided the incentives are on a gasoline equivalent basis and the energy is as well. The big problem has been availability. Where we have been able to go in and specifically target areas around the country—Chicago, Denver, and some of the other places—and look at alternative fuels there, we have been able to provide it through some of the existing infrastructure and it is working very, very well. All we need to do is expand the program.

Ethanol and E-85 is kind of in its infancy as compared to some of the other alternative fuels, but certainly, provided the opportunity, we have a lot of promise and a lot of potential to move forward.

Senator CARPER. Mr. Chairman, I think we have got all these gas stations around the country and they are on our block. Pretty much wherever we live, it is not too far to get to a gas station and we can buy the gasoline that we need for our cars, trucks, and vans. If we want to buy ethanol or soy diesel, if you want to buy some kind of natural gas—I am actually a Governor who used to have a vehicle that was powered by natural gas, a combination of natural gas and gasoline, so I believe in that stuff. But it was hard to find. I think we had three stations in all of Delaware where you could get the stuff, so it was not all that convenient.

But part of the—and we do not expect GM or Chrysler or Ford or anybody to build vehicles that nobody is going to buy. We do not expect them to build vehicles that they are going to lose money on, at least for long.

But this infrastructure, they put their fingers on a big one, and that is that this infrastructure, whether it is hydrogen or gasoline or alternative fuels or ethanol, unless we can somehow get our arms around that one and deal with it we are not going to be successful in this area.

The other thing, if we were on a committee where we actually got to write tax bills, tax legislation, and we could put in place all these incentives, I think we could probably do that pretty well. Unfortunately, that is not our job. But we get to work with the folks who are in that business and hopefully we will have some success in moving them along.

The last thing I would say is at the port of Wilmington we bring in, export GM products, and we are grateful for that business. We do a fair amount of business with Ford, some day maybe with Chrysler. We also do a lot of business with Volkswagen, and I visit with the folks up at Auburn Hills from time to time at Volkswagen America.

They say: You know, back in Europe we do great things with diesel. We get terrific fuel performance with diesel, 40, 50 miles per gallon, even better than that. They said they question why in America we do not do more with diesel. I said, well, it has something to do with the emissions. Someone talked earlier about I think it is the 2006 time target date.

Just take a minute, somebody who is familiar with the emissions problem that we have with diesel. Why are we unable to make as effective use of diesel today in the twenty first century as they are doing over in Europe?

Mr. DANA. That is something that we hope to be able to do, Senator. What has happened is diesel has always been used in Europe at a fairly substantial rate in the passenger automobile fleet, so a lot of the technological development has been driven in Europe. We now have very, very efficient diesels.

Most people in this country do not realize you can build a diesel that is quiet, clean, no black smoke, and is very comfortable to ride in because the diesel penetration in any kind of light duty vehicle in this market is very, very small.

The problem I mentioned earlier, we see diesel as one of the potential tools the industry has to improve fuel efficiency of the vehicle fleet, but because of the conundrum of the existing emissions standards for 2004 and later and the clean fuel that is supposed to be coming in 2006, I think it is difficult for a manufacturer to commit resources with an unsure future.

If we can see a future out there that says this will be viable for the long term, I think they will make the commitment, the dollar commitment to make that technology available. Clearly, there have been very big advances in diesel technology and with the clean fuel we think they can meet most of the emissions standards that are being proposed.

Senator CARPER. The interesting thing, Mr. Chairman, about the diesel alternative is that the infrastructure is there. In most places where you buy gasoline, a lot of those places you can buy diesel as well. If we could figure out how to hit our emissions targets, that would certainly appear to have a fair amount of promise.

I have gone too long. Thank you for your patience. To our witnesses, especially Dr. Mccormick, thank you very, very much for being here and sharing your thoughts. I appreciate the chance to come back to you later on with follow-up. Thank you.

The CHAIRMAN. Well, thank you all very much. I think it has been very useful testimony, and we will adjourn the hearing.

[Whereupon, at 11:58 a.m., the hearing was recessed, to be reconvened on July 18, 2001.]

NATIONAL ENERGY ISSUES

WEDNESDAY, JULY 18, 2001

U.S. SENATE,
COMMITTEE ON ENERGY AND NATURAL RESOURCES,
Washington, DC.

The committee met, pursuant to notice, at 9:30 a.m. in room SD–366, Dirksen Senate Office Building, Hon. Jeff Bingaman, chairman, presiding.

OPENING STATEMENT OF HON. JEFF BINGAMAN, U.S. SENATOR FROM NEW MEXICO

The CHAIRMAN. We will now begin the legislative hearing we have scheduled this morning on research and development provisions of the various energy-related bills that have been introduced and referred to this committee. These bills include the Democratic and the Republican energy policy bills, numerous other specific bills, most of which have bipartisan co-sponsorship.

Energy research and development attracts broad bipartisan support in Congress precisely because most members believe that advancing our understanding of energy, science and technology is crucial to being able to meet the energy challenges of today and tomorrow. Our domestic energy, security, and our future economic prosperity depend upon our ability to use research and development to increase the efficiency of our energy use while at the same time producing the energy that we need more cleanly and economically. Given that reality, it was most unfortunate that the administration earlier this year decided in the context of their budget proposal to make substantial cuts in energy research and development in areas such as renewables and energy efficiency. While barely holding steady the funding on basic energy science, Congress has since rejected these cuts by broad bipartisan majorities, both in the interior appropriations bill and in the energy and water development appropriations bill that is now on the Senate floor.

The Department of Energy is one of the most important science research agencies in the Federal Government. Its overall civilian research and development budget in energy, which is $4.8 billion in fiscal year 2001, is greater than that of the National Science Foundation, which was $3.4 billion. The Department of Energy operates unique scientific facilities that scientists supported by other Federal agencies use to carry out their research. For some scientific disciplines, the Department of Energy is nearly the sole source of Federal support. As we move forward in drafting energy legislation, it is crucial, in my view, that we increase both the size and effectiveness of the Department of Energy's research and development

budget. We need to focus both on increasing support as well as increasing the effectiveness of that program.

Both Senator Murkowski and I have introduced bills that exceed the administration's budget in energy research and development. I hope that in the days and weeks ahead, both the administration and the Congress will embrace a vision of the importance of energy research and development that is consistent with its scientific promise and the need for new energy technologies and the views of the American people.

Before I start with our witnesses, let me call on Senator Murkowski for any comments he has.

[A prepared statement from Senator Domenici follows:]

PREPARED STATEMENT OF HON. PETE V. DOMENICI, U.S. SENATOR FROM NEW MEXICO

Mr. Chairman, thank you for holding this hearing today on energy-related research and development issues. I appreciate that your goal is to develop comprehensive legislation later this month. As we do this, the guidance in the President's National Energy Policy should be carefully followed.

It's certainly important that the Senate act quickly on the National Energy Policy in order to move ahead with its important recommendations. There should be no question that the nation is experiencing an energy crisis, and we need prompt action to improve the current situation. The actions outlined in the Policy will dramatically improve our long-term energy outlook.

There is no single "silver bullet" that will address our nation's thirst for clean, reliable, reasonably priced, energy sources. That's why the National Energy Policy carefully reinforced the importance of many energy options. Energy is far too important to our economic and military security to rely on any small subset of the available options.

As your hearing is being held, we're debating the Energy and Water Development Appropriations bill for Fiscal Year 2002. That bill determines the funding levels for many of the programs being discussed here today. I'm very proud that this bill makes immense progress in funding a diverse set of energy sources and significantly advances the agenda of the National Energy Policy. For example, that bill funds renewable programs at $435 million, even more than proposed in Senator Bingaman's energy bill.

Despite the breadth of the Energy and Water bill, I'm going to focus my comments today on nuclear energy, which now provides about 22 percent of our electricity from 103 nuclear reactors. The operating costs of nuclear energy are among the lowest of any source. That's why I, and 18 of my colleagues, have joined together to back Senate bill S. 472, devoted to insuring that nuclear energy remains a strong contributor in our national energy mix.

Nuclear energy is essentially emission free. We avoided the emission of 167 million tons of carbon last year or more than 2 billion tons since the 1970's. In 1999, nuclear power plants provided about half of the total carbon reductions achieved by U.S. industry under the federal voluntary reporting program. The inescapable fact is that nuclear energy is making an immense contribution to the environmental health of our nation.

We can learn much from the French performance. France generates 76% of its electricity from nuclear. That helps them achieve spectacular results for minimal emissions of carbon dioxide. Their emissions per dollar of GDP are almost 3 times lower than ours. I look forward to the testimony of Mr. Jacques Bouchard from the French CEA to learn first-hand about their experiences.

Unfortunately, when it comes to nuclear energy, we're living on our past global leadership. Most of the technologies that drive the world's nuclear energy systems originated here. Much of our early leadership derived from our requirements for a nuclear navy; that work enabled many of the civilian aspects of nuclear power. Federal actions are required now to insure that nuclear energy continues its vital contributions.

S. 472 has many features, and only some of them are included in today's hearing. One provision would designate an Assistant Secretary to lead the Department's nuclear energy and science programs. To me, it's not appropriate to have Assistant Secretaries leading all the other major energy categories except nuclear.

Several of the provisions in S. 472 authorize important nuclear energy programs—programs which have been included within past Energy and Water Development bills. The Senate is now in final debate on the Fiscal Year 2002 version of this bill which would significantly increase funding for the Nuclear Energy Research Initiative, the Nuclear Energy Plant Optimization, and the Nuclear Energy Technology Program, and almost double funding for university programs.

The bill includes key provisions to improve the ability of our uranium mining industry to compete in the future through research on improved technologies that will have less environmental impact.

The hearing today also covers research toward new Generation IV plants. Technology to build these plants is close at hand. This bill not only supports research and development on these plants, it also helps develop the regulatory framework within the NRC that must be in place before they can be licensed.

Generation IV plants would:

- be cost competitive with natural gas;
- have significantly improved safety features with the goal of passive safety systems that would be immune to human errors;
- have reduced generation of spent fuel and nuclear waste; and
- have improved resistance to any possible proliferation.

Many of the Generation IV concepts would involve small modular plants. With such plants, we should be able to dramatically cut the time required for bringing a plant on line, and do it for far less capital investment than the current very large plants. Small Generation IV plants may be useful in developing countries, where they could help these nations increase their standard of living without compromising clean air.

In addition, we're considering Titles IV and V of S. 472 today. These Titles are devoted to exploring improved strategies for management of spent fuel. They establish an Office to manage research on these key questions. These studies would involve work on reprocessing and transmutation. I'm particularly looking forward to the views of our distinguished witnesses on these subjects today.

Let me emphasize, Mr. Chairman, that I used the phrase "spent fuel" rather than "waste" to refer to the materials coming out of our reactors. Right now our national policy calls for disposing of those materials as waste in a future repository. But we need to remember that these materials still contain 95 percent of their initial energy content.

I've been concerned for years that it highly debatable for us to decide that future generations will have no need for this rich energy source. With improved management strategies, possibly involving reprocessing and transmutation, we can recycle that material for possible later use, recover far more of the energy, and dramatically reduce the toxicity and volume of the materials that are finally declared to be waste.

My speech at Harvard in 1997, which helped start the rebirth of interest in nuclear energy, was the first time I publicly questioned President Carter's decision to ban reprocessing. I believe that was a serious step backward for our country. I'd like to repeat some of the words from that speech:

> *In 1977, President Carter halted all U.S. efforts to reprocess spent nuclear fuel and develop mixed-oxide fuel (MO_X) for our civilian reactors on the grounds that the plutonium could be diverted and eventually transformed into bombs. He argued that the United States should halt its reprocessing program as an example to other countries in the hope that they would follow suit.*
>
> *The premise of the decision was wrong. Other countries do not follow the example of the United States if we make a decision that other countries view as economically or technically unsound. France, Great Britain, Japan, and Russia all now have MO_X fuel programs.*
>
> *This failure to address an incorrect premise has harmed our efforts to deal with spent nuclear fuel and the disposition of excess weapons material, as well as our ability to influence international reactor issues.*

In closing, Mr. Chairman, my S. 472 was designed to enable nuclear energy to be a viable option for our nation's electricity needs. It would help ensure that future generations continue to enjoy clean, safe, reasonably priced, reliable electricity from nuclear energy.

STATEMENT OF HON. FRANK H. MURKOWSKI, U.S. SENATOR FROM ALASKA

Senator MURKOWSKI. Thank you very much, Senator Bingaman. I want to thank you for holding the hearing today. We both have been long time supporters of energy research and development, whether it be fossil or nuclear, renewable or energy efficiency, and through the development of advanced energy technologies, I think we both agree we can avoid the false choices between energy and the environment. We want to make our decisions on sound science. I've said that time and time again, but I think it is most appropriate to reflect on this. So often, you know, we are expected to have the knowledge and background to make a decision. We have to make decisions. We vote yes or no. We can't vote maybe, so we have to depend on people who are willing to put their reputations as experts behind their recommendations. Otherwise, you're going to get what you would expect from pretty much a public forum. You can get expressions and motions but not sound science. In any event, what we are looking for today, through the development of advanced energy technologies, is to try and avoid those false choices. A choice that radical environmentalists from time to time seem very eager to force upon the American people—again without the science.

Nowhere is the value of advanced energy technology more on display certainly in exploration than my State of Alaska, where one only needs to contemplate the rigors of 70, 80, 100, 120 below zero working conditions in areas of permafrost where we have been able to maintain footprints that are extraordinarily compact. Ice roads, 3D seismic, all new technologies that reduce the disturbance on the tundra. Directional drilling, it has been indicated by the engineers that they could drill in this room and come out at Gate 8 at Reagan Airport. They have that degree of accuracy. R&D funded by the Department of Energy and industry has made it all possible and this will yield more benefits in the future. Energy R&D will give us the technologies of tomorrow that will provide a clean, safe and affordable energy supply. Cleaner fossil fuels, safe next-generation nuclear power, affordable renewable energy technology, energy efficient technologies that will allow us to do more with less.

We have to keep in mind that we just can't throw money at it. Money alone is not the answer. We must ensure that our R&D programs are oriented in the right direction with concrete goals and objectives and checks and balances. We can all justify more expenditure, but we have got to have measurements and successes. We must fund a portfolio of priority options just as you would invest in a portfolio of stocks to hedge your bets. And, most importantly, we must be ready to take on some risks—some high risks, high reward for breakthrough technologies. That is how they come about. An R&D program without some failure is not pushing the envelope hard enough, in my opinion. I know the National Academy of Science will have much to say about their recent review of Department of Energy energy R&D programs and I look forward to their suggestions as to what changes they would suggest to help energy R&D along.

One of the frustrating problems that's been before this committee for as long as I have been a member, and that's over 20 years, is

what to do with our high level waste-spent nuclear fuel. Our spent waste, I should say. Reprocessing is one alternative, and I gather that we're going to have a third panel today of witnesses that will address the issue of reprocessing of spent nuclear fuel. I'm going to have to go down to the floor a little after 10 o'clock on energy and water but I hope to get back to participate in the third panel.

Clearly, one of the issues with nuclear power is the storage of the high level radioactive waste. According to some in this Senate, Yucca Mountain is dead. That is pretty hard to take if you are a taxpayer and consider that we've spent over $8 billion so far on Yucca Mountain. I don't think it's dead. Even with Yucca, it makes sense to make as little waste as possible, and that is the advantage of the advanced technology.

Reprocessing does offer a way to use more of the energy stored in the fuel to reduce the waste volume. Of course, there are risks involved, nuclear materials and proliferation, but there are large benefits to be gained if we can develop new technologies to reduce and reuse nuclear spent fuel.

And finally, we must recognize that R&D funding alone is not a sufficient substitute for a comprehensive national energy policy when you look at what other countries are doing, France particularly and Japan in this area of high level nuclear waste reprocessing. In any event, while R&D can help us develop the technologies of tomorrow, it cannot solve the problems of today with the current energy crisis. We still need an increase in supply of conventional fuels, expanded energy efficiency, more renewables. And we need to invest heavily in the infrastructures needed to move the energy from the wellhead or powerplants to the consumers in both pipelines and electric transmission lines. Energy R&D does have a central role to play and I look forward to hearing from our witnesses on how we can better invest in our energy future. Thank you, Mr. Chairman.

The CHAIRMAN. Senator Burns.

STATEMENT OF HON. CONRAD BURNS, U.S. SENATOR FROM MONTANA

Senator BURNS. Thank you for holding this hearing. You know, today's attendance to this hearing is pretty indicative on how sexy an issue this is. If we were talking about the sucker fish, I'll guarantee you couldn't get another person in this place with a shoehorn. But R&D is important for our work over on the Commerce Committee when we worked with the NSF, being involved in EPSCOR, and the R&D that is going on in communications in our universities and even in our energy. No other committee and no other department has more to do with climate change in our high energy physics, our superconductivity, high performance computing. This is where it happens in this country in the high tech field. Now, we can talk about what's happening in the technology of communications, but as far as our every day life, this is where it's at. And yet, you know, we won't get now what is there over at the press table, a half a dozen over there that will write about this hearing today. And yet it's probably one of the most important hearings that we will hold in this committee, Mr. Chairman, and

I appreciate your interest in this. I appreciate your holding this hearing.

We have seen great things happening in wireless communications. I will tell you fuel cells is to the energy industry what wireless was to communications. And we have to look at these kind of different things to complete our work. Thank you, Mr. Chairman. If I can put my statement in, I would sure appreciate that.

The CHAIRMAN. Senator Carper, would you like to make any statement?

STATEMENT OF HON. THOMAS R. CARPER, U.S. SENATOR FROM DELAWARE

Senator CARPER. I feel inspired by the comments of Senator Burns and Senator Murkowski. I would make a very brief comment. I received a memo, I think yesterday, from Robert Simon, our staff director on the Democratic side and Bryan Hannegan, staff scientist, and this goes back to a point that Senator Murkowski was making about not being able to throw money at problems, even though on the R&D side, and I was just reading this last night. It says studies of the areas supported by Department of Energy R&D funding suggest significant payoffs from the research funded according to Department of Energy and validated by a GAO study. Efficiency R&D programs have returned over $100 billion to the U.S. economy for Federal investment of less than $13 billion since 1978. It goes on to mention a new report from the National Academy of Sciences. It reviews the Department of Energy's funding of DOE and fossil and energy efficiency areas and it looked at, I think, 17 R&D programs on energy efficiency that go back to 1978 and concluded that the Department of Energy's investment of $1.6 billion resulted in a return of about $30 billion. So, we're not just throwing money at these problems and issues but actually making some sound accomplishments. I would just want to put that on the record.

The CHAIRMAN. Thank you very much. Why don't we go ahead then with Francis Blake who is Deputy Secretary of Energy. Thank you for being back here with us.

STATEMENT OF FRANCIS BLAKE, DEPUTY SECRETARY, DEPARTMENT OF ENERGY

Mr. BLAKE. Mr. Chairman and members of the committee. Thank you very much for inviting me this morning and also, thank you for moving on the nomination of Dan Brouillette. We are very much looking forward to getting him on board the team. As you know, all major energy legislation has been bipartisan in nature and we look forward to working with this committee under your leadership and moving forward on a number of the legislative proposals you are now considering. For today's topic on research and development, as you all have mentioned, there is an important role for the Government and for the Department of Energy to play on research and development.

There are public benefits that exist that the private sector simply cannot capture and there is an important role for the Department in those areas. And in fact we are looking at technology to address some of the key challenges that we face. However, we can continue

to improve our standard of living and also address the environmental and other concerns that we have.

I would like to just submit my written testimony for the record and then briefly summarize the areas where I think we have agreement and then open my comments up for questions. I think the areas that are addressed in your legislation actually mirror fairly well the areas that the Department is spending research and development monies. You target renewables, hydropower, solar, wind, and we have activity in all of those areas. You have some legislation with recommendations on nuclear energy, particularly in the area of reprocessing. That is part of the President's national energy plan and we are supportive of that although we would note that even as we make progress there, that does not undermine the need for a deep geological repository for nuclear waste.

We also support focused carbon-based fuels research and development. It is particularly important in the environmental area and in improving efficiencies for our installed base and then more basic research on technologies as Senator Murkowski was referencing in the areas of hydrogen, fusion and other varied significant new potential areas. We are at an interesting point as well because as was mentioned, the National Academy has come out with its study that has looked at some of the results from prior Department of Energy R&D efforts, and I think has concluded that the public has received a good payback from that investment. They also have made some suggestions. I haven't read the report but I have seen the executive summary. They have made some suggestions that are very much in line with the administration's own thinking on how we need to be approaching our research and development efforts. We need to have good performance measures and metrics so that the money we spend is wisely spent. And we understand what we are expecting and what the appropriate off-ramps are for our investments.

We need to have a good understanding of the private public relationship, what the private sector will do better than the public sector, and how we can effectively join forces. And I think, as the NAS has emphasized, we do need a portfolio approach where we look at a number of different technologies that address different areas, a number of different stages of development, some basic research, some research and development, some demonstration, and also, different benefits that the research and development can address. Some environmental; some economic and some national security benefits. So, I think we are in large agreement with many of the recommendations that the NAS report is coming out with.

We look forward to working with this committee and just to echo Senator Burns' comment, if you look at the contribution that research and development has made in a number of areas, we view this as one of the critical functions of the department and very much appreciate your leadership and guidance in these areas. Thank you.

[The prepared statement of Mr. Blake follows:]

PREPARED STATEMENT OF FRANCIS BLAKE, DEPUTY SECRETARY, DEPARTMENT OF ENERGY

Mr. Chairman and Members of the Committee, I welcome the opportunity to testify before you today on various legislative proposals pending before the Committee. These proposals include Senate bills, S. 388, S. 597, S. 90, S. 193, S. 242, S. 259,

S. 472, S. 636, S. 1130 and S. 1166, the provisions of which address various aspects of the Department's scientific research and technology development programs.

First, I would like to thank the Chairman and Members of the Committee for your leadership and commitment in addressing the Nation's energy issues. I applaud the Committee's efforts to craft comprehensive long-term energy legislation. This Committee has a long and proud tradition of developing bipartisan energy legislation, and the Administration recognizes that all major energy bills have been bipartisan in nature. I look forward to working with the Committee to find areas of common ground and interest between the Congress and President Bush's policy proposals, as outlined in the National Energy Policy.

Turning to the matter at hand, the general focus of today's hearing is research and development (R&D). The Administration welcomes the Committee's interest in and support of the Department's scientific and research programs. America's energy challenge begins with our expanding economy, growing population and rising standard of living. Our prosperity and way of life are sustained by energy use. To meet our energy challenges of the future—promoting energy conservation, repairing and modernizing our energy infrastructure, and increasing our energy supplies in ways that protect and improve our environment—will require sound science, innovative R&D, and collaborative partnerships among all of our research organizations, public and private.

The Department's R&D programs are an important part of this effort to address and meet many of the challenges facing our Nation's future. They have a long and proven track record of past scientific and technical contributions in this regard. On one timely note in this vein, just yesterday, the National Academy of Sciences released its study of the Department's twenty-year R&D programs in the technology areas of energy efficiency and fossil energy. The Academy reported that the benefits to the Nation of these R&D efforts are large and increasing over time.

The Administration strongly supports research into advanced technologies and their underlying foundation of basic research. As the Academy's study suggests, Federal leadership in partnership with others can have a strong and beneficial influence on the advancement of technical solutions to many of Nation's greatest challenges.

As part of my responsibilities as Deputy Secretary, it is my intention to ensure that the Department's scientific and research portfolio is both well focused on our nation's needs and efficiently managed. One of the Administration's management priorities is for the Department to establish performance metrics for R&D expenditures so that we can look across our portfolio of activities and distinguish programs that are well-targeted and successful from those that are performing poorly or could be better undertaken by others. I look forward to working with this Committee on that effort.

SENATE BILLS

Mr. Chairman, the Senate bills and the particular titles and sections of these bills that are of interest to the Committee today cover a diverse mix of scientific interests, programs, enhancements to these programs, and related administrative actions. There are parts of ten bills, including eight mentioned in your letter of invitation and two bills added since then, of interest here today.

I want to assure the Committee that the Administration is interested in each provision of these bills. I can provide today some general comments on the salient aspects of some of these bills, but in other cases the Administration has not yet developed a full or formal position. We look forward to working with you on this in the weeks and months ahead.

With regard to S. 90 and S. 193, the Department has not yet taken any formal position. S. 90 would require the Secretary of Energy to support an R&D program in nanoscience and nanoengineering, and to establish similarly focused research centers, at authorizations totaling $1.36 billion over 5 years. S. 193 would require the Secretary to support a research program in advanced scientific computing, at authorizations totaling $1.15 billion over 4 years. Both bills are supportive of our ongoing programs in these areas, but the authorization levels are inconsistent with the Administration's budget requests and recent appropriations levels set by Congress.

S. 242 and S. 472 represent the first major nuclear energy legislation since the passage of the Energy Policy Act of 1992. At the outset, I would like to express the Administration's general support for legislation that sets a direction to implement the nuclear components of the Administration's National Energy Policy. S. 242 would require the Secretary to support a program to maintain the Nation's human resource investment and infrastructure in the nuclear sciences and engineering, in-

cluding a program supportive of student fellowships and university research and training reactors, and authorizes funding totaling $240 million over 5 years.

S. 472, entitled the Nuclear Energy Electricity Supply Assurance Act of 2001, would promote expanded use of nuclear energy as a major component of our Nation's energy strategy. The particular sections and titles of S. 472 that are of interest to the Committee at this hearing pertain only to the related research programs (sections 111, 121, 122, 123, 125, 127, 204 and 205), the development of a spent nuclear fuel strategy (title IV), and the application of advanced proton accelerators for the production of various isotopes and the transmutation of spent nuclear fuel and waste (title V). Authorizations for FY 2002 total $184.2 million for the research programs; $10 million for title IV; and $120 million for title V.

Similarly, sections 107 and subtitle B of S. 388 require the development of a national spent nuclear fuel strategy (section 107), and authorize for FY 2002 a total of $95 million for the nuclear energy research initiative, nuclear energy plant optimization, and nuclear energy technology development programs. These nuclear energy bills are supportive of ongoing R&D programs at the Department, but the authorization levels are inconsistent with the Administration's budget request and recent appropriations levels set by Congress.

In addition, S. 388 requires the Secretary to conduct a five-year program of research for natural gas technologies, including transportation and distribution infrastructure, and distributed energy resources and related natural gas-using equipment (section 115), and to establish an energy efficiency science initiative (title VI, section 607), the latter authorized for $25 million in FY 2002—which is an amount inconsistent with the Administration's budget request.

The pertinent sections of S. 597, the Comprehensive and Balanced Energy Policy Act of 2001, concern R&D programs in coal (title VIII); pipeline safety (for the Secretary of Transportation, in coordination with the Secretary of Energy, title XI); and a series of enhancements to R&D programs in energy efficiency, renewable energy, fossil energy, and nuclear energy, and to the fundamental research programs in energy sciences (Division E). These provisions, likewise, are generally supportive of our R&D programs in these areas. However, in light of the review of R&D investment criteria mentioned above, the Administration would prefer that the Committee not add new restrictions to funding allocations that might inhibit optimum allocation of research funds among basic materials, and development and demonstration in applied programs. The Department looks forward to working with the Committee on these matters.

S. 1130, the Fusion Energy Science Act of 2001, requires the Secretary to develop a plan, to be reviewed by the National Academy of Sciences, for a magnetic fusion burning plasma experiment and authorizes a total of $655 million over two years for the fusion energy sciences program energy. These authorizations exceed current Administration budget requests and recent appropriations levels set by Congress. We will be assessing the appropriate funding level for the Fusion Energy Sciences program.

S. 1166, the Next Generation Lighting Initiative Act of 2001, requires the Secretary to establish such an initiative, in conjunction with the establishment of a related research consortium and grant program, with annual reviews by the National Academy of Sciences. A total of $230 million is authorized over the first five years. This initiative is supportive of ongoing research at the Department, but adds funding and requires programmatic structure not currently envisioned by the Department.

ARKANSAS NUCLEAR PLANT DECONTAMINATION AND DECOMMISSIONING (S. 636)

The Administration opposes S. 636, which directs the Secretary to establish a decommissioning pilot program to decontaminate and decommission the sodium-cooled fast breeder experimental test-site reactor located in northwest Arkansas. The Administration's position is that the Federal Government is not, and should not be, responsible for the decommissioning of this privately-owned reactor. The Department has investigated this situation in the past, in response to Congressional direction in 1997 and again in 1998. As we reported to Congress on these occasions, the legislative and contractual records are clear that the owner of the reactor is responsible for decommissioning. In addition, there are matters of precedent to weigh. There were 10 other similar privately-owned research reactor projects which were operated in coordination with the Atomic Energy Commission. All of these other privately-owned reactors have been or will be decommissioned by the owners.

NATIONAL LABORATORIES PARTNERSHIP IMPROVEMENT ACT (S. 259)

Finally, S. 259, the National Laboratories Partnership Improvement Act of 2001, would amend the Department of Energy Organization Act, among other provisions, in order to expand the Department's authorities and activities in the area of technology partnerships. Generally speaking, the Department already has the necessary and sufficient authority under current law. The bill's administrative provisions would unduly restrict the Secretary's discretion to organize the Department and conduct its activities in ways that are effective, complicate laboratory management of existing partnering programs, and add to growing concerns about unfunded mandates.

We note that section 8 of S. 259 would provide DOE with authorities like those already available to the Department of Defense and other agencies with similar missions in science and technology, including the National Aeronautics and Space Administration. We support efforts to encourage innovative partnering arrangements and provide additional flexibility in dealing with entities such as R&D consortia. At the same time, we recognize that "other transactions" authority is a highly flexible authority outside the procurement framework that must be carefully and thoughtfully applied. While we will need to further consider the merits of applying other transactions authority to DOE, we think it is worthwhile to reevaluate current laws as may be necessary to ensure appropriate flexibility is afforded.

CONCLUSION

In closing, the Administration welcomes the Committee's efforts to address our Nation's energy challenges and its strong support of the Department's energy science, research and technology development programs. The legislation under consideration by the Committee is ambitious and many of its provisions would have consequences that must be weighed carefully before enactment. In this regard, I request that the Department be given the opportunity to continue to work with the Committee towards a satisfactory resolution of differences.

This concludes my testimony. I would be pleased to answer your questions.

The CHAIRMAN. Thank you very much. Let me ask a very general question. In the 18 or 19 years that I've been here, I've noticed sort of a cyclical phenomenon going on where interest in energy issues, energy policy concerns obviously increase dramatically as the price of gas goes up and the price of electricity goes up and the price of natural gas goes up. And then when the price comes back down, the interest goes away. And that's a human kind of a reaction which I guess all of us sort of have come to expect. I have noticed, unfortunately though, that there is something similar that happens in the budgeting for energy related research and development, that the interest in maintaining our efforts in those areas at the Federal level comes into vogue and is obvious and then goes away again as soon as the problem recedes in the public consciousness. And I just wonder the extent to which, and I know we've had a rough spot here at the beginning of this administration before you ever came to work, where we got the request for major cuts in funding for some of the activities, research and developments activities, that many of us thought were important. We are correcting that in the appropriations bills and I think the administration and the President has made some statements to the effect that he believes higher levels of funding are appropriate. I'm just hoping we can see a sustained level of commitment to the higher levels of funding for research throughout the balance of the administration. Do you have any way to give us assurance on that at this stage?

Mr. BLAKE. First, just on some of the energy efficiency and renewable budgetary issues, we are, as you know, undertaking a thorough review of those budgetary submissions. We do think that the increases in the House and in the Senate look like they are going to be in line with what we see as the outcome of that review.

I think more generally your point is right. We have to, when we look at our R&D budget, we have to articulate what our objectives are in a way that everybody can understand and that aren't so susceptible to the fluctuations year over year to the price of gasoline and oil. We should be able to say, here's why we're doing it; it's a long payoff; and stick with it.

The CHAIRMAN. I've been concerned. I got a briefing 2, 3 weeks ago during our Fourth of July break from people at Sandia National Laboratory and about the state of the effort that was going on and the state of the technology in various of the emerging sources of energy, in wind energy, for example, and solar energy, and various of these areas, and, frankly, it's a bit disturbing to see how we have lost the lead internationally in use and development and perfecting these technologies and in putting them into application.

My strong sense is that 10 years ago the United States did have the lead in these areas. Today, we do not, at least in some of these areas, and I hope that we can regain that lead and begin to put some real emphasis on energy related research and development that will help us do that. I don't know if that is something you have a change to focus on as to what has happened in some of these areas. Some of the specific examples, when you say, how about wind turbines, they say, well you have to buy those in Europe. They are the ones that make the wind turbines.

Mr. BLAKE. I will say, in terms of my prior employment before the Department of Energy I had the opportunity to look at a number of wind companies. Your observation is correct that there are far more substantial wind companies in Europe than in the United States. I would say, though, that when you look at what are going to be the leading edge technologies for wind power going forward, turbine design, efficient motors, efficient gear structures, I believe the United States will in fact have a leading position on those cutting-edge technologies.

The CHAIRMAN. Let me ask you, in your testimony you refer to—this is a quote from your testimony—performance metrics for R&D expenditures is one of the administration's management priorities. What do you have in mind as far as performance metrics? I have always thought of research and development as something that it was a little hard to measure performance until you actually—I mean, it is one of these things that, if you do too good a job of insisting on performance, you stifle a lot of what might prove to be very promising.

Mr. BLAKE. I think that's a fair point. You have to look at your metrics, understanding that a lot of what you are doing is at the developmental stage by definition. I think the Academy report had an interesting suggestion in terms of how they developed a matrix. They looked at a matrix. Are you improving knowledge? Are you getting to commercialization and lower economic costs? Are you getting environmental benefits? You should at least be able to articulate what you think are the potential benefits from the program and then track how you are moving to those benefits. I think looking both to your current performance and at what point do you say, well, this isn't getting what we thought we were going to get and

it is time to move on to a different program or change funding priorities.

The CHAIRMAN. And you see the Department of Energy sort of performing this quantification, or this application of metrics each year when it puts together a budget? Is that what I am understanding?

Mr. BLAKE. Ideally, what we should have is performance operational reviews where we understand and have agreement on what the appropriate metrics are, have those reflected in our budgetary priorities, and be able to engage in pretty straightforward conversation with the Congress and interested third parties, on how we see our priorities.

The CHAIRMAN. Let me stop with that and defer to Senator Murkowski.

Senator MURKOWSKI. Thank you very much, Mr. Chairman. With reprocessing in the sense of the state of the art as we know it today, with what the French are doing and have done for some time with the Japanese and some other nations, what is your opinion on whether we will still need Yucca Mountain as predetermined by the Congress and as you and I both know, we have got about $8 billion of taxpayers money in that.

There was a contract signed by the Federal Government with the nuclear industry back some time ago and the due date to take that waste was 1989. The Federal Government did not honor that contract. I do not know what the sanctity of the contract means to the Federal Government but in this case, clearly not much. It is my understanding that the ratepayers have paid in some $18 billion to the general fund, which was to enable the Federal Government to dispose of the waste. It is my understanding that there is somewhere in the area of $60 to $80 billion in litigation potential to the Federal Government for non-performance of that contract. It seems to me that the taxpayer is looking at a pretty good hit, somewhere in the area of $100 billion—something of that nature. So, what about Yucca Mountain?

Mr. BLAKE. Senator, we will still need Yucca Mountain or a deep geological repository even with reprocessing. By the nature of any recycling effort, you still have residues. The repository will still be needed.

The CHAIRMAN. Would you use the word retrievable in describing the future use of Yucca Mountain?

Mr. BLAKE. I am not sure I understand.

The CHAIRMAN. Well, Yucca Mountain was to be a permanent repository. My question to you is, as science and technology changes, should it be structured to be retrievable—the waste retrievable—as opposed to not?

Mr. BLAKE. Senator, let me provide an answer for the record on that. I don't know what the implications of that would be.

Senator MURKOWSKI. While it is not a new subject, it has been discussed.

Mr. BLAKE. It is just not one I am personally aware of.

Senator MURKOWSKI. Well, I think it is probably appropriate that we dust it off again and see if there is any change in the position of our scientist on it because from time to time we have heard the argument, well, at some time this is going to be of value and it will

be of value from the standpoint of reprocessing. And then you get into the discussion on whether the price of uranium is relatively inexpensive and then you question the need for it. But nevertheless, we have made a determination that this is a permanent repository and would suggest you put it away and keep it there forever and then others say, no, it should be convertible or retrievable if indeed that need arises.

Mr. BLAKE. Senator, I've just been advised that yes we do believe it would be retrievable.

Senator MURKOWSKI. Okay. Well, I think it would be appropriate probably to review that and if you want to make it a policy statement, then I think that would be appropriate that we recognize that. Secondly, how will decisions on reprocessing and long term storage facilities like Yucca Mountain affect the future of the nuclear industry?

Mr. BLAKE. I think it is very important for the future of the nuclear industry. Solving the waste issue, I think, is going to be key to the future development of the industry and without that, I think the industry obviously faces some severe and difficult issues.

Senator MURKOWSKI. Well, of course the difficult issue here is getting Congress to move. The last count we had, we had 66 members basically supporting the proposal to put temporary waste at Yucca Mountain until we could get the licensing and the programs. I've got a chart in front of me that was made by a couple of Philadelphia lawyers that clearly shows the process that you have to go through and we are somewhere over in the middle here. In the year 2001 we are funded for a science and engineering report and supplemental drafts and NAS reports and so forth. But with the cut of funding proposed in the Energy and Water Appropriations Committee, this program is going to be set back for an extended period of time. It is very difficult to say how long. Can you comment on this?

Mr. BLAKE. I've been briefed on that timeline and we need the funding to proceed. I cannot tell you exactly what would happen on the timeline for each dollar of loss but this activity is a difficult scientific study that needs to be undertaken now, to proceed with our obligations as you laid out.

Senator MURKOWSKI. It is my understanding this reduction would lay off 650 Federal contract personnel. It would indefinitely delay license application. It renders the 2010 spent fuel receipt date unachievable. It would provide a loss of 75 percent of Federal staff performing oversight, a loss of quality assurance, a loss of ability to conduct independent technical reviews, termination of the early warning drilling program, elimination of university involvement and loss of modeling, loss of licensing application. This list goes on and on. And when you consider the investment we have here and the realization that, while I certainly appreciate the position of our friends from Nevada, which is that they don't want it, but it has to go somewhere and the taxpayer has a hundred—what is it, 80 to 90? Well, it just goes on. A billion dollars here, a hundred billion dollars in this thing and we cannot move it out of the constriction of the Congress, which is a sad state of affairs and by cutting it to the extent that it's cut, we're simply setting it back and saying, well, it's not going to happen on the watch of a few

Senators from the State of Nevada. I don't know whether I could make it any more plain, and both of them are my good friends, and I don't have a constituency on this but I think we have an obligation in this committee to recognize that nobody wants the waste. We've created it. Twenty percent of our energy is dependent on it.

My last question, and I would just leave you with that degree of frustration because, Senator Bingaman, this is something I inherited and now you've inherited. I wish you a little better luck than I had but we have simply got to address it. Given the broad authority of DOE, under the DOE Organization Act, are specific authorizations necessary for each and every R&D program?

Mr. BLAKE. I would not think so. No, I think we can adjust within our R&D program.

Senator MURKOWSKI. Thank you.

The CHAIRMAN. Senator Carper.

Senator CARPER. Thank you, Mr. Chairman and Mr. Blake, welcome. We appreciate your being here and appreciate your testimony. I want to follow up just a little bit on a somewhat different direction. The questioning was being pursued by Senator Murkowski. And if you don't know a whole lot of detail, that's fine. But with respect to nuclear energy, I'm an old Navy guy and in the Navy, we have ships that are powered by nuclear powerplants. We have submarines that are powered by nuclear powerplants and I told my colleagues at a Senate Democratic retreat earlier this year that I took a bunch of boy scouts down to the Norfolk Naval Station and we visited the *Teddy Roosevelt*, the big aircraft carrier. It is about a thousand feet long and about 25 stories high. Maybe 5,000 people aboard when they deploy about 70 aircraft and it needs to refuel once every 25 years. I was struck by that and the kind of potential that I think nuclear power continues to offer to us in this country. I know some of the research that you do relates to what to do with the waste product that comes from nuclear powerplants. And I would just appreciate a little primer on what's the latest. What is going on in that area? Is there some promise; is there something new that we ought to know about and be mindful of?

Mr. BLAKE. Well, I think the technology probably that this committee is aware of involves using accelerators to reprocess and render inert the residues. I am not, although I have had some experience with the nuclear industry, I am not a technologist. So, I'm going to need a primer as much as you do, Senator.

Senator CARPER. I thought you were talking about the accelerators on a car.

[Laughter.]

Senator CARPER. Can you provide for the record just an update for me on what's going on, and I'm not looking for a tome or anything.

Mr. BLAKE. I will.

Senator CARPER. Another issue. I presume that we have a fair amount of research that goes on within your own laboratories, your own employees, and I presume that we contract with folks in academia to do some research projects. And I presume there's a partnership. They exist in the private sector. I think that one of our friends from General Motors may have alluded yesterday to fuel

cell research where the Government played a role. Can you just tell us how it works and how we try not to end up duplicating one another's efforts but are actually working together?

Mr. BLAKE. I can tell you again from the experience I had in the private sector. The way that works is the Government suggests areas where further developments and enhancements would be appropriate. The Department will typically get bids in from the private sector, saying I can build a car of X-efficiency or Y-efficiency. They will select the winning bidder and then the terms of the work is laid out. The Department and the private sector participant will sit down and they will map out a program saying this is what we are going to do. We need to develop these kinds of technologies, materials, and the like. The Government will typically retain some intellectual property in what's developed and there will be an agreement on cost sharing and a review of how costs are allocated to that contract.

Senator CARPER. Okay.

Mr. BLAKE. And it does vary a bit contract to contract. Some, the Government share is relatively modest and in others it is the predominant share.

Senator CARPER. Maybe one other question, if I could ask. The appropriate role, it seems to me, of the Federal Government is research, R&D in these areas. I like to say the role of government is to steer the boat, not to row the boat, and I think that is probably true here. But having said that, I am also struck sometimes by our inability as a country to take some very good research and development information and to be able to commercialize that research and to put it in products or projects, in some cases products that people will buy.

We had our auto folks here yesterday and we talked a bit about hybrids. We have hybrids but for the most part, we are not seeing hybrid cars, trucks, vans produced in this country. We're not going to see very many produced in this country that even take good advantage of that technology. However, we're seeing Toyota and Honda actually begin to work with it pretty well.

Basically, my question is commercialization. What role does the Department of Energy play and I ask this as a new member of the committee. I've been here a week. What role does the Department play with respect to not just helping fund the R&D and direct the R&D, but actually to nurture and to encourage the commercialization of the most promising technologies so we will get a real payoff from the research that has been done?

Mr. BLAKE. I think our bias, Senator, is similar to yours which is that the actual commercialization belongs in the private sector. There are some instances where the Department will participate in that but they are infrequent, and the history is that they haven't been very successful. The fuel cell is an interesting example in the sense that it was originally developed as part of a governmental program with NASA and that technology was not commercialized obviously for years and years but then when you get changes in energy prices, some constraints on the transmission grid, some interest in further fuel efficiency in vehicles, that spurs additional research and development that the Department participates in, and then hopefully commercialization. But in direct answer, I think we

try not to involve ourselves too often in the direct commercialization but leave it that to the private sector.

Senator CARPER. Thank you, Mr. Chairman.

The CHAIRMAN. Thank you.

Senator Burns.

Senator BURNS. Thank you, Mr. Chairman. I am interested in the statement of energy prices getting real high and it drives us to do different things in R&D. The other day I was out in Nebraska, I filled up on Sunday in North Platte, Nebraska for $1.21 a gallon and I come back here and all the pressure is off of us to do something about the cost of energy. Emotions go up and down like that. Nothing spurs conservation or R&D into conservation like $3 gas. That's what drives conservation.

And we can do a lot of things here. We can go through the motions of trying to be more efficient and all of that but we just cannot get any steam behind it until gasoline is $3 a gallon, and so that's how that works. I was disappointed in it when we just finished with the Interior appropriations and of course much of our work that is being done in our fossil fuels making them more efficient and the impact that fossil fuels have on our environment. Those funds were cut back but we restored most of those funds as you well know and they are on their way. We will conference that. We hope we can hold that money together for you as time goes on.

Let me ask you, if you had the magic wand on this, what direction should we be going in our R&D? I am a proponent. I am really a big proponent of fuel cells. I just believe that they will play a major role in our energy, and how we deliver it, and how we manufacture it, and how we store it. And I would just ask your opinion, is that the direction we should be going or tell us where do you think we should be going?

Mr. BLAKE. I think first the right approach, as was suggested, is a portfolio approach where you look at a number of different technologies. Some nearer term, some longer term. You don't put all your bets on one technology. On fuel cells specifically, it's a very interesting technology. It has some significant hurdles as well. You have to be able to reform the fuel as it comes in if you're using natural gas or something like that. On the front end or on hydrogen, you obviously have to be able to make the hydrogen and store it. There are other larger fuel cell technologies where you can do them in combined applications with existing natural gas fired turbines that look very promising.

So, there are a lot of interesting developments in that area. A lot of companies are working in that area. DOE is supporting that with research dollars, but I think the general answer is a portfolio approach.

Senator BURNS. We are seeing a lot of interest in coal bed methane right now in our part of the world. And it is a fuel that can be extracted from a fossil base basically, and once we figure out what to do with the water and after the extraction, why, I think it has a great future. Also, in the area of nuclear, as I looked at Le Hauge in France, where they vitrify and reprocess high-level nuclear waste and in particular those rods that come out of powerplants. We look and we're kind of shortsighted in this country, thinking that well, most of these rods come from our ability to

produce electricity, and I think Senator Carper brought it up. We've got a Navy that's nuclear. It moves by nuclear power. We have to do something to deal with that situation and so I would imagine. Are we still doing some R&D on vitrification and reprocessing on another way to deal with high level nuclear waste?

Mr. BLAKE. Yes, sir. I cannot respond on vitrification but on reprocessing, yes.

Senator BURNS. Well, that tour we took both at Avion and in Marseille in South of France and also there at Le Hague was very interesting, and it's my understanding that most of that technology was developed in this country. So, I'm saying that even if they don't want to store this in Yucca Mountain, we're still going to need a repository. There's no doubt about that and we must just realize that and move on.

So, I appreciate what you do in the R&D area. I plan to be a very strong supporter of yours as far as dollars are concerned. There again, dollars as mentioned here is not the complete answer. But nonetheless our R&D plays an important role in our every day lives and I want to be a supporter of that. I thank you for coming today. I thank you for your testimony.

The CHAIRMAN. Senator Craig, did you have questions of this witness?

Senator CRAIG. I do not. Thank you, Mr. Chairman.

The CHAIRMAN. Well, thank you very much, Secretary Blake. We appreciate your coming again today. Why don't we move right to the second panel. If they would come forward, please.

Okay, why don't we go ahead with the second panel. We have a group of very eminent scientists who are here to testify. Dr. John Holdren, professor at Harvard University; Dr. Robert Richardson, vice-provost for research at Cornell University; Dr. Ernie Moniz, who is a professor at MIT and formerly with the Department of Energy; Mr. Bob Fri who is the Director of the Smithsonian Museum of Natural History; Dr. H.M. Hubbard. Thank you very much for being here. He is with the Pacific Center for High Technology Research, retired, Lee's Summit, Missouri; and also Dr. Mike Corradini, who is with the University of Wisconsin in Madison.

Why don't you go ahead. We'll just take you in that order and we will include your full statement in the record. But if you could take 5 or 6 minutes each and summarize the main points you think we need to be aware of.

Dr. Holdren.

STATEMENT OF DR. JOHN P. HOLDREN, PROFESSOR, HARVARD UNIVERSITY, CAMBRIDGE, MA

Dr. HOLDREN. Thank you, Mr. Chairman, members, ladies and gentleman. I am John Holdren. I am a professor at Harvard, both in the Kennedy School of Government and in the Department of Earth and Planetary Sciences. I was a member of President Clinton's Committee of Advisors on Science and Technology (PCAST) and in that connection, I served as chairman of three PCAST studies on energy R&D policy between 1995 and 1999. I am grateful indeed for the opportunity to testify this morning before this committee on what I believe and I know you believe is a very timely and important subject.

The scope of the hearing this morning is very broad. It covers proposals related to energy and scientific research, development, technology deployment, education and training relating to eight different bills in the Senate, and I am going to focus my own comments more narrowly this morning, confining myself mainly to the energy research and development sections of S. 597 and the relation of those provisions to the recommendations of the PCAST energy R&D studies that I chaired.

The 1997 PCAST study, in particular, was a comprehensive review of U.S. Federal energy research and development strategy. It examined the recent history of public and private energy R&D. It looked at the rationales for public involvement in this kind of activity. It looked at the existing R&D programs of the Department of Energy and it offered recommendations on the focus and targets and budgets for those Department of Energy R&D programs for the five fiscal years 1999 to 2003. I want to mention that the study was carried out by a panel of 21 senior individuals who came from industry, from academia, from public interest organizations. Some had been previously in government service. It had members from a wide array of energy expertises, fossil fuels, renewables, nuclear energy, fusion, increased end-use efficiency and it included people of senior research and management experience, including a former chairman of the Council of Economic Advisors who had no particular brief for increasing Federal expenditures on energy R&D.

That panel, based on its detailed review of the then-existing portfolio of applied energy technology R&D efforts in the Department of Energy, concluded that those programs in DOE have been well focused and effective within the limits of available funding but that the programs have not been and are not commensurate in scope and in scale with the energy challenges and opportunities that the 21st century will present. It noted that this judgment takes into account the likely contributions of the private sector to energy R&D in the decades ahead, and it argued that the inadequacy of the current energy R&D is especially acute in relation to the challenge of responding prudently and cost-effectively to the risk of global climate change from society's greenhouse gas emissions.

The panel recommended ramping up DOE's applied energy technology R&D spending from $1.3 billion a year, which is what it was in the fiscal year 1997 baseline for our study, baseline at the time the report was written, ramping up that R&D to $2.4 million in as-spent dollars in fiscal year 2003, which would represent about a 50 per cent increase over a 5-year period in inflation-corrected dollars. The recommendations were very detailed in terms of how much should be spent in each area, how much for efficiency, for fission, for fusion, for renewables, for fossil fuels. And the budget recommendations were unanimous notwithstanding the diversity of the panel that produced them and notwithstanding the long-standing controversies about the allocation of resources in energy R&D. That unanimity of the panel emerged from detailed joint review and discussion of the content of existing programs, the magnitudes of the unaddressed needs and opportunities, the current and likely future role of private industry in each sector, and the size of the public benefits associated with advances that R&D could bring about.

Efficiency and renewables receive the bulk of the recommended increment and increase their share of the total from 50 percent in fiscal year 1997 to about 64 percent in the recommended budget for FY 2003 because they scored high on potential public benefits and on R&D needs and opportunities not likely to be fully addressed by the private sector.

Those recommendations of the 1997 PCAST study have been partly reflected in administration requests and to a somewhat lesser degree in congressional appropriations in the intervening years. In the most recent completed appropriations, those for fiscal year 2001, the total applied energy technology R&D budget reflects about half of the increment recommended in the PCAST study for that year over the fiscal year 1997 or 1998 baseline. Broken down, 100 percent of the increment recommended by PCAST was appropriated for fossil fuels, 55 percent of the increment for nuclear, 50 percent for efficiency and for fusion, but only 30 percent for renewables.

The Bush administration's fiscal year 2002 budget request for applied energy technology R&D totaled only about $1.3 billion compared to the $1.7 billion appropriation in fiscal year 2001. That is the request proposed what I would characterize as a large step backward, one that would return the country to the fiscal year 1997-1998 R&D spending levels. That proposal is not consistent with the administration's recent statements about the importance it attaches to energy and to the role of technological innovation in addressing energy issues. In fairness, though, it has to be said that the fiscal year 2002 budget request had to be submitted before Vice President Cheney's Energy Task Force had completed its work. In any case, I hope that Congress's appropriation for fiscal year 2002 will not follow the numbers in the administration's request but rather will substantially boost energy R&D spending toward the trajectory recommended by PCAST in 1997.

That brings me to the bills under consideration in today's hearing, specifically S. 597 and let me say just a couple of words about that bill. Title XIV of S. 597, the comprehensive and balanced national energy policy act of which Mr. Chairman, of course, you were the principal sponsor, contains a great deal of the recommendations of the PCAST study. The specific focuses, the targets, the budget levels for the various components of applied energy technology R&D although slid back to 2006 from 2003 because of the gap that has materialized in the meantime, even the PCAST recommendations on the management of DOE's science and technology programs in title XV of the bill follow quite closely the PCAST recommendations on those points.

I just want to say that my colleagues and I on the PCAST panel are very appreciative of the weight placed on our recommendations by you, Mr. Chairman, and your co-sponsors in the development of this bill. We did our best in that study to develop in our report a comprehensive and balanced Federal energy R&D program, and we're delighted to see so much of it reflected in the comprehensive and balanced national energy policy act that you wrote. As the authors of that bill and the other bills under consideration in this hearing are well aware, of course, a comprehensive energy policy has to include a lot more than R&D. Many of the other elements

of a comprehensive policy—aspects of tax policy, regulatory policy, infrastructure development, performance standards, consumer protection—are addressed in the array of bills before the committee today. Other elements, though, such as an appropriate framework of incentives and/or regulations to work in combination with advanced energy technologies to adequately reduce greenhouse gas emissions remain to be developed. Also remaining to be developed, in my view, is an adequate approach to international cooperation in energy technology innovation so that needed improvements occur worldwide. That was the subject of the 1999 PCAST study which I am not going to talk about today.

R&D, in any case, should be the easiest part of energy policy in respect to gaining approval and finding the money because it is relatively non-controversial and it is relatively inexpensive. With respect to cost, let me just note that the difference between the $1.7 billion being spent on Federal applied energy technology R&D in fiscal year 2001 and the $2.4 billion recommended by PCAST for fiscal year 2003 amounts to about two-tenths of one percent of the U.S. military budget and it is equivalent to an extra 0.7 cents per gallon on the price of gasoline. Yet recent history makes it clear that even such modest investments in a secure and sustainable energy future are astonishingly difficult to attain. The chairman, the members and the staff of the Senate Committee on Energy and Natural Resources are to be commended for the major effort that you're investing as manifested in S. 597 and in this series of hearings, of which today's is just one, to address this problem. I thank you for the effort, for the confidence you've placed in the PCAST recommendations and for allowing me to present these views this morning.

[The prepared statement of Dr. Holdren follows:]

PREPARED STATEMENT OF DR. JOHN P. HOLDREN, PROFESSOR, HARVARD UNIVERSITY, CAMBRIDGE, MA

Mr. Chairman, members, ladies and gentlemen:

I am John P. Holdren, a professor at Harvard in both the Kennedy School of Government and the Department of Earth and Planetary Sciences. Since 1996 I have directed the Kennedy School's Program on Science, Technology, and Public Policy, and for 23 years before that I co-led the interdisciplinary graduate program in Energy and Resources at the University of California, Berkeley. Also germane to today's topic, I was a member of President Clinton's Committee of Advisors on Science and Technology (PCAST) and served as chairman of the 1995 PCAST study of "The U.S. Program of Fusion Energy Research and Development", the 1997 PCAST study of "Federal Energy Research and Development for the Challenges of the 21st Century", and the 1999 PCAST study of "Powerful Partnerships: The Federal Role in International Cooperation on Energy Research, Development, Demonstration, and Deployment". A more complete biographical sketch is appended to this statement.

My work at Harvard on energy R&D policy over the past five years has been funded, at various times, by the U.S. Department of Energy, the Energy Foundation, the Heinz Family Foundation, the MacArthur Foundation, the Packard Foundation, and the Winslow Foundation. The opinions I will offer here are my own and not necessarily those of these funders or of the other organizations with which I am or have been associated. My statement draws in part on testimonies on energy policy that I presented to other Congressional hearings earlier this year and last year (1-3) and on a review of the PCAST energy studies and their impact that I wrote with a colleague for publication in *Annual Review of Energy and the Environment* this fall (4). I am grateful indeed for the opportunity to testify this morning before the Senate Committee on Energy and Natural Resources, at this timely and important hearing.

The scope of this morning's hearing is very broad, covering proposals related to "energy and scientific research, development, technology deployment, education, and

training" in portions of eight Senate bills (S. 388, S. 597, S. 472, S. 90, S. 193, S. 242, S. 259, and S. 636). I will focus my comments more narrowly, confining myself mainly to the energy R&D sections of S. 597 and the relation of those provisions to the recommendations of the energy R&D studies that I chaired for PCAST. The 1997 PCAST report (5), in particular, is so central to my observations here that I ask that its Executive Summary be included in the hearing record as an appendix to my statement.

That study was a comprehensive review of U.S. federal energy research and development, examining the recent history of public and private energy R&D, the rationales for public involvement in this activity, and the existing energy R&D programs of the Department of Energy, and offering recommendations on the focus and budgets of these programs for the five Fiscal Years 1999-2003. The study was carried out by a panel of 21 senior individuals from industry, academia, and public-interest organizations. In addition to members with experience and expertise across the full range of energy options—fossil fuels, nuclear fission and fusion, renewable energy sources, and increased end-use efficiency—it included others of senior research, management, and policy-advising experience outside the energy field (including a former chair of the Council of Economic Advisors and a former CEO of Hewlett-Packard), who held no prior brief for increasing federal energy research. In what follows, I first summarize the key findings of the PCAST panel and then turn briefly to the related content of S. 597.

U.S. ENERGY R&D THROUGH FY1997

In the FY1997 base year for the PCAST study, Federal budget authority for applied energy-technology R&D—that is, R&D focused specifically on developing or improving technologies for harnessing fossil fuels, nuclear fission, nuclear fusion, renewable energy sources, and increased efficiency of energy end use—totaled about $1.3 billion.[1] Correcting for inflation, this was precisely what the country had been spending for applied energy-technology R&D thirty years earlier, in FY1967, when real GNP was 2.5 times smaller and the reasons for concern about the adequacy of the nation's energy options were far less manifest (5, p 2-8). Federal applied energy-technology R&D ramped up sharply after the Arab-OPEC oil embargo of 1973-74, reaching a peak of over 6 billion 1997 dollars per year in FY1978 in the process of adding sizable investments in advanced fossil-fuel technologies, renewables, and end-use efficiency to the fission- and fusion-dominated portfolio of the 1960s. After Ronald Reagan assumed the Presidency in 1981, however, with his view that any energy R&D worth doing would be done by the private sector, applied energy-technology R&D spending fell 3-fold in the space of 6 years. A Clean Coal Technology Program that was a joint venture of government and industry brought a brief and modest resurgence from 1988 to 1994, but thereafter the overall decline continued. Similar declines in government-funded energy R&D were also being experienced in most other industrial nations: the relevant expenditures fell sharply between 1985 and 1995 in all of the other G-7 countries except Japan. Japan's governmental energy R&D budget in 1995 was nearly $5 billion, in an economy only half the size of that of the United States. (Nearly $4 billion of the Japanese total was concentrated in nuclear fission and fusion, however, a pattern similar to that in the United States in the early 1970s.)

Private-sector energy R&D in the United States had been estimated by a 1995 Secretary of Energy Advisory Board study (6) at about $2.5 billion per year at that time. Complete and consistent R&D figures for the private sector are difficult to assemble, but it appears that these expenditures had, like those of the Federal government, been shrinking for some time: the Department of Energy estimated that U.S. industry investments in energy R&D in 1993 were $3.9 billion (1997 dollars), down 33 percent in real terms from 1983's level; a study at Battelle Pacific Northwest Laboratory showed U.S. private-sector energy R&D falling from $4.4 billion (1997 dollars) in 1985 to $2.6 billion in 1994, representing a drop of about 40 percent in this period . Combined public and private investments in applied energy-technology R&D in the mid-1990s, at under $5 billion per year, amounted to less than one percent of the nation's expenditures on fuels and electricity. This meant that the energy

[1] The "energy R&D" line in DOE's budget contains a number of other categories that bring the FY1997 total to almost $2.9 billion. These include Basic Energy Sciences (which includes search in materials science, chemistry, applied mathematics, biosciences, geosciences, and engineering that is not directed at developing any particular class of energy sources), biomedical and environmental research, radioisotope power sources for spacecraft, and some energy management and conservation programs that are not actually R&D at all. The PCAST-97 focus was primarily on the applied energy-technology R&D component, although one recommendation did address, in a general way, the Basic Energy Sciences part of the budget.

business was one of the least research-intensive enterprises in the country measured as the percent of sales expended on R&D. Average industrial R&D expenditures for the whole U.S. economy in 1994 were about 3.5 percent of sales; for software the figure was about 14 percent, for pharmaceuticals about 12 percent, and for semiconductors about 8 percent.

Why had energy R&D investments in the United States fallen so low? On the private-sector side, R&D incentives had been reduced by the rapid fall, since 1981, of the real prices of oil and natural gas (together constituting over 60 percent of U.S. energy supply) and by energy-sector restructuring (resulting in increased pressure on the short-term "bottom line", to the detriment of R&D investments with long time horizons and uncertain returns). Perennial factors limiting energy-industry R&D include the low profit margins that often characterize energy markets, the great difficulty and long time scales associated with developing new energy options and driving down their costs to the point of competitiveness, and the circumstance that much of the incentive for developing new energy technologies lies in externality and public-goods issues (e.g., air pollution, overdependence on oil imports, climate change) not immediately reflected in the balance sheets of energy sellers and buyers.

As for the government side of low propensity to invest in energy R&D, the "let the market do it" philosophy of the Reagan years was certainly important in the steep declines from FY1981 through FY1987. It was augmented by the bad taste left in taxpayers' and policy-makers' mouths by the ill-fated government forays of the late 1970s into very-large-scale energy development and commercialization ventures (notably the Synfuels Corporation and the Clinch River breeder reactor); by the overall Federal budget stringency characterizing the first Clinton term; by Congressional concerns about the effectiveness of DOE management; and by lack of voter interest, in the absence of gasoline lines or soaring energy bills or rolling blackouts, in energy policy.

There was, finally, the "eat your siblings" character of energy-supply constituencies: the tendency of advocates of each class of energy options (e.g., nuclear fission, fossil fuels, renewables, energy end-use efficiency) to disparage the prospects of the other options—a tendency aggravated by the zero- or declining-sum-game characteristics of energy R&D funding in this period . In the grip of this syndrome, segments of the energy community itself formulated the arguments ("renewables are too costly", "fossil fuels are too dirty", "nuclear fission is too unforgiving", "fusion will never work", "efficiency means belt-tightening and sacrifice or is too much work for consumers") that were used by various factions in the government to cut energy R&D programs one at a time. There was no coherent energy-community chorus calling for a responsible portfolio approach to energy R&D that seeks to address and ameliorate the shortcomings of all of the options.

While investments in energy R&D had been falling, however, concerns about the future adequacy of the country's portfolio of energy options had been growing. Imports as a fraction of U.S. oil consumption, which had fallen from a high of 49% in 1977 to just 29% in 1985, had risen again to 51% by 1996 The rate of decline of energy intensity of the U.S. economy, which had averaged 2.8 percent per year from 1973 to 1986, had averaged only 0.9 percent per year between 1986 and 1996. The 1995 Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) had concluded that "the balance of evidence suggests a discernible human influence on global climate" and that "climate change is likely to have wide-ranging and mostly adverse impacts on human health" as well as "negative impacts on energy, industry, and transportation infrastructure; human settlements; the property insurance industry; tourism; and cultural systems and values". The United States, one of 170 nations to sign and ratify the United Nations Framework Convention on Climate Change in the early 1990s, had pledged along with other industrial-nation signers to hold its year-2000 greenhouse-gas emissions to 1990 levels; but by 1996 U.S. emissions of carbon dioxide, the most important anthropogenic greenhouse gas, were 9% above 1990 levels and rising. These were among the factors that led to the President's request for the 1997 PCAST study.

RATIONALE FOR FEDERAL ENERGY R&D

The panel's report began with an overview of the energy-linked economic, environmental, and national-security challenges faced by the United States as it moves into the 21st century, noting that (5, p ES-1)

> Our economic well-being depends on reliable affordable supplies of energy. Our environmental well-being—from improving urban air quality to abating the risk of global warming—requires a mix of energy sources that emits less carbon dioxide and other pollutants than today's mix does. Our

> national security requires secure supplies of oil or alternatives to it, as well as prevention of nuclear proliferation. And for reasons of economy, environment, security, and stature as a world power alike, the United States must maintain its leadership in the science and technology of energy supply and use.

The report also noted at the outset that U.S. interests in energy are closely coupled to what is happening in the rest of the world, above all in developing countries. The panel wrote (5, p ES-1)

> The combination of population growth and economic development in Asia, Africa, and Latin America is driving a rapid expansion of world energy use, which is beginning to augment significantly the worldwide emissions of carbon dioxide from fossil fuel combustion, increasing pressures on world oil supplies, and exacerbating nuclear proliferation concerns. Means must be found to meet the economic aspirations and associated energy needs of all the world's people while protecting the environment and preserving peace, stability, and opportunity.

In addressing the rationale for federal government involvement in energy-technology innovation to help address these challenges, the panel stressed the large "public benefits" dimension of energy issues—the point that the interests of society as a whole in environmental quality, reliability of energy supply (in both its economic and national-security dimensions), meeting the basic energy needs of society's poorest members, and providing a sustainable energy basis for economic development considerably exceed the interests of private firms in these outcomes, as reflected in the returns they can expect to gain from investments in energy R&D. The panel also noted that a number of trends within energy industries themselves—such as deregulation, energy-sector and corporate restructuring, and increasing competitive pressures on the short-term "bottom line"—were evidently combining to reduce private-sector investment in energy R&D, above all those components of energy R&D entailing substantial risks or long time horizons.

Notwithstanding the force of these arguments, the panel recognized that the private sector has the dominant role in bringing advanced energy technologies into widespread use, that this will be even more true in the future than it has been in the past, and that, therefore, it is essential to shape the government's efforts in energy-technology innovation to complement and utilize the strengths of the private sector, not in any sense to replace them. The panel wrote, in this vein, that projects in the federal energy R&D portfolio (5, pp 7½)

> should be shaped, wherever possible, to enable relatively modest government investments to effectively complement, leverage, or catalyze work in the private sector. Where practical, projects should be conducted by industry/national-laboratory/university partnerships to ensure that the R&D is appropriately targeted and market relevant, and that it has a potential commercialization path to ensure that the benefits of the public R&D investment are realized in commercial products.

Although it had not been asked to address the possibility of government efforts extending beyond R&D in the direction of commercialization of advanced energy technologies, the panel offered an argument that the same public-benefits rationale supporting government involvement in energy R&D, combined with the existence of a variety of barriers to private-sector commercialization of some of the advanced energy technologies offering very large public benefits, does justify a degree of government engagement in promoting commercialization in particular circumstances. It wrote (5, p ES-28)

> After consideration of the market circumstances and public benefits associated with the energy-technology options for which we have recommended increased R&D, the panel recommends that the nation adopt a commercialization strategy in specific areas complementing its public investments in R&D. This strategy should be designed to reduce the prices of the targeted technologies to competitive levels, and it should be limited in cost and duration.

The panel did not, however, propose either a magnitude or a source of funds for such a commercialization initiative, considering this too far beyond its mandate.

PCAST BUDGETARY AND PROGRAMMATIC RECOMMENDATIONS

From its detailed review of the then-existing portfolio of applied energy-technology R&D in DOE, in the context of the rationales for government involvement as just

described, the PCAST panel concluded that these programs "have been well focused and effective within the limits of available funding" but that they "are not commensurate in scope and scale with the energy challenges and opportunities the twenty-first century will present". It noted that "[t]his judgment takes into account the contributions to energy R&D that can reasonably be expected to be made by the private sector under market conditions similar to today's", and it argued that "the inadequacy of current energy R&D is especially acute in relation to the challenge of responding prudently and cost-effectively to the risk of global climate change from society greenhouse-gas emissions" (5, p ES-1). It recommended ramping up DOE's applied energy-technology R&D spending from the $1.3 billion level of the FY1997 appropriation (and from the $1.4 billion level of the FY1998 request, not yet acted upon by Congress at the time the report was written) to $2.1 billion in FY2003 (expressed in constant 1997 dollars). The following table shows the distribution of the proposed increases.

Table 1.—PCAST-RECOMMENDED DOE BUDGET AUTHORITY FOR ENERGY-TECHNOLOGY R&D

[Millions of Constant 1997 Dollars]

	FY 1997 actual	FY 2003 proposed	FY 2003 increment over FY 1997	Share of FY 1997-2003 increment	Share of FY 2003 total
Efficiency	373	755	382	48.6%	36.5%
Fission	42	102	60	7.6%	4.9%
Fossil	365	371	6	0.8%	17.9%
Fusion	232	281	49	6.2%	13.6%
Renewables	270	559	289	36.8%	27.0%
Total	1282	2068	786	100%	100%

These budget recommendations were unanimous, notwithstanding the diversity of energy (and nonenergy) backgrounds represented on the panel and notwithstanding the history of disagreements among the different energy constituencies about funding priorities. The unanimity on the panel emerged from detailed joint review and discussion of the content of the existing programs, the magnitudes of unaddressed needs and opportunities, the current and likely future role of private industry in each sector, and the size of the public benefits associated with the advances that R&D could bring about. Efficiency and renewables received the great bulk of the increment—and increased their share of the total from 50% in FY1997 to almost 64% in the FY2003 recommendation—because they scored high on potential public benefits and on R&D needs and opportunities unlikely to be fully addressed by the private sector.

Among the key findings and recommendations about the main classes of energy technologies were the following.

Energy End-Use Efficiency—The Panel found particular promise in enhancements to energy-efficiency R&D, which it found could bring relatively rapid and cost-effective reductions in local air pollution and greenhouse-gas emissions, oil imports, and energy costs for households and businesses. From 1975-1986, the panel noted, U.S. energy efficiency increased by almost one-third (measured as the ratio of real GNP to primary energy use); if the energy-intensity of the economy had remained constant from 1970 to 1997, by contrast, U.S. energy expenditures in 1997 would have been some $150-200 billion per year greater than they actually were. The improvements in energy efficiency that were achieved helped pull the U.S. economy out of the stagflation that followed the oil-price shocks of the 1970s, helped set the stage for sharply declining world oil prices, and gave the U.S. economy more than a decade and a half of opportunity to deal with the energy problem (an opportunity that, regrettably, went largely unused). The panel found that investments in advanced energy-efficiency technologies—beyond those likely to be brought forth by the marketplace—offered the potential for further large gains in the future and recommended that the DOE's budget for energy-efficiency R&D be doubled in constant dollars from the 1997 actual level of $373 million for R&D to $755 million in 2003 (which would be about $880 million in as-spent dollars, given inflation at the projected rates).[2]

[2] These figures do not include weatherization, state and local grants, and other non-R&D activities funded by DOE under the "energy efficiency" budget lines.

The panel proposed a number of specific goals for efficiency-improvement efforts in the various end-use sectors, including:

- development of the technologies for, and facilitating the construction by 2010 of, 1 million zero-net-energy buildings, and achievement in all new buildings of an average 25-percent increase in energy efficiency as compared to new buildings in 1996;
- development, with industry, of a 40-percent efficient microturbine by 2005 and a 50-percent efficient microturbine by 2010, initiation of new Industries of the Future programs in agriculture and bio-based renewable products, and reduction of the energy intensity of the major energy-consuming industries—forest products, steel, aluminum, metal casting, chemicals, petroleum refining, glass—by one-fourth by 2010;
- cooperation with industry to achieve the goal, previously established under the Partnership for a New Generation of Vehicles, of developing an 80-mile-per-gallon production prototype passenger car by 2004, as well as working with industry to develop a production prototype of a 100-mpg passenger car with zero equivalent emissions by 2010, high efficiency (tripled fuel economy) Class 1-2 trucks and (doubled fuel economy) Class 3-6 trucks by 2010, and a high efficiency (10 mpg) heavy truck (Class 7 and 8) by 2005.

The panel concluded that, overall, "DOE research, complemented by sound policy, can help the country increase energy efficiency by a third or more in the next 15 to 20 years.

Fossil Energy Technology—Fossil fuels supply more than three-quarters of primary energy worldwide and 85 percent of primary energy in the United States,[3] and they will remain a mainstay of energy supply for many decades to come. Recognizing the very large size of the private sector's fossil-energy activities, including R&D, the panel emphasized restructuring DOE's fossil-energy program towards activities with a higher public return. It recommended the phase-out of R&D on near-term coal power technologies, because there was relatively less public benefit to be expected from furthering this work than was the case for longer-term coal-technology programs underway in the Department—notably Vision-21 (28)—and because the market potential of these technologies was very limited given the significantly lower cost of advanced gas turbine cycles fueled by natural gas.[4] Similarly, direct coal liquefaction was recommended for termination, on the grounds that it was not likely to be cost-effective in the foreseeable future, would significantly increase emissions of carbon dioxide, and offered no synergies with other technologies under development—in contrast to indirect coal liquefaction, which uses gasification technologies that are also relevant to advanced power generation and other programs. The panel recommended increased support, in the fossil-fuel sector, for DOE's advanced power, carbon sequestration, fuel cell, hydrogen, and advanced oil and gas production programs, as these could increase the country's leverage against the greenhouse-gas/climate-change and oil-import problems, among others. The initiation of research on methane hydrates was also recommended, both to better evaluate the resource and to determine if it could be tapped in the longer term to supplement conventional gas resources as a bridging fuel to low- or no-carbon energy systems. Continued support for advanced technologies for the low-cost recovery of oil and gas from lower margin resources was also recommended. Such programs have long been targets of government-spending critics concerned with "corporate welfare"; but the panel's review found that those benefitting were small companies with little ability to conduct research, that advanced approaches helped maintain domestic production, and that to close these wells without such recovery would effectively foreclose further production from them permanently.

The panel's review of fossil-energy issues also clarified and highlighted the importance, for U.S. fossil-energy-technology R&D strategy, of international markets for these technologies. In the U.S. electric-power sector, most new capacity in recent years has been in the form of natural-gas-fired gas-turbine combined cycles, and this is likely to remain the case until natural gas prices experience sustained increases to levels that seem improbable in this country for some time to come. That would mean that the major markets for advanced coal-power technology will be outside the United States in the decades immediately ahead, above all in coal-intensive developing countries such as China and India where natural gas is in very limited supply.

[3] These percentages account for the estimated contributions, often left out of official tabulations, from the "traditional" biomass energy sources (fuelwood, charcoal, crop wastes, and dung). Without these, the fossil-fuel percentage contributions would appear even larger.

[4] The Panel did not recommend cuts in R&D on pollution control technologies for current or near-term coal power systems, however.

For the United States to maintain leadership in these technologies, they will need to be developed in forms suitable for those markets and U.S. companies will need to learn to operate successfully there. Altogether, the changes recommended by the panel would have resulted in DOE's fossil-energy R&D budgets staying roughly level in constant dollars from FY1997 through FY2003.

Nuclear Energy—Energy from nuclear fission supplies about 17 percent of world electricity and 20 percent of that of the United States. But concerns about nuclear energy's cost, accident risks, radioactive-waste burdens, and potential links to nuclear proliferation have clouded its future. No new reactors have been ordered in the United States since 1978. Federal expenditures on R&D in fission energy, once as high as $2 billion per year in 1997 dollars, had fallen by FY1997 to just $40 million (and dropped to $7 million in FY1998). The panel concluded, however, that the potential role of an expanded contribution from nuclear energy in helping to address global carbon dioxide emissions justified a modest Nuclear Energy Research Initiative (NERI) to determine whether and how improved fission technologies might be able to address cost, safety, waste, and proliferation concerns. Whether or not such work led to a possibility of expanding nuclear energy's contribution in the United States, it would be useful in helping to maintain positive U.S. influence over the safety and proliferation resistance of nuclear-energy activities in other countries.

The panel recommended, accordingly, that DOE funding for nuclear fission should increase in constant dollars from $42 million in FY1997 to $102 million in FY2003 ($119 million in as-spent dollars in 2003). In addition to NERI, a small part of this funding—$10 million per year, to be matched by industry—would be used to investigate problems that otherwise might prevent the safe extension of the operating life of existing reactors. The NERI effort, in contrast to previous research efforts in DOE's Nuclear Energy Program, would be organized as a competitive solicitation for investigator-initiated R&D focused on the indicated key issues affecting fission's future.

In the case of fusion energy, the panel endorsed the overall findings of the 1995 PCAST study of fusion R&D (7) and recommended that DOE funding for fusion be increased from $232 million in FY1997 to $281 million in 2003 in constant dollars ($328 million in FY2003 in as-spent dollars). The Panel affirmed that the guiding principles for the U.S. fusion program should be maintaining a strong domestic base in plasma science and fusion technology; collaborating internationally on an experimental program for the next steps in ignition and moderately sustained burn, and participating in international efforts to develop practical low-activation materials for fusion energy systems.

Renewable Energy—Few people disagree with the premise of renewable energy—tapping natural flows of energy from the sun, wind, and other sources to produce environmentally clean, non-depletable energy for people's use; the problem has been the high cost of successfully capturing these diffuse flows of energy and converting them to the needed end-use forms. Over the past two decades, however, remarkable progress has been made. The cost of energy from technologies such as photovoltaics and wind turbines has dropped as much as ten times. Based on the outstanding progress that has been made, the high potential of renewable-energy technologies in every sector of the energy economy (electricity, fuels, and heat for buildings, industry, and transportation), and the high public benefits of achieving such contributions, the Panel recommended that funding for DOE's renewable-energy programs should be increased from $270 million in FY1997 to $559 million in FY2003 in constant dollars ($652 million in FY2003 in as-spent dollars).

Priority areas identified by the panel for R&D increases included solar photovoltaics (particularly thin-film technologies and balance-of-system issues), advanced wind turbines (particularly light-weight, variable-speed designs), and bioenergy (especially integrated power-and-fuels systems), as well as solar thermal, geothermal, and hydrogen energy systems. As for much fossil and nuclear technology, the panel noted, international markets are critical for renewables. Roughly three-quarters of U.S. photovoltaics production is exported, and most of the wind-turbine market has likewise been outside the United States in recent years (domestic sales of wind-turbines, however, increased sharply in 1998 and 1999). And the modularity and small scale of many renewable-energy technologies match well the needs of developing countries, particularly in rural areas. A further advantage in developing-country applications is that the inherent cleanliness and safety of most renewable energy technologies minimizes the need for the complex regulatory controls that fossil- and nuclear-energy systems require.

Other Recommendations—Besides the recommendations just summarized for the applied-energy-technology sectors in DOE's portfolio, the panel made a number of recommendations that cut across those sectors. In addition to the recommendation about commercialization strategy, mentioned above, these included:

- increased coordination between DOE's Basic Energy Sciences (BES) program and its applied-energy-technology programs;[5]
- more systematic efforts within DOE at integrated assessment of its entire energy R&D portfolio "in a way that facilitates comparisons and the development of appropriate portfolio balance, in light of the challenges facing energy R&D and in light of the nature of private sector and international efforts and the interaction of U.S. government R&D with them" (5, p ES-6);
- other improvements in DOE's management of its energy R&D portfolio, including that overall responsibility for that portfolio be assigned to a single person reporting directly to the Secretary of Energy and that increased use be made of industry/national-laboratory/university advisory and peer-review committees, while reducing internal process-oriented reviews.

The panel also recommended strongly that increased attention be devoted to the opportunities for strengthening international cooperation on energy-technology innovation—a recommendation that became the basis for a subsequent PCAST study with this focus (8).

FEDERAL ENERGY R&D SINCE THE PCAST REPORT

Table 2 shows the distribution, across the energy sectors, of PCAST's recommended budgets for FY1999-2003, Administration requests for FY1999-2002, and Congressional appropriations for FY1999-2001, along with the appropriations from FY1998. These figures show that the requests and appropriations rose, through 2001, in a pattern similar to that recommended by PCAST, but at a slower pace and with a particularly conspicuous shortfall in the renewable category. Notable instances of progress (or the lack of it), through the FY2001 budget year, on issues addressed by the 1997 PCAST report include the following:

End-Use Efficiency—The administration launched in 1998 the Partnership for Advancing Technology in Housing, based in part on discussions with industry begun in 1994, which aims—with strong private-sector participation—to achieve an average 50-percent increase in energy efficiency in new homes by 2010. In concert with industry, DOE launched an Industries of the Future program for agriculture, building on DOE's success using this model in other industries. The Partnership for a New Generation of Vehicles (PNGV), which predated the PCAST report, has continued on track—the major participating automobile companies all demonstrated prototype vehicles in early 2000—but a PNGV-2 focused on longer-term options such as fuel cells has not been initiated. The Twenty-First Century Truck initiative was launched in Spring 2000, with goals of doubling to tripling the fuel economy of trucks on a ton-mile basis. Activities in microturbines, fuel cells, and Combined Heat and Power have been strengthened.

Fossil Fuels—The direct-coal-liquefaction program has been phased out and near-term clean-coal power-technology R&D has been reduced. The Vision-21 program, which predated PCAST-97, to develop cost competitive coal-fired power plants with low or no carbon or polluting emissions has been strengthened. Geological carbon sequestration and methane hydrate R&D programs have been launched.

Fusion—Administration requests at $243 million and Congressional appropriations at $255 million for FY2001 have started to move in the direction of, but still fall short of, the PCAST recommendation of $290 million (as spent dollars) for fusion energy in FY2001.

Table 2.—FEDERAL ENERGY TECHNOLOGY R&D: CONGRESSIONAL APPROPRIATIONS, ADMINISTRATION REQUESTS, AND PCAST RECOMMENDATIONS FY1998-2003

[Millions of as-spent-$]

	effic.	renew.	foss.	fiss.	fusn.	total
FY98 appropriation	437	272	356	7	223	1295
FY99 appropriation	503	336	384	30	222	1475
Administration request	598	372	383	44	228	1625
PCAST recommendation	615	475	379	66	250	1785

[5] The PCAST-97 study did not review the content of the BES program, but it did recommend, in light of the close coupling between advances in BES and progress in the applied-energy-technology R&D, that DOE consider expanding its BES effort in parallel with the recommended increase in applied-energy-technology work and the proposed increase in coordination (5, p ES-2).

Table 2.—FEDERAL ENERGY TECHNOLOGY R&D: CONGRESSIONAL APPROPRIATIONS, ADMINISTRATION REQUESTS, AND PCAST RECOMMENDATIONS FY1998-2003—Continued

[Millions of as-spent-$]

	effic.	renew.	foss.	fiss.	fusn.	total
FY00 appropriation	552	310	404	40	250	1559
Administration request	615	398	364	41	222	1640
PCAST recommendation	690	585	406	86	270	2037
FY01 appropriation	600	375	433	59	255	1722
Administration request	630	410	376	52	247	1715
PCAST recommendation	770	620	433	101	290	2214
FY02 Administration request	475	237	333	39	255	1339
PCAST recommendation	820	636	437	116	320	2329
FY03 PCAST recommendation	880	652	433	119	328	2412

Notes: The values listed here may vary from other tabulations due to rescissions, uncosted obligations, inclusion or exclusion of other budget lines, and other factors. The efficiency line listed here does not include state and local grants, or the Federal Energy Management Program. The nuclear fission line includes only direct civilian energy-related R&D and University training support. The fossil energy line does not include expenditures for the clean coal program, which is a demonstration rather than a research anddevelopment effort.

Nuclear Fission—The Administration launched and Congress funded both the Nuclear Energy Plant Optimization program (addressing issues related to license extension) and the Nuclear Energy Research Initiative (addressing the longer-term issues that will shape fission's future). These two initiatives form the basis of the current DOE Nuclear Energy program.

Renewables—Administration budget requests and program direction have largely aligned with PCAST recommendations, but at lower funding levels, and appropriations have been well below the requests (even falling from FY1999 to FY2000 before recovering somewhat in FY2001). With strong bipartisan support, President Clinton issued Executive Order 13134 which launched an integrated bioproduct, biofuel, and biopower program with a goal of tripling U.S. bioenergy use by 2010. Congress passed and the President signed the Agricultural Risk Protection Act of 2000, Title III of which codified an integrated bioproduct and bioenergy research program. Principal focuses of increased renewables funding other than for biomass were for photovoltaics and advanced wind systems.

Cross-Cutting Issues—Since the PCAST study, DOE has undertaken a major effort in integrated analysis of the Department's entire energy R&D portfolio, which reaffirmed the overall direction of the program while highlighting some key gaps, including energy-system reliability and international cooperation on energy-technology innovation. DOE has also made considerable effort at, and progress in, addressing its management challenges, which were pointed out not only in the 1997 report but also in the 1995 SEAB study (6) and a 1999 review by the National Academy of Public Administrators. The critical question raised by PCAST about a role for government in the commercialization of high-public-benefit energy technologies, moreover, has not yet been addressed by the Department or, more importantly, by Congress.

As indicated in Table 2, the Bush Administration's FY2002 budget request for applied energy-technology R&D, totaling about $1.3 billion, proposed a large step backward—one that would return the country to essentially the FY1997-1998 spending levels. This proposal is completely inconsistent with the Administration's recent statements about the importance it attaches to energy issues and to the role of technological innovation in addressing them (although, in fairness, it must be said that the FY2002 budget request had to be submitted before Vice President Cheney's energy task force had completed its work). In any case, I hope that Congress's appropriation for FY2002 will ignore the numbers in the Administration's request and substantially boost energy R&D spending toward the trajectory recommended by PCAST in 1997. This brings me to the bills under consideration in today's hearing—particularly S. 597—to which I now turn.

ENERGY R&D PROVISIONS OF S. 597

The essence of the procedure used to develop the budget recommendations for applied energy-technology R&D in Title XIV of Division E of S. 597 (the Comprehen-

sive and Balanced National Energy Policy Act) was, as I understand it, to shift to FY2006 the FY2003 spending targets recommended in the 1997 PCAST study and then to provide annual increments above the FY2001 authorization levels so as to meet those targets by 2006.[6] (This procedure reflected a concern, I believe, that the widening gap between the PCAST recommendations and the actual appropriations out to FY2001 has made it impractical to get back onto the PCAST-recommended trajectory by 2003.) The specific focuses and targets of the energy R&D efforts laid out in S. 597 also match quite closely the recommendations in the PCAST report, as do the recommendations on management of DOE science and technology programs in Title XV of the bill. My colleagues on the 1997 PCAST energy panel and I are most appreciative of the weight placed on our recommendations by Chairman Bingaman and his co-sponsors in the development of this bill. We did our best to develop and describe, in our report, a comprehensive and balanced Federal energy R&D program, and we are delighted to see so much of it reflected in the Comprehensive and Balanced National Energy Policy Act.

The recommendations for R&D on nuclear fission in S. 597 combine programs related to commercial nuclear electricity generation with programs on nuclear medicine and nuclear power for satellite and space missions, among other categories, and the bill's budget totals for fission cannot be compared directly to the PCAST recommendations in which applications other than commercial electricity generation were not included. I believe it would be useful to disaggregate these budget categories in the final version of the bill.

I have some concern, in any case, with the wording in the current version (Sec. 1405, part 7.b) characterizing the nuclear appropriation as being for "demonstration and initial deployment assistance" as well as for research and development. The PCAST recommendations on nuclear fission were for R&D relating to extending the operating lifetime of existing reactors and to exploring advanced approaches to improving the economics, safety, waste management, and proliferation resistance of nuclear energy systems in the future. In my personal view, the question of whether government resources should be allocated to demonstration and deployment (as opposed to research and development) of advanced fission technologies needs further exploration, and I am certainly not convinced that any of the advanced approaches warrant government expenditures for demonstration and deployment today.

CONCLUDING OBSERVATIONS

As the authors of S. 597 and the other bills under consideration in this hearing are well aware, a comprehensive energy policy must include far more than energy R&D. Many of the other elements—including aspects of tax policy, regulatory policy, infrastructure development, performance standards, and consumer protection—are addressed in this array of bills. Other elements, such as an appropriate framework of incentives and/or regulations to work in combination with advanced energy technologies to adequately reduce greenhouse-gas emissions from energy supply, remain to be developed.

R&D in any case should be the easiest part of the energy-policy equation with respect to gaining approval and finding the money, inasmuch as it is relatively noncontroversial and relatively inexpensive. With respect to cost, it may be noted that the difference between the $1.7 billion being spent of federal applied energy-technology R&D in FY2001 and the $2.4 billion recommended by PCAST for FY2003 is about two tenths of a percent of the military budget and is equivalent to an extra 0.7 cents per gallon on the price of gasoline. Yet recent history reveals that even such modest investments in a secure and sustainable future energy supply are astonishingly difficult to attain.

The Chairman, the members, and the staff of the Senate Committee on Energy and Natural Resources are to be commended for the major effort they are investing—as manifested in S. 597 and in the series of hearings of which today's is but one—to address this problem. I thank you for this effort, for the confidence you have placed in the PCAST recommendations, and for allowing me to present my views this morning.

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[6] This is apparent by direct comparison of the PCAST FY2003 and S. 597 FY2006 budgets in the renewables case but not in the efficiency, fossil, and nuclear cases, where the authors of the bill used different conventions than the PCAST panel did in deciding what programs to count as part of energy R&D. The fusion science budget is treated in the bill (as DOE also treats it) as part of the Fundamental Energy Science program rather than as applied energy-technology R&D, and I did not find a breakdown indicating what part of this program would be designated for fusion.

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(6) Secretary of Energy Advisory Board, Task Force on Strategic Energy R&D. Energy R&D: Shaping Our Nation's Future in a Competitive World. Washington, DC: Government Printing Office. 1995.

(7) President's Committee of Advisors on Science and Technology, Fusion Review Panel. *The U. S. Program of Fusion Energy Research and Development.* Washington, DC: Government Printing Office. July 1995. http://www.ostp.gov/PCAST/fusionenergypub.html.

(8) President's Committee of Advisors on Science and Technology, Panel on International Cooperation in Energy Research, Development, Demonstration, and Deployment, Powerful Partnerships: The Federal Role in International Cooperation on Energy Innovation. Washington, DC: Government Printing Office. June 1999. http://www.ostp.gov/html/p2epage.html.

The CHAIRMAN. Thank you very much for your testimony, Dr. Richardson. Why don't you go right ahead.

STATEMENT OF DR. ROBERT C. RICHARDSON, PHYSICS PROFESSOR AND VICE PROVOST FOR RESEARCH, CORNELL UNIVERSITY

Dr. RICHARDSON. Mr. Chairman, Senator Craig, I am Bob Richardson, I am physics professor and vice provost for research at Cornell University. I also serve as chair of the physics policy committee of the American Physical Society, an organization of 40,000 people. I would like to thank you for the opportunity to testify today. My testimony principally concerns the administrative structure of the Department of Energy and the effect that the structure has had on the performance of the office of science and the energy research programs. But first I would like to comment briefly on the Department of Energy's research budgets for fiscal year 2002, particularly in the context of the public's renewed awareness about energy issues.

The Vice-President's energy task force report highlights the important role that research must play in securing our energy future by creating and bringing to market new energy technologies, enhancing efficiency of energy production in use and mitigating environmental impact of existing technologies. A sustained commitment must be made to invest in both fundamental science and applied energy research. Even if energy were not on the policy front burner, the President's budget request would short change the Department of Energy's civilian research programs.

As the chart over there shows, the Department of Energy, the lead agency for physical sciences, has seen its research budget decline steadily during the 1990's. Last year, recognizing that technology drives the economy and that today's science becomes tomorrow's high tech product, the Republican Congress and the Democratic White House reversed this trend with major increases in many of Department of Energy's research programs.

The budget request submitted by the current administration turns the clock back. With energy on everybody's mind, that request is not only bad policy; it is bad politics. Admittedly, the administration submitted its request before the Vice-President's energy task force had released its report and its amended budget. The administration has sought to remedy some of the deficiencies, but I believe that it has not gone nearly far enough nor have the House and Senate Appropriations bills. I hope this committee sends a clear signal through its authorization bill that the budgetary momentums established last year for Department of Energy's research programs must be sustained for fiscal year 2002. Our economic future requires it and our energy future depends on it and the technology workforce of the future will vanish without it.

There are many reasons why Department of Energy's research programs have fared poorly in the budgetary process for some time. The end of the cold war reduced defense exigencies. Cheap fuel prices created a feeling of energy security and hazardous waste, and lax security at some of our national laboratories gave the Department a bad reputation. But the administrative structure within the Department of Energy has exacerbated matters. The highest level administrator with sole authority for science is the Director of the Office of Science who sits on three levels below the Secretary. Today, one Under Secretary oversees the national nuclear security agency and one oversees all other activities. Only rarely has an Under Secretary had a science background, with Department of Energy's weapons programs and environmental management activities absorbing major attention. Policymakers in the executive branch and in the Congress have often ignored the Department's research programs.

I am here today speaking as a representative of a panel of ten other scientists who have had extensive administrative and policy experience with Department of Energy's scientific programs. The report from which the balance of my testimony is drawn, "Department of Energy's Science in the Future" was stimulated by discussions that took place at a meeting of the American Physical Society's Physics Policy Committee last year.

With the Chairman's permission, I would like to have this report included in the record.*

The CHAIRMAN. We would be glad to include that.

Dr. RICHARDSON. The report makes several observations specifically regarding the Office of Science. First, the office oversees outstanding national laboratories whose capabilities for solving complex interdisciplinary problems are not easily matched elsewhere. It builds and operates large-scale user facilities of importance to all areas of science and in large part has been enormously successful.

*The report can be found in the appendix.

And it supports a large array of university research programs that are responsible for educating and training the next generation of scientists.

Second, as I noted earlier, for about a decade the Department of Energy's science budgets have been declining and have fared very badly compared to other agencies. These difficulties have been exacerbated by perceptions of mismanagement and security problems throughout the Department. In many areas, the budget situation has reached crisis proportions jeopardizing future U.S. leadership in many essential areas of science.

Last, the Director of the Department of Energy's Office of Science has responsibilities comparable to those of the Director of NSF and not very different from those of the Directors of NIH and NASA, but does not have comparable authority or visibility.

Mr. Chairman, our report proposed two alternative recommendations, one of which comes under the purview of this committee. It is also one that appears in division E, title XV, section 1503 of S. 597. That recommendation is to establish a position of Under Secretary for science and technology. I urge the committee to adopt this in its final mark-up.

Our report also recommended that the Under Secretary serve as a science advisor to the Secretary as called for in S. 597, subsection B3. Although our report did not set out additional details for the Under Secretary, I think the panel would feel comfortable in endorsing the remaining duties described in subsection B.

Additionally, as the Department moves toward stricter accountability for research performance, the Under Secretary will have an important role in ensuring that the Department of Energy strive for quality science as well as efficient program administration. Our report expressed the hope that a qualified Under Secretary would be an influential scientist who could be an effective leader and spokesperson for the Department of Energy science and energy and comparable visibility and authority to the Directors of NSF, NASA and NIH. I would be pleased to answer questions.

The CHAIRMAN. Well, thank you very much for that testimony. Dr. Moniz, welcome back to the committee. We are glad to see you. We are aware of your title and name, so go right ahead.

STATEMENT OF ERNEST J. MONIZ, PROFESSOR OF PHYSICS, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Dr. MONIZ. Thank you, Mr. Chairman and Senator Craig. It is good to see you, as well, again. In fact, it is refreshing to be back here but not having my testimony cleared by the OMB or without Sherpas to carry the Q&A books that were always required. Thank you for inviting me to comment on the committee consideration of bills that can have a significant impact on energy, scientific research and technology development programs at the Department of Energy. My perspective is, of course, as a former Under Secretary and I am very pleased that the record will show that Bob at least implicitly acknowledged that I am still competent as a scientist.

I will organize my remarks very briefly along four areas: science, education and training, R&D management, energy, all areas touched upon very deeply in the collection of bills before us. In science, the committee is very well aware of the Department's key

role in American science and technology. The Department remains the largest supporter of basic and applied research in the physical sciences and I would like to use that statement simply to reinforce the importance of administration and congressional support for balanced Federal investment across science and engineering, and most specifically, reinforcing what Bob said, the need to maintain a momentum in having the physical science investments keep pace with need and with investments in other areas like life sciences.

Secondly, the Department has had, and I want to emphasize, a very important role especially through its laboratories in developing what I would call enabling technologies that cut across the mission areas and that prove to be of broad and deep national value. Large scale scientific computing, advanced materials, accelerators, isotope applications, genomics, many of these. This context, I think, emphasizes the importance of some of the bills that the committee has before it. For example, those on scientific computing and nanoscience. On computing, for example, the nuclear weapons program has traditionally been a principal driver for super computer development. We need a vigorous and integrated push today in the civilian area. The benefits will be major to ASCI. They will also be very, very major to science broadly, combustion, global systems, plasmas infusion, subsurface transport of contaminants, quark structures of matter, advanced materials, functional genomics, etc. The convergence of technology and scientific community commitment has been there now for several years to drive this kind of enabling technology. The resources have not kept pace. It is time to get on with the task.

Education and training. The committee has correctly pointed to the diminished state of university education in nuclear engineering and has proposed, for example, some human resource programs to help rectify that. Those are certainly in the right direction. However, I believe to be effective two other issues well known to the committee simply must be addressed.

First, to attract young faculty to the field, there must be a forward looking robust research program. The NERI program that we started a few years ago, for example, has been a great stimulus in the field. Congress must now resolve issues about the program's trajectory, in particular. In my view, the program cannot sustain itself and attract new people without evolving into more costly laboratory work based upon the most promising concepts developed in the earlier phase. This will take significant increases in funding. The administration request actually cut the funding, but I think that is a key policy issue here. If we are to be committed to exploring the concepts for intrinsically safe, proliferation resistant, waste minimizing and economic new approaches, then we simply must make the commitment to move these programs into the laboratory stage.

The second issue is that of research infrastructure, again without which human resource development will be ineffective. University reactors are an example of this and I believe that we need a systemwide evaluation of those reactors and an evaluation integrated with that for Department of Energy site infrastructure. The goal, in my view, should be a well structured hierarchy of teaching and

research facilities on campuses at strengthened regional academic centers and at Department of Energy sites.

The third issue: R&D management. Let me start with portfolio management, which has been a major topic today and will be, I am sure, later on. Starting in 1998, the Department did, in fact, substantially revise its approach to R&D portfolio management with four linked processes: portfolio development, portfolio analysis, strategic roadmapping and improved corporate R&D oversight. To a large extent, this is a realization of the portfolio process recommended by the PCAST panel on energy that John Holdren chaired. Very importantly, the products of this portfolio analysis were well integrated into the fiscal year 2000 and fiscal year 2001 budgets. The importance of it can be stated in a couple of ways. First of all, it is very important that portfolio architecture is not geared to organizational units. It is geared to strategic goals of the Department. The core of the process is a formal portfolio analysis that brings out key gaps and opportunities aligned with strategic goals. The value of the process can be seen just by giving you examples. In the first year, a focus on energy system reliability came out well before the problems in California, with now robust programs in electricity and gas system reliability. In the second year, the group raised a very interesting idea of using an environmental air quality multi-attribute life cycle analysis as criteria for programs. My point simply is that this shows how a new cross-cutting perspective has been injected into portfolio management and has really evolved the portfolio to meet emerging strategic needs of the Nation. There is considerable buy-in. I believe we need support for this process. I would make, respectfully, a recommendation. The committee, for example, in its technology transfer bill, suggests getting an annual report. I would respectfully suggest considering asking for an annual report as well from the portfolio analysis activity. That will couple this committee very well to the process of aligning R&D with the strategic goals and help keep the process moving forward.

Tech transfer. I'll be very brief given the time. This committee continues to show a very important interest in that area and, indeed, I believe leadership of this committee may be very important for providing stability and resources essential for engaging private sector partners. The partners are diverse; the spill-over effects are enormous. We did, in the last 2 years, establish a formal corporate process that I believe helps the laboratories, helps the small businesses understand how to interact with the system. S. 259 could help to solidify these advances and, again, congressional support is essential if technology transfer and partnership programs are not only to be sustained but, frankly, are to be able to withstand success.

A third area in R&D management is organization. Bob has just spoken about that, the consideration to establish the position of Under Secretary for Science and Technology. Given my last position, I must express concern with the proposal, a concern that can be relieved, certainly, with further elaboration. My concerns with the proposal would weaken or help advance the progress made in the last few years in achieving somewhat better integration and coordination across the science, energy and environmental quality

business lines. The invigorated R&D council, chaired by the Under Secretary and particularly the R&D portfolio roadmapping process provided mechanisms to advance integration and coordination and to enhance the interception of technology policy with energy and environmental policy. So, the details are going to matter a lot here. I don't presume to offer a solution but to raise my concern in the spirit of a do-no-harm approach in the absence of greater detail on the overall partitioning of responsibilities among all Under Secretaries and the deputy secretary. Integration and coordination games are hard won and more easily lost.

Finally, in energy, clearly the past year has brought great energy challenges and the committee has before it the consideration of many energy technology initiatives. I won't go through a number of them that have come out in the context of our portfolio analysis. They are in the written testimony. I would just conclude by reinforcing the earlier statements that the challenges and the opportunities being brought out through portfolio analysis require the kinds of increases in energy and technology development that John Holdren in particular has spoken of. Any increase must match the scale of the challenges and I strongly support the committee's commitment to, in fact, supporting these programs and to hopefully moving forward with the portfolio-based approach. Thank you and I will be happy to answer questions.

[The prepared statement of Dr. Moniz follows:]

PREPARED STATEMENT OF ERNEST J. MONIZ, PROFESSOR OF PHYSICS, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Thank you for inviting me here today to discuss proposed legislative actions that can have a significant impact on energy, scientific research, and technology development programs at the Department of Energy. My perspective on these is informed by my recent service as Under Secretary in the Department.

SCIENCE

This Committee is very well aware of the Department's key role in American science and energy technology development. Nevertheless, some aspects bear repeating. The Department remains the largest supporter of basic and applied research in the physical sciences, activities that not only underpin national security and economic growth in the information age, but also provide the technological basis for many stunning advances in the life and medical sciences. One need only look at some of the very recent developments to get the flavor of the DOE national laboratories' continuing importance to the nation's science and technology enterprise:

- a record 14.7 Tesla electromagnet at the Berkeley lab
- insight into particle-antiparticle asymmetry at SLAC
- creation of the second-hardest bulk substance (after diamond) at Ames
- two Discover Magazine awards to Pacific Northwest, for a landmine detector and for a combined optical and magnetic resonance microscope for cellular research
- an experimental microbeam radiation therapy at Brookhaven for brain tumors in infants and young children

This reinforces the importance of Administration and Congressional support for balanced Federal research investments across science and engineering. The Administration FY02 budget request is very disappointing in this regard. Members of this Committee are to be commended for urging that the Congress restore a stronger investment approach to research in the physical sciences and engineering; this will serve both science and the nation well in the years ahead.

More specifically, the Department of Energy, through its unmatched national laboratory system and its support of university researchers and educators, and because of the diversity of its missions in nuclear security, energy, and environmental remediation, has played a very strong role over many decades in developing enabling technologies that cut across the mission areas and have proved to be of broad and

deep national value. Examples are well known, including large scale scientific computing, advanced materials, accelerators, nuclear isotope applications, genomics, and others. Beyond the evident metrics of success (such as over seventy Nobel prizes in science, or a third of the R&D100 Awards for technology), these sustained enabling technology developments associated with the Department's frontier research programs and national laboratories underpin a significant part of our economic productivity gains, year-in and year-out certification of the nuclear weapons stockpile, unparalleled medical diagnostics, a new generation of efficient energy technologies, and many more developments central to our nation's future.

This context brings out the importance of the Committee's initiatives in advanced scientific computing and in nanoscience. The nuclear weapons program has traditionally been a principal driver for supercomputer development and the associated software and applications tools. This has never been more important to the weapons program than it is today, with the need to certify the nuclear stockpile without underground testing. Large scale simulation is the integrator of previous test data and continuing experimental tests of weapons subsystems. However, we are also reaching the level of computational power that will allow true discovery potential to be realized across numerous areas of basic science and technology development. Indeed, the DOE and NSF jointly sponsored a 1998 National Academy workshop on scientific simulation, and the "friendly skeptic" chairman, Professor James Langer of Santa Barbara (former Director of the Institute for Theoretical Physics and President of the American Physical Society) concluded from the meeting that scientific simulation could in this decade take a place alongside traditional experimental and theoretical inquiry as a tool of discovery.

The challenge to do so is considerable, but within grasp with strong support and leadership. The Accelerated Strategic Computing Initiative (ASCI) in Defense Programs is urgently stretching the hardware frontier, but much remains to be done in systems software, visualization, algorithm development, data storage and transmission, and other areas to most efficiently utilize the raw computational power. The task calls for large integrated teams of physical scientists, computer architects and engineers, and software designers. An equally vigorous and integrated push in the civilian applications areas (science, energy, environment) will bring a talented and much larger community in both labs and universities into developing the necessary tools for a major leap forward in scientific simulation during the next several years. This will be a major benefit to ASCI.

The broader scientific rewards will be enormous. In 1998, the Department chartered groups drawn from the entire American research community to map out the potential impact of such a program in diverse scientific areas (combustion, global systems and climate, plasmas and fusion, subsurface transport of contaminants, quark structure of matter, advanced materials, functional genomics, . . .). The conclusion was that several of the areas would immediately make major strides at the tens of tera-ops level if the integrated program were pursued; other areas (such as vadose zone science) would do so if the simulation program was coupled to a synergistic experimental and observational program.

Permit me to elaborate slightly on one example of relevance to the energy theme of this hearing. Combustion is one of the areas primed for a major advance through simulation at the 10-100 tera-op scale. Quantitative analysis, led by Sandia lab, showed that scientists could for the first time link molecular level processes all the way to engineering scale devices. This is a pathway to significant advances within ten years in efficiency and emissions reductions for combustion devices. The implications are clear for meeting our expanding energy needs and stringent environmental demands simultaneously, while also advancing basic science in chemical reactive flow, turbulence, multiphase flow, and other areas that come together in a combustion device. This is why I strongly support the Committee's advancement of DOE's advanced computing proposals. It is part of the longstanding tradition of driving critical enabling technology through frontier research. The convergence of computer technology and scientific community commitment has been demonstrated over the last three years, without funding adequate to support that commitment. It is time to get on with the task.

The nanoscience initiative at DOE and at other agencies (NSF, DOD, DOC, . . .) is another excellent example of such enabling science and technology, and the Spallation Neutron Source under construction at Oak Ridge will soon offer to a national community of university, lab, and industrial researchers a powerful frontier capability to study advanced materials. Nanoscience and nanotechnology, which essentially seek to design and engineer novel materials at the atomic level, will have profound implications, from communications to life sciences to robotics and intelligent machines (another area roadmapped by DOE, together with NSF, NASA, and DOD, in a multi-lab effort). These are all critical enabling science and technology areas

where the national laboratories, in conjunction with universities, can put together the needed large interdisciplinary teams, can build upon decades of accomplishment, and do the work that drives future mission success.

EDUCATION AND TRAINING

The Committee's evaluation of the diminished state of university education in nuclear engineering correctly suggests that the U.S. (and possibly other industrialized nations) may soon face a shortage of trained and creative personnel in this area. That manpower will be needed not only to satisfy DOE facility staffing and in the event that nuclear energy is expanded, but also to address the wide spectrum of nuclear science and technology needs throughout our society. Proposed programs, such as that for junior faculty research grants, can help attract talented young people. However, I wish to emphasize two issues, well known to the Committee, that must be resolved if such human resource development programs are to succeed.

First, there must be a forward-looking, robust research program. The Nuclear Energy Research Initiative (NERI) and the associated Generation IV discussions are central. NERI, in its three year existence, has stimulated new thinking about advanced reactors, fuels, and fuel cycle concepts. I note that, at a small nuclear energy meeting held at MIT a few months ago, much of the discussion about new ideas had roots in NERI, despite its youth and modest funding. This modest funding to date has confined the sponsored work to studies, appropriate for the first few years. However, the Congress must soon resolve issues about the program's trajectory; in particular, it cannot sustain itself and attract new people without evolving into more costly laboratory work based on the most promising concepts developed in the earlier phase. In this regard, the Administration-proposed budget cut for NERI will clearly have the opposite effect to that intended by several members of the Committee. Significant increases in funding are needed in the years ahead if the nation is committed to exploring advanced concepts that are intrinsically safe, more proliferation-resistant, waste minimizing, and still economic. This is not to judge whether any of these new concepts will play an enhanced role in our future energy mix, but the time scales for a major impact are long, the constraints on fossil fuel emissions will become more severe, and exploration of advanced options belong in a balanced R&D portfolio. This is independent of whether or not there is an expansion of nuclear power based on current technology. Further, the NERI program should be broadened to include as much international collaboration as possible, consistent with policy and diplomatic constraints.

Second, human resource development and execution of the next phase of NERI both require an adequate research infrastructure. The Nuclear Energy Research Advisory Committee (NERAC) has examined this question. The university reactors are, as a class, underfunded and underutilized. There are probably too many. An evaluation of the university reactors as a system is called for, and the evaluation should be integrated with that for nuclear infrastructure at the DOE sites. The goal should be a well structured hierarchy of teaching and research facilities on campuses, at strengthened regional academic centers, and at DOE sites. This is an area where strong and strategic collaboration between the DOE labs and facilities and the universities is essential for meeting long term goals.

Another manpower issue raised by the Committee is that of mobility of contractor personnel, for example, between different laboratories. I would like to raise a slightly different point on mobility. The Department of Energy technical manager corps is in need of augmentation and rejuvenation. Such positions should be viewed as part of a possible career path for laboratory scientists and engineers. The Department, the laboratories, and the programs would benefit (the same holds true for production sites and cleanup sites). To accomplish this may require legislation that would permit the type of responsibilities in rotational assignments that would present the career opportunities attractively and on an appropriate scale.

R&D MANAGEMENT

Portfolio Management

Starting in l998, the DOE substantially revised its approach to R&D portfolio management. The approach has been applied, with some variation, across all four business lines (science, national security, energy, environmental quality) under the umbrella of the R&D Council, chaired by the Under Secretary. The approach involves implementation of four linked processes: (1) portfolio development—identifying activities and mapping them to strategic goals; (2) portfolio analysis—identifying gaps and opportunities and defining "corporate" priorities; (3) strategic road-mapping—defining directions and milestones for selected corporate priorities together with stakeholders; (4) improved corporate R&D oversight—managing the portfolio

and the research enterprise. To a large extent, this is a realization of the portfolio process recommended by the PCAST panel on energy R&D, chaired by John Holdren. Very importantly, the portfolio process was integrated into preparation of the Department and Administration budget proposals for FY00 and FY01 through active participation of the Chief Financial Officer.

A few points are worth elaboration in the context of the Energy R&D Portfolio, which we will focus on for this hearing, and on the Portfolio Analysis (that is, the first two steps above). The first key point is that the portfolio architecture is not geared to organizational units but rather to strategic goals of the Department. This immediately breaks down some of the stovepipes and provides a language that interfaces more easily with broader policy makers. Thus, the portfolio:

1. Describes and explains DOE's current R&D activities and showcases recent accomplishments.
2. Provides a basis for evaluating portfolio balance vis-à-vis pursuit of strategic goals.
3. Better aligns technology investments with policy goals.
4. Provides the basis for planning future investments through portfolio analysis and roadmapping.

The core of the entire process was an annual formal portfolio analysis exercise, carried out by an expert panel. The Laboratory Energy R&D Working Group (LERDWG), composed of senior laboratory personnel, played a key organizational role. The expert panel also had senior career technical people from DOE and private sector experts (universities, NGO's, industry groups). A specific analytical tool developed by the Sandia lab, called the Vital Issues Process, was applied to the portfolio with the PCAST strategic, diversity, project, and public-private partnership criteria in mind. The principal output is a set of priority gaps/opportunities in the portfolio when viewed from the perspective of strategic goals and a set of cross-cutting portfolio planning opportunities.

The value of the process can be seen with a couple of examples (other elements of the output will appear in the next section of the testimony). In the first year, a strong focus emerged on energy system reliability (both electric and natural gas infrastructures); I note that this occurred well before the recent reliability problems surfaced, demonstrating the value of strategic thinking coupled to policy. Reliability R&D is an example of a crucial area that did not fit neatly into programs organized by fuel type. The strong FY00 Department budget proposal in this area is the type of R&D investment that can have major beneficial consequences down the road.

In the second year, a potentially important direction emerged when the analysis group raised the issue of using indoor environmental air quality and multi-attribute life-cycle analysis as important criteria for evaluating classes of R&D proposals. This interesting idea would take some time to implement effectively, but can also have significant benefits. I raise this and the earlier point on reliability here just to exemplify the type of new cross-cutting perspective injected into the portfolio management and portfolio evolution process (the Committee may be interested in the full analysis reports). This earned the process considerable "buy-in" from career professionals, from the labs, and from external participants and observers. An Executive Secretariat was set up in the Policy Office. There is considerably more to be done in advancing the process, such as further integrating the individual laboratory institutional plans with the portfolios, but substantial gain has been realized.

As the Committee has considered asking for an annual report from a technology transfer oversight group (to be discussed below), I respectfully suggest consideration of requesting an annual report from the portfolio analysis activity. This can be a way to use a demonstrably successful process to more rapidly evolve the energy R&D agenda to meet new challenges associated with strategic goals and to spur further integration of the entire DOE R&D system.

Technology Transfer

This Committee continues to show considerable interest in laboratory technology transfer and partnerships, as indicated by S. 259 introduced by Senators Bingaman, Domenici, and Murray. Overall, Congressional support for partnerships has been very uneven over the last six or seven years, so the leadership of this Committee may be important for providing the stability and resources essential for engaging private sector technology partners. There are many scholarly discussions about the value of such partnerships and the mechanisms to be followed, but the value is perhaps made most clear by simply looking at a few recent examples:

- Partnership with Intel: an arrangement to provide a no-fee license to DOE to redesign Intel's Pentium processor into a radiation-hardened chip for space and defense uses

- Partnership with Celera Genomics: strategic framework for advancing the state-of-the-art supercomputing and hardware design for genome-based research in the life sciences
- Partnership with Columbia University: an innovative program to explore the potential of establishing a joint Integrated Analysis and Modeling of Earth Sciences and Engineering Center at the unique Biosphere 2; this might provide unprecedented opportunities for controlled ecological experiments on the meso-scale
- Partnership with California Energy Commission: a model work-for-others agreement that has resulted in over $20 million in increased joint research activities
- Partnership with ASML: first-of-a-kind cooperative agreement with this foreign-based firm to join a $250 million U.S. effort to develop next generation lithography equipment

This is an extraordinarily diverse set of partners. In every case, the Department's laboratories bring unique expertise and/or facilities to the partnership and the project is important for DOE missions. The partners bring a mix of resources, unique facilities, and complementary expertise. The spillover effects beyond the partners can be substantial.

During 1998-2000, the Department moved forward to assist the laboratories with more uniform corporate oversight of technology transfer. A variety of issues, such as inconsistent treatment of intellectual property issues at the field level, called for more high-level corporate attention and centralized policy direction (while leaving individual CRADA decisions to the laboratories within the policy framework). A key step was establishing the multi-program Technology Transfer Working Group (TTWG) under the R&D Council chaired by the Under Secretary; an Executive Secretariat was established in the Policy Office, together with that for portfolio management. The TTWG coordinates policy and implements reforms; a partial list of steps taken include:

- streamlining DOE technology transfer procedures and practices and, in particular, optimizing the process for concluding cooperative research and development agreements (CRADA's)
- promoting public awareness of opportunities and resources available for technology partnerships
- developing clear guidance for stewardship of intellectual property and assuring that international partnerships safeguard U.S. economic interests
- implementing management reforms to assure coordination and performance of DOE technology transfer activities
- drafting two new orders to promote technology transfer within DOE, to establish DOE policy to leverage resources through partnerships, and to define clear roles and responsibilities for programs and field elements
- establishing ombudsman capability throughout all thirty DOE facilities that engage in technology partnerships
- developing performance measures for inclusion in M&O contracts
- developing model agreements to streamline process for lab partnership with state research organizations

A number of these steps particularly facilitate partnerships with small business.

S. 259 can help solidify these advances and set the stage for new ones. The level of corporate oversight and systemization provided by the TTWG and R&D Council produces a reasonable degree of accountability and allows the Department to more easily facilitate complex CRADA's. Congressional support is essential if the technology transfer and partnership programs are to sustain (and withstand) success.

Organization

The Committee is considering establishment of the position of Under Secretary for Science and Technology. This individual would monitor the Department's R&D programs. A number of my colleagues in the science community support such an idea. However, as one who has just served as Under Secretary for Energy, Science, and Environment and who, I believe, would generally be accepted as having the qualifications spelled out for the new position, I must express concern with the proposal, a concern that might be relieved with further elaboration. I should add that the nature of the "customers" and the agencies with which one deals does, in my view, support the current structure of two Under Secretaries, one for the national security mission, another for civilian missions. This discussion clearly addresses only the latter.

My concern is whether the proposal would weaken or help advance the progress made in the last few years in achieving somewhat better integration and coordination across the Science, Energy and Environmental Quality business lines, in par-

ticular the science and technology programs. The current organization provided an opportunity to further infuse the energy and environmental quality programs with a science and technology perspective, to extend the use of competitive merit-review-based processes in those programs, and to bring a technically grounded perspective to broader policy discussions in the Department and within the Administration. The invigorated R&D Council chaired by the Under Secretary and particularly the R&D portfolio/roadmapping process provided mechanisms to advance integration and coordination and to enhance the intersection of technology policy with energy and environmental policy. The details clearly matter. At one extreme, if the new Under Secretary had only one office in the line, the Office of Science, this stovepiping would be detrimental to the integration and coordination discussed above, since convening power for R&D monitoring would not match up well to the line organization. The discussion must be clarified in the context of the responsibilities of all the Under Secretaries and the Deputy Secretary (in particular, the COO responsibilities). For example, since most of the civilian R&D is in the Science and Energy business lines, while the Environmental Management program offers large scale "COO-like" challenges, a separation along those lines could be effective; this would still suggest the need to integrate the environmental quality business line into the overall R&D system, but clearly no organizational scheme can cleanly meet diverse management issues. I do not presume to offer an overall solution, but raise my concern in the spirit of a "do no harm" approach in the absence of greater detail on the overall partitioning of responsibilities. Integration and coordination gains are hard won, and more easily lost.

ENERGY

The past year is one that has brought energy challenges to the fore. The Administration's National Energy Policy correctly states that advanced energy technologies represent the ultimate answer to those challenges (although the Administration budget proposal for DOE energy technology programs appears to be inconsistent with that statement). This Committee's commitment to strong energy R&D will pay dividends well into the future, just as previous Federal investments have helped shape today's energy sector. The fact is that, while reliance on competitive markets is a bipartisan "first principle" of U.S. energy policy, Federal support for energy R&D, often in partnership with the private sector, is essential for moving energy technology forward at a competitive pace. The strong externalities in the energy business, the long time to technology commercialization, the significant R&D cost for some technologies, the aversion to a high degree of risk in a highly competitive environment, and the need for a diverse set of technologies conspire to keep the private sector from making investments commensurate with the public good benefits. Indeed, deregulation trends have reduced significantly the longer term, pre-competitive R&D investments made by industry-wide organizations such as the Electric Power Research Institute (EPRI) and the Gas Technology Institute (GTI). It is important that the contributions made by these organizations over the years be sustained.

The Committee is considering numerous energy technology areas. I will highlight a few areas tied to the portfolio/roadmap process and organize my remarks around the preeminent challenges identified in the 1998 Comprehensive National Energy Strategy and the September 2000 Powering the New Economy:

1. Enhancing America's Energy Security

World dependence on oil for transportation and the dependence of OECD countries on substantial oil imports contribute to volatility in oil prices and attendant economic and social disruptions for both consuming and producing nations. Similarly, volatility has been seen in natural gas markets over the last year. We have three basic strategies to address this concern:

- improved vehicle efficiency (automobiles and trucks)
- improved exploration and production technologies (increased access and lower cost)
- alternative fuels (biofuels, natural gas derived fuels, hydrogen for oil replacement; natural gas alternatives for electricity production e.g. renewables; . . .)

All three paths have been vigorously pursued over the last years and should continue to be pursued aggressively. The first, improved automotive and truck efficiency, is the area that can have the greatest impact on oil import requirements in the relatively near term. PNGV has helped spur development of numerous technologies that can substantially improve auto efficiency, and hybrid autos may begin penetrating the market in appreciable numbers within a few years. Major gains are similarly realizable with trucks. Alternative fuels could have a similarly large im-

pact in a somewhat longer time frame, as fuels infrastructure challenges are overcome for widespread use. Also, some alternative fuels may reduce oil import dependence but place a significant additional demand on domestic natural gas supply. This leads back to a continuing focus on cost-shared R&D for new exploration and production technologies. As one example, the DOE in calendar year 2000 engaged with the private sector to develop a technology roadmap for ultradeep (5000 feet and substantially deeper) off-shore drilling technologies. This roadmap envisions fundamentally different architectures for environmentally sound oil and natural gas production, with expectations especially high for gas. This development would be costly, would extend over many years, but could also lead to large returns for the nation. This type of cost-sharing and risk-sharing with industry has led to substantial gains in the past. Ultradeep drilling technology is an example of a roadmap driven by strategic objectives.

2. Increasing the Competitiveness and Reliability of U.S. Energy Systems

As already noted, this was identified in 1998 as an important R&D focus area for the Department. The reliability initiative has three principal components:

- Electric reliability by focusing on regional grid control, distributed resources and microgrids, information system analysis, possible offsetting of peak summertime electric load with distributed generation and natural gas cooling technologies for example, and high capacity transmission
- Natural gas infrastructure reliability to include storage, pipeline and distribution R&D
- Critical infrastructure protection, secure energy infrastructures, vulnerability assessments, risk analysis, and the development of protection and mitigation technologies

The Committee is considering a variety of natural gas pipeline integrity and safety issues. The technology development is essential here, since the public must be assured in the wake of recent tragedies of pipeline safety if the large natural gas infrastructure expansion needed over the next decades is to be realized.

We also note the importance of supportive regulation and legislation if some of these technologies are to be put into widespread use and thus provide maximal benefit. For example, distributed generation has enormous potential for enhancing electric system reliability and power quality and other public goods, but substantial regulatory and business barriers need to be removed or at least substantially lowered consistent with legitimate utility concerns. Here, comprehensive Federal restructuring legislation may be essential for providing national rules of the road.

3. Mitigating the Environmental Impacts of Energy Production and Use

Energy production and use is the principal contributor to smog, acid rain, and greenhouse gas emissions that threaten our climate. Energy technology development is essential for addressing these problems at various length scales (urban, regional, global) and at various time scales. For the relatively short time frame, the R&D portfolio process led to an ultra-clean fuels initiative to address the need for cleaner fuels within the context of existing refining infrastructure. The initiative mobilizes industry and the national laboratories to develop and demonstrate new technologies for making large volumes of clean fuels from diverse fossil resources. The initiative is integrated with the PNGV and truck programs to ensure synergistic development of fuels and very efficient engines. This is another example of the portfolio process leading to a crosscutting initiative that addresses strategic goals in the context of an evolving regulatory environment.

A key component of addressing all these environmental challenges is increased efficiency. This is applied across all sectors—buildings, vehicles, industry, energy production. For example, previous DOE sponsored work has already led to major gains in buildings compact fluorescent lights, optical coatings for windows, integrated building designs. These technologies can be advanced further, but new directions may also take hold, such as fuel cell driven combined heat and power systems for buildings. Similar successes could be recited for energy intensive industries (oxy-fuel glass making, . . .) or energy production (very high efficiency utility scale gas turbines, IGCC coal technologies, . . .).

Another key ongoing focus is renewable technologies. Very substantial progress has been made in bringing down the costs of these clean technologies, for example, wind in the 3 to 7 cents/kWh range and photovoltaics less than 20 cents/kWh. Niche markets are readily available to these technologies today and market penetration will increase with further cost reduction. For the long term, these technologies can transform many aspects of energy supply in an environmentally sustainable fashion. Other technologies also have the potential to be transformative in the very long term. Carbon sequestration, for which an extensive roadmap was developed jointly

by the Offices of Science and Fossil Energy, could radically change the prospects for coal use in a greenhouse gas constrained world. And fusion continues to hold out hope as a major electricity source with virtually no emissions and unlimited fuel. The increased focus on alternative concepts is very important, and a burning plasma experiment is an important step to carry out within the current decade or so, preferably in collaboration with international partners. It is by no means clear that these very long term options will realize their potential. However, it is the very nature of a portfolio approach to invest in technology developments that cover a range of risks and time scales, and efforts such as sequestration and fusion carry with them very substantial scientific gain as part of the integrated science and technology program. Indeed it is generally the case that the very long term programs have significant unresolved science questions (complex plasma behaviors for fusion, and fundamental carbon fixation questions for long term sequestration).

The greatest international long term environmental challenge is clearly that of greenhouse gas emissions and climate change. It is clear that the energy infrastructure development in developing countries can have global consequences. The U.S. should, in my view, sponsor a much more extensive and coordinated program of clean energy development and deployment in such countries. In addition to the environmental and associated benefits, this would help stimulate the competitive position of American industry in these markets. In some cases, the opportunity to engage in technology "leapfrogging" there could have major unexpected benefits here.

4. Providing Diverse Energy Technologies for the Future

We have already indicated the breadth of technologies needed to address our strategic energy goals and the process introduced into the Department in 1998 to align the R&D investments with those goals. The total energy R&D budget has declined dramatically (correcting for inflation) over the last two decades. I believe an increase would match the scale of the challenges discussed above and in the Administration National Energy Strategy. The portfolio process will help ensure that those additional resources are applied towards strategic goals with an appropriate balance of time scales and risk for a healthy overall return on taxpayer dollars.

Thank you, and I would be happy to address any questions from the Committee.

The CHAIRMAN. Thank you very much. Mr. Fri, why don't you go right ahead.

STATEMENT OF BOB FRI, CHAIRMAN, COMMITTEE ON BENEFITS OF DOE R&D ON ENERGY EFFICIENCY AND FOSSIL ENERGY

Mr. FRI. Thank you, Mr. Chairman. While I do have a day job at the Smithsonian Institution, I am appearing here today as chair of the committee on benefits of the Department of Energy R&D and energy efficiency and fossil energy, the Academy report to which to you and others have already referred this morning. I have submitted my testimony for the record and since the report has in fact been discussed several times, let me just hit the high spots.

The question we were asked was essentially this: Over the past 22 years the Department of Energy has spent in 1999 dollars $22 billion on these two programs. We were asked, was it worth it and how can you tell? We developed a methodology for trying to be able to talk sensibly about the benefits and the core of it is in the chart across to my left, the matrix to which Secretary Blake referred earlier this morning, and is composed of two simple but very powerful ideas which have already been mentioned this morning. One, Dr. Moniz just mentioned and that is that the Department has some strategic goals that energy research and development is supposed to serve. We have characterized those in the rows of this matrix as economic, environmental, and security objectives. And the other is the notion that you mentioned that research and development has lots of different kinds of products, not necessarily just finished technologies. We characterize those in the columns of the matrix as

realized benefits, technologies that are actually in place working and producing real benefits, options for the future that may be needed in a different economic and policy environment and very important knowledge benefits that almost all research and development should produce. This turns out to be a very useful way of discussing the benefits of energy research and development and in distinguishing public benefits—which is the purpose of Federal funding—from private benefits. Basically, private benefits are in the northwest corner of this matrix. You would expect the private sector to realize economic benefits and take advantage of them. That is important for the Government as well, but the Government is practically the exclusive player in the other eight types of benefits that are characterized by this matrix and that is why we are here talking about energy R&D.

Was it worth it? On the whole, yes. Let me give you a few figures but first a cautionary note and that is, we were asked and indeed did look only at actual outcomes of research thus far. There's a lot of research in progress with benefits that can reliably be expected to be produced in the future. We did not count those. We got results, not expectations, but it is kind of nice to know that results actually prove the pudding as well.

In terms of realized benefits, we calculated that something like $40 billion of realized economic benefits had resulted over this past period from energy R&D. Interestingly, three-quarters of that benefit came from three small programs in the energy efficiency area, the sum total of which cost the Government around $15 million in the building sector. Three magnificent home runs. However, the results were positive in virtually all areas.

In the realized environmental benefits, the shoe was on the other foot. The environmental benefits were of the same order of magnitude as the economic benefits, if you try to price them out, which is not easy, but it is possible. But most of those came from a couple of small programs in fossil energy, which helped produce particular savings, reductions in nitrogen oxide omissions in powerplants. Then, if you can do that in a few big powerplants, that has a big impact just like making improvements in glass in the building sector does.

The story is less good in security benefits, while some have been produced. Basically getting at the major oil consuming sector of our economy, namely, the transportation sector, which is where the security benefits lie. It has not been particularly productive thus far. We would have great hopes for the Partnership for a New Generation of Vehicles program, but so far that has not been one of the big success stories.

And finally, there are at least 3 important options that have been produced that we think are likely to produce very substantial benefits and very plausible futures. One is the PNGV program. The other two are the integrated gas fired combined cycle program and the advanced turbine systems program. We studied 39 programs, and I am clearly not going to go into all of that.

Our recommendations boil down to these: One, fill in the whole matrix. Public funds should try to produce a balanced set of benefits and public benefits that are described by these nine boxes.

Secondly, our observation of the actual results strongly endorses the portfolio approach to planning. Clearly, we had some fantastic home runs. We had some strike-outs in this package. We had a bunch of singles and doubles. You need to look at the whole package and decide whether you are getting the benefits in taking appropriate risks which will improve failures.

Thirdly, we looked at a lot of different past evaluations of these programs, discovered that they were inconsistent, often overstated. We believe that is important for the Department and the administration and the Congress to have a consistent, accepted, uniform peer review method for evaluating benefits, both retrospectively and prospectively and while we know that the system that we have developed in our study for doing that needs a lot of improvement and refinement, we believe it serves the purpose and we are pleased with the interest that the Department has already shown and as Secretary Blake indicated this morning. In implementing that approach, we look forward to working with the Department to do that and certainly with the committee and the Congress if we can be helpful in that regard. Thank you and I would be happy to answer questions at the appropriate time.

[The prepared statement of Mr. Fri follows:]

PREPARED STATEMENT OF ROBERT FRI, CHAIRMAN, COMMITTEE ON BENEFITS OF DOE R&D ON ENERGY EFFICIENCY AND FOSSIL ENERGY

Good morning Mr. Chairman, Senator Murkowski, and members of the Committee. My name is Robert Fri. I am Director of the National Museum of Natural History and served as the Chair of the Committee on Benefits of DOE R&D on Energy Efficiency and Fossil Energy of the National Research Council. The Research Council is the operating arm of the National Academy of Sciences, National Academy of Engineering, and the Institute of Medicine, chartered by Congress in 1863 to advise the government on matters of science and technology. The committee I have chaired this last year was given the charge of assessing the benefits and costs of Department of Energy research and development in fossil energy and energy efficiency since 1978 by the U.S. Congress. The committee's report was released yesterday afternoon. I appreciate this opportunity to summarize it for you and to respond to your questions about our assignment.

The executive summary of the report is attached* to my written testimony, and both the summary and the full report describe the analytic approach we adopted to carry out our work. This background provides essential context for our conclusions. Although I will not dwell today on these methodological details, it is important to point out that:

1. We studied only the fossil energy and energy efficiency programs of the Department of Energy (DOE) because these programs fall within the jurisdiction of the House Interior Appropriations Subcommittee, which directed that the study be undertaken. Since 1978, DOE has spent about $22.3 billion on these programs, or about 26 percent of its total energy R&D expenditures.

2. Our assignment was to assess the benefits actually realized since 1978 as a result of DOE-sponsored research in these programs. We did not account for benefits that might occur in the future. This focus on outcomes distinguishes our study from most other evaluations of DOE's research.

3. Time and human resources constrained us to analyze in depth thirty-nine of DOE's research programs. We believe that this is a representative sample for purposes of this study, but falls well short of looking at all of the research conducted by DOE over the past two decades. This is particularly true for the energy efficiency area.

4. We had a dual assignment. The more obvious one was to assess the benefits and costs of energy R&D. The second but equally important task was to develop an analytic framework for conducting such assessments in the future.

This said, in the next few minutes I want to concentrate on the major messages of the report. In particular, I would like focus on four questions:

* Retained in committee files.

- What should we count as the benefits of energy research and development?
- Did the benefits of the programs we analyzed exceed their cost?
- What actions might improve the odds of successful energy R&D?
- How can the evaluation of benefits be improved in the future?

The most fundamental issue we addressed was how to define and systematically capture the diverse benefits that result from publicly funded research. To answer this question, we developed an analytic framework designed to capture two dimensions of such research: 1) that DOE research is expected to produce public benefits that the private economy cannot reap, and 2) that some benefits may be created even when a technology does not immediately enter the marketplace to a significant degree.

We identified the public benefits to be captured as those associated with DOE national energy mission:

- Economic benefits, measured by the change in the market value of goods and services resulting from the introduction of a technology stemming from DOE research.
- Environmental benefits, based on changes in the quality of the environment that have occurred as a result of DOE research.
- Security benefits, measured by changes in the probability or severity of abnormal energy-related events.

To characterize the uncertainty about whether research will in fact produce benefits that can be captured, we defined three categories of research outcomes:

- Realized benefits; which are benefits almost certain to be produced. An example is the cost saving resulting from the development of electronic ballasts for fluorescent lights.
- Option benefits, which are associated with technologies that are fully developed but for which economic and policy conditions are not yet favorable for commercialization. Integrated gasifier-combined cycle technology is an example of research that has produced an option benefit.
- Knowledge benefits include all other benefits that we identified, because all research produces some knowledge. We recognize that this is a catch-all category, and that a more refined analysis of knowledge benefits would improve our methodology.

Using these definitions, we created an accounting framework to provide a consistent, comprehensive assessment of the benefits and costs of the fossil energy and energy efficiency programs. The framework is a matrix, shown on the chart before you. We also defined a set of rules that provide a calculus for measuring the values to be entered in each of the yells. These rules are thoroughly documented in an appendix to our report.

We successfully applied this analytic framework to thirty-nine technologies funded by DOE since 1978. We found that these programs yielded significant realized benefits, important technological options for potential application in the future, and useful additions to the stock of engineering and scientific knowledge. Tables 2 and 3 in the executive summary show how each technology we studied produced benefits in one or more elements of the matrix.

Based on this analysis, we were able to address whether the benefits we identified exceed the cost of producing them. Our findings on this question are:

1. The estimated total net realized economic benefits associated with the energy efficiency program we reviewed were about $30 billion, substantially exceeding both the $1.6 billion cost of the representative sample of programs that we analyzed and the $7 billion in DOE's total research investment in energy efficiency since 1978. Most of these benefits are attributable to three relatively modest projects in the buildings sector carried on in the late 1970s and 1980s—more efficient refrigerators, electronic ballasts, and low-e glass.

2. The estimated realized economic benefits associated with the fossil energy program amounted to nearly $11 billion, approximately equal to the cost of DOE's research investment. However, the benefits of fossil energy programs conducted from 1978 to 1986, which included several alternate fuels projects, produced benefits of $3.4 billion and cost $6 billion. From 1986 forward, the economic benefits of $7.4 billion exceed the costs of $4.5 billion.

3. Although quantifying environmental benefits is difficult, we estimate that both programs realized benefits of this type valued at between $60 billion and $90 billion. Fossil energy programs that reduced nitrogen oxide emission account for most of this benefit. Other environmental benefits came from reducing emissions through energy efficiency.

4. Both programs produce important technologies that are viable options for reasonable policy and economic conditions that are likely to exist in the future. Chief among these option benefits are the Partnership for a New Generation of Vehicles, the Integrated Gasifier Combined Cycle program, and the Advanced Turbine Program.

5. National security has been enhanced by a number of programs, notably fossil energy programs that increased domestic oil production and reserves additions and efficiency programs that reduced oil consumption. However, DOE's research programs designed to reduce dependence on oil in the transportation sector have been disappointing so far.

Based on our analysis of these programs, we found that the benefits flowing from DOE's R&D programs were influenced by the structure and management of the programs. Among the useful lessons learned that can improve the odds of conducting successful research are the following:

- The largest realized benefits accrued in areas where public funding would be expected to have considerable leverage. Thus, the buildings sector is fragmented and the prevailing incentive structure is not conducive to technological innovation. Similarly, the nitrogen oxide reduction achieved in fossil energy is an environmental benefit that the private markets cannot easily capture. We believe, therefore, that DOE's research should focus on achieving the department's national public good goals.
- Important but smaller benefits were achieved in fossil energy's oil and gas programs and energy efficiency's industry programs. We concluded that DOE participation in these areas took advantage of private sector activity to realize additional public benefits. The lesson is that a clearly defined DOE role is crucial to ensuring that public funding is likely to produce appropriate benefits.
- It is particularly important that DOE manage a balanced portfolio of research. Individual research projects may well fail to achieve their goals, but DOE and Congressional policymakers should not view these as symptoms of overall program failure. Even failures generate considerable knowledge and a well-designed R&D program will inevitably include such failures.
- Where DOE seeks to develop technologies for near term deployment (as in the industrial energy efficiency program, for example), success is more likely when technological goals are consistent with the economic incentives of users to adopt the technologies. Standards can also serve as an important incentive, and the committee saw cases of both success and failure. Our case studies include a number of instances that did not meet this condition and so failed to produce significant economic benefits.
- Our case studies highlighted the need for periodic reevaluation of goals against changes in the regulatory or policy environment, projected energy prices and availability, and the performance of alternative technologies. Similarly, DOE should develop clear performance targets and milestones for achieving program goals. To evaluate progress against goals, we recommend that DOE expand its reliance of regular, independent, peer reviews that enlist the participation of experts who are not otherwise involved in DOE's programs.

Finally, we addressed the question of how the evaluation of benefits can be improved in the future. We reviewed many other evaluations of DOE programs and found no consistent methodology or framework estimating and evaluating the benefits of research. This inconsistency was often associated with an overstatement of economic benefits and/or a tendency to assign too much weight to realized economic benefits (only one of the nine boxes in our matrix).

On the other hand, we believe that the benefits matrix adopted for this study is a robust framework for evaluating program outcomes. Its application imposes a rigor on the evaluation process that clarifies the benefits achieved and the relationship among them. Accordingly, we recommend that DOE adopt an analytic framework similar to that used in our study as a uniform methodology for assessing the costs and benefits of its R&D programs. DOE should use this framework for reporting to Congress on its programs and goals under the terms of the Government Performance and Results Act.

We recognize, however, that the framework we developed for this study requires refinement. Among other things, DOE should improve the guidelines for benefits characterization and adopt consistent assumptions to be used across programs. As a first step, DOE should convene a workshop of analysts, decision-makers, and members of our committee to discuss the problems we encountered in the application of our framework. Longer term, DOE should seek to enhance the transparency of the process by, among other things, providing external peer review of the application of the framework.

That concludes my prepared remarks, Mr. Chairman. I want to thank the members of our committee for the extraordinary effort they put into this challenging assignment, and to express our collective appreciation to the DOE staff that so diligently worked to respond to our extensive requests for data and analysis. I would now be pleased to respond to any questions you may have.

The CHAIRMAN. Thank you very much for that testimony. Dr. Hubbard, why don't you go right ahead.

STATEMENT OF DR. H.M. HUBBARD, THE PACIFIC CENTER FOR HIGH TECHNOLOGY RESEARCH (RETIRED), LEE'S SUMMIT, MO

Dr. HUBBARD. Mr. Chairman, thank you for the opportunity to be here. My name is H.M. Hubbard and maybe that is were the B came from. At the present, I call myself a semi-retired independent consultant. I am actually spending quite a bit of time with the University of Missouri system and as special advisor to the chancellor on engineering and computer science education. Before that, I had been through a lot of different kinds of operations. For about 50 years I worked for industry, the DuPont Company. I was part of their atomic energy division and part of one of their commercial divisions. I was executive vice president of a Midwest research institute in the process of which I ran what was then called SERI, you know, called

The CHAIRMAN. You might just pull that microphone a little closer if you can.

Dr. HUBBARD. Is that better?

The CHAIRMAN. That is a little better. Thanks.

Dr. HUBBARD. Where was I? Let's see. I was at the National Renewable Energy Laboratory for about 10 years. Since then, I spent 5 years in Hawaii with the University of Hawaii and with the Pacific International Center and since that time, I've spent some 6 years chairing the National Academy's committee Board for Energy and Environmental Systems and most recently, and I guess the reason you asked me here, is I chaired a study committee in the NRC which was looking at the programs for the Office of Power Technologies. Now, that is a pretty narrow slice of Department of Energy but it encompasses all renewable energy technologies, particularly looking at electricity production. And as you do that, it pretty much transcends that because you have to look at the connections. And in looking at those programs, we were looking primarily at the potential for electrical production and the state of those programs. In general, the technology itself I would rate as good to excellent and I am talking about solar radiation and a resource for biomass, wind, hydropower, geothermal and oceans. When I say it is excellent, I mean we pretty well understand what the resource is. And we have a pretty good concept of what you need to do to get at it. Of those programs, oceans have presently dropped by the way side, not because the potential is not there, but we understand it fairly well and in the next few decades it is unlikely to be economic except in a very few situations.

We also looked at what I call enabling technology. Now, I mean storage, hydrogen, superconductivity, et cetera. Again, the technology is making progress. They need more attention than they're getting and they need better organization than they're getting. We began to look at what I would call systems issues from what Dr.

Corradini was talking about. I think he was talking about cross-cutting issues. How do we integrate across the programs? What do we know about distributors' resources? What do we know about coordinating a cross-program and how about our planning and analytic capabilities? Things were not so good there. It was somewhat neglected and it needs a lot more attention.

Let me go into my bottom line which are points that I really want to emphasize. The first is the importance to our country's future of having a renewable energy option available. Renewable energy alone will not solve our energy concerns but without it our chances and the world's chances of creating a sustaining energy supply system and distribution system we need are pretty close to zero. We need a diverse portfolio of energy, technologies, and energy resources. And there is that portfolio word again.

The second is that in spite of its problems, and they have been considerable, the cooperative Federal industry program has been remarkably successful in developing a science and technology base and we understand that pretty well. And in many cases, one in particular, PV, in particular, biomass, to some degree, there has been pretty effective cooperation between industry and the Nation and the laboratories. When we talk about an R&D program, we always talk about it as an RD&D program, research, development and deployment, because making that transition from the laboratory to industry or Federal laboratories to implementation and deployment and commercialization is difficult and it requires direct contact. You don't just hand it over. You have got to work it over and that has sometimes been neglected.

The third is that renewable energy R&D is a necessity, a long term effort, and we are not there yet. The core program requires stable funding at reasonable levels tied to program objectives. Stable funding, reasonable levels, defined program objectives. Since the early 1980's the program has generally been underfunded and subject to erratic fluctuation. And it is also true that in general the energy industry has never been notable for their investment in research and development. So, what the government does is really critical, important and essential.

The fourth is that in general, energy RD&D needs stronger, more effective leadership than they have usually received. They need to do better planing, better metrics, clearer definition of program objectives and more effective coordination of program elements. Having sat in on some of the nomination hearings, maybe you need a few more drill sergeants in the Department. That might help.

At the risk of embarrassing former Under Secretary Moniz, you need more Ernie Monizes in the Department. That orientation of one of the senior officials towards R&D and the understanding of it is critically important and at the time we looked at the OPT programs, which was in 1999, we looked at the programs as they were then operating and we saw these deficiencies more with respect to management and leadership than with respect to the technological capability. Parallel with that, the R&D council, which Dr. Moniz referred to, began to develop a process of strategic planning and a process of developing administration of the R&D programs by portfolio. We mentioned those deficiencies in our initial report and the Department of Energy said, well, we are working on those. And we

said, well, prove it because we don't see the impact yet. In response to that, we were asked to do a follow-on study with a letter report in which we reviewed the progress that the R&D council were making and where they were in that process. That was very reassuring to us. Now, that needs to go on. It cannot be dropped at this point without a huge waste of effort and spinning of wheels. So, that needs to be picked up by the new Administration. And I think they can build on it, and they really need to do that.

The fifth one is, as Dan Yergin once said, let's put the E back in DOE. Only about 20 percent of the budget in general, as you well know, really addresses energy and energy problems. And it is also true that sometimes, as has been said in the hearing, that as a result, the senior management at Department of Energy has very often been distracted from looking at energy research and very often, frankly, ignorant of it. So, that needs attention. And I think the idea of a single person not just for science but for research, energy research, development and deployment, responsibility for those programs, would be important. I think that can be done. And in the process, answer the legitimate concerns that Dr. Moniz has. And it would be consistent with a recommendation that was made by the Yergin study group in 1995; namely, that there should be a single person at the Under Secretary or Deputy Secretary level reporting directly to the Secretary of Energy, who has responsibility for strategy, budgeting, management and integration over these various energy research programmatic divisions. With that, I will subside and be happy to answer any questions. Thank you.

[The prepared statement of Dr. Hubbard follows:]

PREPARED STATEMENT OF DR. H.M. HUBBARD, THE PACIFIC CENTER FOR HIGH TECHNOLOGY RESEARCH (RETIRED), LEE'S SUMMIT, MO

Mr. Chairman and members of the Committee thank you for inviting me to testify at this important hearing on legislative proposals related to energy and scientific research, development, technology deployment, education and training. I was specifically asked to testify on the condition and prospects for renewable energy.

In May of last year the National Research Council (NRC) issued a report, *Renewable Power Pathways.* The report is the result of a study carried out by the NRC's Study Committee for the Programmatic Review of the Office of Power Technologies (OPT). this was followed, in late August, by a letter report of a follow-up study by the Committee on *Recent Initiatives by the Office of Energy Efficiency & Renewable Energy and The Office of Power Technologies.*

The study committee which I had the privilege of chairing consisted of a group of energy experts coming from different sectors of the energy research community. The final reports were reviewed by a variety of reviewers according to the NRC's usual procedures. A list of committee members and the reviewers is appended to this testimony.

The majority of the opinions and recommendations presented in this testimony are drawn from those reports and the discussions of the NRC Study Committee. In areas in which my testimony goes beyond the scope of the NRC study I have drawn on other sources and my own long experience in the energy and environmental research and development. While I believe that the opinions and conclusions presented here are consistent with the views and conclusions of the Committee, I take personal responsibility for the testimony as it stands.

ENERGY—A CRISIS OR A CHRONIC CONCERN?

For the last three decades of the twentieth century energy has been a matter of continuing concern to the American public and hence to our elected representatives and business leaders. Will we have it—i.e., power and fuel—when we need it?

Will it continue to be cheap? What is it doing to our air and water? And more recently, what is all this noise about "global warming"? Is it a myth promoted by

over-zealous scientists and over-wrought environmentalists or do we need to be concerned about it?

Believe me, we do need to be concerned about it and the majority of the American public understands that. Occasionally our chronic concerns develop into acute anxiety for good and sufficient reasons. Witness the impact of electricity blackouts and high prices in California as well as the high gasoline prices in the Midwest. In the past as a problem abated public attitudes and political priorities settled down and energy issues took a back seat but the chronic concern lingered.

To date, energy concerns have rarely if ever reached a state that could be called a "national crisis" but we cannot be sure that this will always be so. We are confronted by an increasing dependence on imported fuel, concerns about the environmental damage and health risks associated with energy production and use. Also there are concerns arising from questions about economic security and geopolitical stability. We as a nation have good reason for a continuing anxiety about our energy supply.

We face a promising but unpredictable future. In the face of these uncertainties and questions, we know that we need a more robust and flexible energy infrastructure with a diversity of fuel resources and energy conversion technologies.

We need a diverse energy portfolio! Where will renewable energy technologies (RET) fit? Almost all energy planers and analysts from those of international organizations like the World Bank to the forward looking energy companies, public and private thank tanks, and non-governmental (NGO) advocacy groups agree that renewable energy will play an increasing role over the next century in this portfolio. As the CEO of one of the world's largest natural gas producers and distributors remarked to me when we shared the platform at an Aspen Institute energy forum a decade ago: "After sometime around 2025 the energy world will belong to you guys (renewable energy) but until then it belongs to us." That company is now busily engaged in developing renewable energy projects to complement its primary fossil energy business.

RENEWABLE ENERGY TECHNOLOGIES—CURRENT STATUS AND PROMISE

The federal government began a major R&D effort twenty-five years ago to develop the science and the advanced technologies necessary to provide electric power, transportation fuels and thermal energy from our domestic renewable resources. These resources include solar radiation, geothermal energy, hydropower, biomass, wind, and ocean energy. We have made remarkable progress and the result is a diverse set of renewable energy technologies several of which are already making a significant contribution to our energy supply and our economy.

Over this period substantial improvements have been made in the performance and reductions in cost of these technologies. In fact, most of DOE's goals and objectives in performance and cost of production have been met or exceeded. The DOE technical managers and the laboratory researchers should take a bow. Photovoltaic and wind turbine technologies are outstanding examples of successful cooperation between industry and government research. There has been important progress in other areas as well, biomass conversion, hydrogen fuels, solar building design, and solar thermal systems, etc. In general the advantages and disadvantages associated with the different resources and conversion technologies are well understood.

On the other hand the renewable technologies have disappointed their supporters. The deployment goals set by DOE and the industry have not been met and the use of renewable technologies in the U.S. economy is still limited. There are several reasons for this. Most importantly, the energy market has changed. Our economy has become much more energy efficient and the market more competitive. Conventional energy prices have remained lower than expected. DOE in concert with the emerging industry has often set deployment goals based on unreasonable expectations and unrealistic promises.

Nevertheless as R&D continues to reduce costs and as conventional energy prices fluctuate up and down the new renewable technologies, i.e. those other than biomass combustion and conventional hydropower, are emerging in the market at a rapidly increasing rate. U.S. shipments of solar cell modules increased by 23 percent over the previous year. The approximately 2500 MW of wind energy capacity installed in the U.S. is expected to double by the end of this year. New wind farms are going up in southern California, west Texas, on the high plains of Kansas/Colorado, in Minnesota and in Iowa. In a related development, a third or more of U.S. consumers can now choose some type of "green power", i.e. power from renewable sources, from either their regulated utility or in competitive markets.

What can we expect from renewable energy in the future? Energy projections and forecasts are notoriously uncertain. But within a broad uncertainty band there

seems to be some consistency among the fearless experts. Ten years ago the five National Laboratories most involved in renewable energy were asked to develop a "consensus" on the *Potential of Renewable Energy*. The resulting "white paper" issued in March of 1990 projected a renewable energy contribution in 2030 of between 15 and 28 percent. The lower number in the case of a business as usual scenario and the higher number if federal policy supports and "intensified" Research, Development, and Deployment (R,D&D) scenario. Other attempts to estimate the RET contribution run in the range of 20 to 50 per cent in the time period of 2025 to 2050.

The *Report to the President on Federal Energy Research and Development for the Challenges of the Twenty-First Century* was issued in November of 1997 by the President's Committee of Advisors on Science and Technology (PCAST). In that report the Panel on Energy Research and Development stated that "the Panel believes that with a strong R&D program coupled to appropriate demonstration and commercialization incentives that many of the renewable energy technologies in the (DOE) portfolio have good prospects of becoming fully competitive with conventional technologies in whole scale applications. The time to get there was projected at less than ten years for some (wind appears to be ahead of schedule), up to 20 to 25 for others, i.e. transportation fuels from energy crops. Shell International Petroleum Company has projected that by 2025 "renewable energy sources could contribute to global energy one-half to two-thirds as much as fossil fuels do at present with new renewable sources (excluding hydropower and traditional biomass) accounting for one-third to one-half of the renewables total." The Intergovermental Panel on Climate Change (IPCC) has made similar statements concerning the energy contribution from rewnewables.

There is a problem! In fact a couple of them that make it difficult for the program planners and the emerging RET industry to know how to proceed. It also makes achieving the potential of renewables difficult. The current director of the National Renewable Energy Laboratory, Admiral Truly, stated them clearly in a recent statement.

> "Beginning in the 1970's, every administration and Congress has had a different set of national goals, R&D investment levels and policy actions for developing these technologies" resulting in "1) the erratic up-and-down nature of annual federal R&D investments for energy efficiency and renewable energy, and 2) the confusing and inconsistent array of national energy strategies, tax incentives, and regulatory policies (superimposed on the program) since the programs began."

Hopefully this Committee can do something about these problems! We need more stability in the budget, and more consistency in policy direction. Under present conditions it is very difficult to develop and implement a coherent strategic plan for a long range research and development program. That however should not keep DOE from trying and recently they have begun to do so. Hopefully the process will be continued by the new administration.

RENEWABLE ENERGY PROGRAM MANAGEMENT

The Study Committee was directed to do a "programmatic" review of DOE's office of renewable power technologies. The Office, a major unit of the Office of Energy Efficiency and Renewable Energy (EERE) conducts R&D programs for the production and distribution of electricity from renewable energy resources. The individual program elements dealing with production include: photovoltaics, wind, solar thermal, geothermal, biopower, and hydroelectric technologies: Others deal with "crosscutting" issues; storage, transmission (including superconductivity) hydrogen, and distributed power. We began with an examination of the individual programs but were rapidly lead into the broader issues of program management, planning, and coordination with other R&D units in the Department doing related work.

In the report there are recommendations for each of the individual Programs. I will not go into them here but in general the technical performance was excellent. The individual program plans varied in quality from nonexistent to well thought out. While we did not attempt to give formal ratings to the programs my own opinion that they varied from "not bad" to outstanding with the majority in the "good to excellent" range. We were, however, concerned by the apparent lack of coherence and coordination among the program elements and with other governmental organizations doing related work. This is reflected in our recommendations for the overall program as indicated below.

- OPT should develop criteria and a systematic process for selecting specific research and development programs.

- OPT should focus more on integrating its programs, identifying common needs and opportunities for research, and clarifying how the individual programs can further their objective. Bench marking and other planning techniques used by industry could be adapted for measuring progress and selecting priorities.
- OPT should develop a robust rationale for its portfolio of renewable energy technology projects. OPT and its individual programs should de-emphasize short-term deployment goals (which have often been unrealistic, overly optimistic, and which are not within DOE control) as the metrics for defining success. The stated objectives should be the development of a sound science and engineering base. The metrics should be stated in terms of technical performance, decreasing costs and the development of technologies that meet the needs of industry and the marketplace.
- OPT should institute a process of regular external peer reviews (at least every two years) of its proposed and ongoing projects and programs as well as its overall goals. As part of the process OPT should report to the public and the Congress how it responds to the recommendation of the reviewers.

REVIEW OF RECENT DOE INITIATIVES

First a note of explanation: The OPT programmatic review was proposed in discussions between EERE and the NRC in the summer of 1988. The scope work was approved and the study funded in the late fall. The committee was first convened in March of 1999. A draft report was produced by the Committee with the help of the study director and his staff in December for appropriate review resulting in the issue of the final report in May. As you have seen the Study found a lot of merit in the programs (along with some deficiencies) but was quite critical of the renewable energy management because of a lack of leadership in the areas of coordination, planning, monitoring process, setting realistic goals and metrics.

While the Study Committee was conducting it's review at the program level (a kind of bottom-up look at how OPT does it's work) DOE senior management under the leadership of the under secretary and the newly established DOE R&D Council was continuing its "initiative to apply portfolio approaches to managing Departmental R&D". This lead to initiatives by OERE and OPT which in the opinion of OERE management addressed many of the deficiencies and responded to many of the recommendations of the Study Committee as well as those contained in a "top-down" *Review of Management in the Office of Energy Efficiency and Renewable Energy* by the National Academy of Public Administration (NAPA). As part of their response to the Study Committees report OPT asked the Study Committees to review those initiatives and recent managements steps. This review was conducted in June, July, and August during which time the Committee conducted a review of materials provided by EERE and OPT regarding those changes and initiatives and held a meeting to interact with DOE senior managers including the Under Secretary, the Assistant Secretary of EERE, the Deputy Assistant Secretary for OPT and the OPT Associate Deputy Assistant Secretary. An NRC letter report was issued in late August. The letter report should not be interpreted as a review of the findings, conclusions or recommendations of the earlier Committee report. Rather the letter report is strictly a consideration of recent action.

What did the Study Committee conclude? The documents submitted, "taken together, are the major elements of a comprehensive management and planning system designed to identify R&D needs in EERE/OPT program areas, to establish visions, goals, and objectives, and to develop roadmaps and multi-year plans for achieving them. In addition, EERE and OPT have made numerous management changes to facilitate and promote communication, cooperation, coordination and collaboration across organizational lines, improve capabilities, and enhance management efficiency and effectiveness.". . .

"The Committee recognizes that the completion and implementation of strategic and program plans is a work in progress—as is the implementation of the recently developed concept of a Strategic Management System (SMS). The Committee encourages EERE/OPT to complete the process and believes that the results will address many of the concerns identified in the recent NAPA and NRC reports."

Successful long-term implementation depends on the acceptance by DOE senior career personnel. For the full potential on the initiatives and management changes to be realized, they must become embedded in the way DOE/EERE/OPT conduct their business. Among the challenges EERE/OPT now face is clearly and unambiguously presenting the system and goals to the Congress and to the new administration along with the benefits that are expected to result.

In the year 2001, if DOE/EERE/OPT can build on the encouraging start they made the previous year in improving their program planning they will clearly be "moving in the right direction".

FINAL REMARKS AND RECOMMENDATIONS

In the conclusion there are several points that I would like to emphasize to the Committee:

- The first is the importance to our country's future of having the renewable energy option available. Renewable energy alone will not solve our energy concerns but without it our chances and the world's chances of creating the sustainable energy supply and distribution system are close to zero.
- The second is that in spite of its problems the cooperative Federal/Industry program has been remarkably successful in developing the science and technology base.
- The third is that renewable energy R&D is of necessity a long term effort. We are not there yet. The core program requires stable funding at reasonable levels tied to program objectives. Since the early 1980's the program has been generally under-funded and subjected to erratic fluctuations.
- The fourth is that energy R&D in general and renewable energy programs in particular need stronger, more effective leadership than they have usually received, including better planning, metrics, clearer definition of program objectives and more effective coordination of program elements.
- The fifth is put the E back in DOE. It is often pointed out that only about twenty per cent of the DOE budget is devoted to energy R&D and that the attention of senior DOE officials is often directed to other responsibilities. In June of 1995 in the *Final Report of the task Force on Strategic Energy Research and Development* know as the Yergin report it was recommended that "responsibility for energy R&D portfolio strategy, budgeting, management, and integration over existing programmatic division be given to a single person at the Under Secretary or Deputy Secretary level reporting directly to the Secretary of Energy." The Study Committee in its discussions endorsed that recommendation and urges its implementation.

The CHAIRMAN. Thank you very much. The final witness on this panel is Dr. Mike Corradini. Why don't you go right ahead, Dr. Corradini?

STATEMENT OF DR. MICHAEL L. CORRADINI, UNIVERSITY OF WISCONSIN, MADISON, WI

Dr. CORRADINI. Thank you. I want to thank the chair and the committee for inviting me. I have a lot of graphics.

The CHAIRMAN. Okay. We are glad to see it.

Dr. CORRADINI. Typical class. I wanted to thank you all. I am chair of the nuclear engineering and engineering physics program at the University of Wisconsin Madison and that is, I guess, the reason I was asked to be here. I was also chair of the nuclear energy research advisory committee's panel to study the future of nuclear engineering programs and university reactors. And about a year ago, we gave the NERAC our report. It was endorsed, passed on within the Department of Energy and from that, as I understand it, S. 242 has addressed a lot of these concerns. So that will probably be my main topic for my verbal comments. You have my written testimony which addresses some of the other Senate bills.

A little history. Nuclear energy, or nuclear engineering, I should say, is really one of the first disciplines that spanned engineering systems from the macroscopic world to the microscopic world. Students learned many things at various levels and because of that, it really became a major contributor in three areas to the public good. Energy where it is a major source of electricity I think has been mentioned at least five times today. Over 20 percent of our

electricity is from nuclear energy. Secondly, it is an enabling technology in medical sciences. This is probably not as well known. At Madison we actually have two departments of nuclear engineering, so to speak. One in the medical school, medical physics, and one in engineering, engineering physics. And third, it is really an underlying technology for national security. The difficulty is we really have some current threats and issues.

So, the first thing I put up here is that over the last 20 years, and particularly over the last 10 years, we've had a precipitous fall in the number of nuclear engineering programs, that is the degree-programs, approximately 50 percent of what we had about 20 years ago. Similarly, if I could have the next one. I am going to make the staff help me a bit here. We've had a precipitous drop in the number of university research reactors. Dr. Moniz made a mention of this earlier and I think this is another indication of our loss of infrastructure. And probably the most important thing, if you want to move on, so I can stay within my 5 minutes, is the human resource. The thing that most concerns me because I am at a university and what concerns me is education and people, is that we have had a very precipitous drop, particularly in the last 8 to 10 years of enrollment in nuclear engineering programs at the Ph.D. level, the masters level and the BS level. And that has led us to the final picture. I am used to PowerPoint these days. I apologize. I am back to posters. And this is a study from the American Society of Engineering Education, and I want to spend a bit of time on this. This was done for the ASEE and basically shows the deficit in employment where we look at bachelors and masters graduates in the industry. And this is primarily the nuclear industry. So, I think primarily utility industry is a sample case. And what you see here is a bar of red which is growing and something in the future estimated to be about 500 individuals, which is at least three times the number of graduations we seen in the discipline. So, we have a real threat relative to the human resource. Okay? And that is really what I want to address today. The testimony talks abut a number of things. Our panel work gave a wide range of recommendations which you have in written form.

I want to address three things. First of all, because I am interested in the human resource and how we can effectively change the direction, is that we recommend fellowships for masters and Ph.D. graduates in nuclear engineering. I focus on graduate because the masters degree is one of the silent successes in education. And what you find is we have a number of people that come from various disciplines—physics, mathematics, other branches of engineering—into nuclear engineering and what we are recommending is an increase of the masters and Ph.D. fellowships to essentially support these students. Secondly, increased funding for NERER grants. Dr. Moniz made mention of the NERI program, which is a unique program for university, industry and laboratory partnership. But the NERER grants are particularly the equivalent of the NSF grants for universities. Because it was mentioned earlier, nuclear engineering, or nuclear energy, is essentially precluded from support by NSF and so the NERER program is the only way in which basic research, innovative research, can be done at universities. So, we recommend and strongly support an increase in the

NERER grant program. What it really does is really create knowledge and attracts talent. I am back to the human resource. It attracts talent of faculty going into the discipline and that to me is incredibly important for keeping the pipeline going.

And the third thing is continuation and augmentation of what is called, I guess in the lingo of the DOE industry matching grant program. What that really is is something that was thought up about 10 years ago by my predecessor, the chair of nuclear engineering at Madison, Max Carbin, in where he suggested that the deal we support with the industry provide a match, fifty-fifty match, of essentially flexible funds for departments. Those funds could be used for scholarships, undergraduate scholarships, for improvement of infrastructure of the various departments which they have been used for, laboratories, etc. Also, they could be used for outreach. And that program has been enormously successful to the point that it is oversubscribed every year. And it really provides flexible funds for programs.

And I think that is about it. I want to identify three things in particular and open it up for questions if you have any.

[The prepared statement of Dr. Corradini follows:]

PREPARED STATEMENT OF DR. MICHAEL L. CORRADINI, UNIVERSITY OF WISCONSIN, MADISON, WI

It is an honor to present testimony at this committee hearing on the current state and future of nuclear science and engineering programs. I would like to thank Chairman Bingaman for inviting me here today. I currently am chairman of the Engineering Physics Department at the University of Wisconsin, Madison and a Member of the National Academy of Engineering. I was also chairman of a seven-member subcommittee of the Nuclear Energy Research Advisory Committee. This subcommittee was tasked with examining the Future of Nuclear Engineering Programs and University Research and Training Reactors. It is in this capacity that I would like to address the senate committee today, on the particular issue of human resources and related nuclear energy topics.

CURRENT SITUATION

Nuclear science and engineering was born from early discoveries of noted physicists in the late 1890's. These discoveries, along with the discovery of nuclear fission in the 1930's, convinced a group of leading physicists and engineers to recommend that the United States support nuclear research for the common good of the nation; i.e., nuclear science and engineering would provide for our nation's security, supply some of its power and contribute to medical advances enhancing human health. This promise from nuclear energy has come to pass. For example, over 20% of the electricity in our nation comes from nuclear fission power plants. In these times of energy shortages and electrical power outages, reliable, safe and economic fission power is a proven, valued and sustainable resource. Additionally, the use of nuclear science and engineering advances have been pivotal in the improvement of human health, by advances in medical imaging, nuclear medicine and radiation treatment of cancer. The key ingredient in all of these advances is talented people with the motivation, skill and dedication to innovate, educate and use the technology in a safe, economic and sustainable manner.

Nuclear engineering programs and departments were originally formed in the late 1950's and 1960's from interdisciplinary efforts in many of the top research universities, providing the people for the emerging nuclear industry. In the same time period, university nuclear reactors were constructed and began operation, providing key facilities needed for research and training of students engaged in nuclear technology. Since the 1960's, U.S. universities have led the world in nuclear engineering with a commitment to furnish the necessary human resources and associated infrastructure.

However, over the last decade, the U.S. nuclear science and engineering educational structure has not only stagnated but is in a state of serious decline. The number of nuclear engineering degree programs (Figure 1) and the number of operating university nuclear research and training reactors (Figure 2) has fallen by

about half, and the enrollment in nuclear engineering degree programs has plummeted (Figure 3). Enrollment declines are particularly worrisome at the masters level, where many students from other engineering and science disciplines focus on nuclear engineering as a capstone professional degree. Only in the last year have enrollments nationwide seemed to stabilize, and a small increase is noted in undergraduate enrollments.

On the other hand, the demand for nuclear-trained personnel is again on the rise. A study by the American Society of Engineering Education (G. Was, T. Quinn, D. Miller, 1999—see Figure 4) indicates that the shortfall in qualified nuclear engineers at the bachelor and masters level could reach over 500 professionals annually by 2003. Workforce requirements at operating U.S. nuclear power plants are increasing and will undoubtedly remain high, given the plans for plant-life extension in the vast majority of operating U.S. light-water reactors. In addition, there is a continued growth of nuclear power in the Pacific Rim and continued advances in the design of a future generation of nuclear fission reactors. Moreover, new initiatives have begun in applied radiation sciences in collaboration with medical research as well as biotechnology. Finally, nuclear science and engineering expertise continues to be needed for national security, including technology related to arms reduction and verification and enforcement of international treaties as well as providing the U.S. Navy with effective, safe nuclear propulsion. There is a need to provide an adequate supply of professionals to meet the nation's needs in the coming decades.

FUTURE OF NUCLEAR ENGINEERING PROGRAMS AND FACILITIES: PANEL CHARGE

In November 1999, the DoE Office of Nuclear Energy, Science and Technology requested that Nuclear Energy Research Advisory Committee (NERAC) establish an ad hoc panel to consider educational issues related to the future of nuclear science and engineering; i.e., address the future of university nuclear engineering programs, establish a process toward support of university research and training reactors, and identify appropriate collaborations between DoE national laboratories and university programs. The panel consisted of myself, Marvin Adams of the Texas A&M University, Donald Dei, Chief Physicist of the U.S. Naval Nuclear Propulsion Program, Tom Isaacs, Senior Scientist at Lawrence Livermore National Laboratory, Glenn Knoll of the University of Michigan, Warren Miller, Senior Advisor to the Lab Director at Los Alamos National Laboratory, and Kenneth Rogers, Retired Commissioner of the U.S. Nuclear Regulatory Commission. The panel made a series of recommendations to the DoE.

FUTURE OF NUCLEAR ENGINEERING PROGRAMS: RECOMMENDATIONS

First, we recommended that DoE assist universities as they refocus nuclear engineering programs to enhance research activities in nuclear science and engineering, as well as to maintain the human resource necessary for continuing the discipline through the 21st century. It should be noted that the National Science Foundation has historically left support of nuclear engineering research and infrastructure to the DoE. Thus, our panel proposed that specific efforts of the DoE should focus on:

1. Enhancing the graduate student pipeline to maintain the health of the discipline: This effort should be focused on providing a continuing supply of graduates with post-baccalaureate education and technical expertise that can be employed at our leading universities, the national laboratories and all parts of the industry; i.e., providing role models for future undergraduate and graduate students. This requires a coordinated effort for recruitment at each level in the university program as well as the proper resources for graduate student fellowships and scholarships. Currently, the DoE and the industry have limited programs for these fellowships; i.e., the current program of $0.8 million provides fewer than 5 new doctoral fellowships every year for the whole nation in fission and health physics. This effort needs to be augmented in size and scope for our future success in the discipline. This is particularly important at the masters level, where many undergraduates from various engineering and science disciplines can obtain advanced training in nuclear engineering. The panel recommended that the DoE consider the more historic Atomic Energy Commission traineeship model for doctoral fellowships and masters scholarships in nuclear science and engineering at a steady-state level of $5 million per year; i.e., awarding a steady-state of 20 doctoral fellowships each year and 40 masters scholarships.

2. Recruiting and retaining new faculty in nuclear science and engineering fields: The panel recognized that nuclear engineering departments have had difficulties in attracting new faculty members into their programs. Future faculty need to see potential research opportunities and active research programs in their field before seeking an academic career. The panel recommended that a targeted research pro-

gram for junior faculty (6 years or less from the time of their first academic appointment) would be of great benefit to the young faculty. In addition, it could benefit the nuclear engineering programs by demonstrating to their administrators that a program exists to provide new faculty the opportunity to begin their research careers. This "Nuclear Engineering Junior Faculty Research Initiation Grant" program would be run in a manner similar to the NSF or DoD Young Investigators program. It would be a competitive program in support of DoE basic research needs in nuclear science and engineering affiliated with the mission-oriented goals of the nation's energy policy.

3. Enabling and enhancing research discoveries in nuclear science and engineering: A science-based research program, predicated on involvement of these universities, should be supported. It should also extend to the national laboratories and the nuclear industry in peer-reviewed, pre-competitive research and development. To accomplish this, we recommend maintaining the Nuclear Engineering Education Research program (NEER), as well as significantly increasing the base funding for the NEER. Currently, this program involves a very modest investment in university research into basic nuclear science and engineering ($5 million in FY2000). This program has allowed university researchers to be able to pursue high-risk ideas and make discoveries that can take us beyond our present understanding; i.e., provide the "spark" for innovation and future technologies. Since the NSF and other basic science programs generally believe that nuclear science and engineering basic research is the responsibility of the DoE mission-oriented office, the NEER program plays a very critical role in sustaining the intellectual growth and development of the discipline in our university research communities. The panel recommended that the NEER program funds be substantially increased to near $20 million per year. This program includes the Junior Faculty Research Initiation Grant program mentioned above. The panel also supported the Nuclear Energy Research Initiative program (NERI). The panel also recognized that this program should be synergistic but remain separate from the NEER program. NERI involves larger collaborative research and development tasks, which establishes a research partnership among universities, national laboratories and industry, and which places a larger emphasis on engineering applications and integrated technologies that respond to the DoE mission guidance.

4. Improving the undergraduate nuclear science and engineering experience: The panel recognized that the undergraduate discipline will continue to evolve in the 21st century and this evolution will be different within various university programs. Nevertheless, the panel feels that the discipline should be preserved as a "systems engineering core competency". This belief is predicated on the need for our graduates to have professional training in nuclear fission engineering within the context of systems engineering and design. This may be one of the most important responsibilities of university nuclear engineering faculty as they reestablish the groundwork for a resurgence of the discipline in the future. This is a fertile area for innovation in which research advances can play a role in the reshaping of undergraduate and graduate curricula and their associated pedagogy. Curriculum development should be a key part of DoE resource investment in the future. The DoE can also partner with the NSF in this particular area since the NSF has historically been very active and quite effective in promoting improvement in undergraduate science and engineering education. The current program at the DoE that supports the core competency in "nuclear systems engineering" is the "DoE/Industry" Matching Grant program. This program was begun in 1991 by the efforts of my predecessor as chair at the University of Wisconsin. Over the 10 years since its inception, it has become a powerful force in improving the educational infrastructure for undergraduates in nuclear science and engineering. It is a true "public-private" partnership, in which industry matches DoE contributions dollar for dollar, and needs to be maintained in the DoE at a level of at least $1 million/yr. It provides flexibile funds for scholarships as well as infrastructure improvements for laboratories and curricular innovations, which are crucial for maintaining excellence of these educational programs.

5. Enhancing national activity in nuclear science and engineering outreach. It is my personal opinion that nuclear engineering specifically (and probably the physical sciences in general) suffers from a distinct lack of understanding by the general public. One could contend that this is one of underlying reasons why the technology is viewed with uncertainty and apprehension. The panel felt that the university nuclear engineering programs may be in the best position to work with the DoE to develop an innovative approach to public outreach and education. Innovations in this area could have a major impact in regard to the image of the discipline and preserving its future human resource needs.

FUTURE OF UNIVERSITY RESEARCH AND TRAINING REACTORS: RECOMMENDATIONS

Since nuclear science and engineering is expected to be an important part of the research and development landscape in the 21st century, a lasting federal investment is needed to support this infrastructure at universities. University research and training reactors (URRs) are an important part of the nuclear engineering infrastructure that must be maintained. The panel felt that URRs:

- Are vital for advancement of knowledge in nuclear science and engineering education at the graduate level and provide powerful research tools for the advancement of many other disciplines;
- Provide undergraduate and graduate students with an otherwise unobtainable "hands-on" educational experience, allowing for learning about nuclear fission reactor processes, and understanding the interaction of radiation with matter (also providing for enrichment courses for professional nuclear engineers);
- Give the general public an opportunity through outreach activities to better understand and become familiar with nuclear processes and ionizing radiation as well as nuclear fission power.

The URRs have a major impact on research and development in the neutron sciences and technologies, and also provide necessary facilities for the education of future scientists and engineers who are critical to sustaining the nation's technological base in a diverse spectrum of fields. Research work at existing URRs is responsible for developing new radio-pharmaceuticals for diagnosis and treatment of cancers, for providing structural information on new high-technology materials, for developing critical data on the behavior of metals, ceramics, polymers, and reactor coolants in radiation environments, and for providing critical data from neutron activation analysis to make advances in a variety of diverse fields (e.g., allowing archaeologists to date prehistoric artifacts). Most of these areas of technology are uniquely in the domain of nuclear research reactors and not easily duplicated on accelerator-based radiation sources. The facilities that exist or can be developed at URRs for the study of materials, trace element analysis, and for producing isotopes are complementary rather than competitive to those found at the National Laboratories. This URRs are located in the highly creative and multidisciplinary environment of the university where a diversity of students can take advantage of these unique resources. In their role of providing graduate education and training for radiation scientists, URRs exploit these benefits of the university and provide educational advantages that are generally superior to those afforded by the national user facilities. This is the concept for "feeder research reactors" that has been highly successful in Europe and is an important factor in propelling these countries into their present dominant leadership roles in the nuclear sciences. With adequate support of URRs, this model can also be implemented here to help ensure that these technologies are not permanently lost by the U.S.

The URRs also have a major impact in the realm of undergraduate education, outreach and training. Based on U.S. data collected by the panel for its report to NERAC, over 1000 students are enrolled in courses that use these URRs annually, and over 5000 visitors tour a URR or are given demonstrations at a URR annually. Beyond these educational activities, many URRs are used for nuclear reactor operator training with local nuclear utilities. The panel felt that these URRs and the university programs that support them are unique and may be in the best position to work with the DoE to develop innovative approaches to outreach and education.

Currently, there are twenty-eight university reactors in the U.S. with total annual support of about $10 million from their individual university budgets and over $5 million from extramural research and services. These university expenditures are specifically for the operational, safety and licensing activities of these nuclear reactors; i.e., staff salaries as well as materials and supplies related to operation. The panel has recommended a competitive peer-reviewed program be instituted to provide the resources above a base program, that are needed to revitalize URRs as a key resource at universities in the U.S. The panel proposed to:

Maintain a base program for University Research and Training Reactors: This panel recognized that the DoE Office of Nuclear Energy currently has the "University Reactor Fuel Assistance and Support" as an on-going program for university research and training reactors. These program funds are provided for reactor refueling, reactor instrumentation and reactor sharing for users of these facilities (i.e., researchers at universities with funded research in need of research reactor services). These current programs serve as the minimum external resource base that helps maintain this educational infrastructure for the operation of these university research and training reactors. Specifically, the DoE budget lines for reactor replacement fuel, reactor instrumentation upgrade and reactor user sharing total about

$4.3 million for FY2000. Note that the bulk of these funds are for reactor refueling costs ($2.8 million); the remaining $1.5 million represents less than 10% of the total operational costs.

Establish a Competitive Peer-Reviewed Program for University Reactors: The panel proposes that a competitive peer-reviewed program augment current DoE financial support for these university research and training reactors. This program would focus on activities beyond operation and would support infrastructure costs associated with personnel and instrumentation upgrades in support of extramurally funded research (e.g., from DoE NEER or NERI grants) as well as facility upgrades and personnel costs that involve innovative training and educational outreach activities. This program would provide additional multi-year grants for reactor facilities that are part of focused proposals by groups of collaborators that can emphasize research, training and/or educational outreach. The panel believes that such a program can provide the needed financial support for qualified university research and training reactors. These resources are for activities that go beyond what is needed only for base operation and provide a competitive arena where innovative ideas can be nurtured. The total program cost would be $15 million per year, which is consistent with the proposals to DoE by the University Working Group in 1996 and with previous studies dating back to the 1988 study by the National Resource Council. The panel suggests that this program be instituted incrementally in FY02 and FY03 budgets to allow for development of the needed DoE administration that would accompany this new activity. The panel recommends the following elements for this expanded DoE program for URR support:

A. Key Elements of Competitive Program

1) Multi-year funding awarded through peer-reviewed proposal process.
2) Proposals encouraged for research, for education and for public outreach.
3) Funding levels ranging from small outreach efforts to multi-university teams.
4) URR is required to "qualify" before its proposal is considered. (Specific qualifying criteria have been proposed by the panel see part C).
5) University must provide cost-sharing (auditable using NSF-like procedures).

B. Suggested Guidelines to this Competitive Program

- Defined missions: The RFP would include suggestions for missions for research, education/training and outreach, with a university or university teams free to propose different missions.
- Base infrastructure funding: The program would allow a specified fraction of the budget to be used for personnel, instrumentation upgrades and materials and supplies related to the specific deliverables in the proposal. If DoE does not wish to directly fund such items, then the cost sharing offered by the universities could be used. Overhead (indirect costs) on the contracts could also help the university with base and infrastructure funding.
- Funding period: One to five years. (5 years would be needed for a "center", but shorter periods should not be discouraged for other projects.)
- Level of cost sharing: This needs to be consistent with other federal agencies; e.g., NSF and NIH require a 33-50% cost share (with a possible maximum instituted, so that universities can afford to submit large proposals).
- Funding level: The panel proposed funding to ramp up to $15M/yr (just for this program, without reducing other NEST programs). This funding level was taken from the URR Center of Excellence proposal (1996). It is similar to what was originally proposed in the NRC study in 1988 and is also consistent with general comments in the DoE 1994 report and the proposal by the University Working Group in 1996. The panel feels this is a minimum level of investment based on the basic principle that annual infrastructure investments of about 5-10% of the initial capital investment is needed to maintain a level of competence; note that the capital investment for these URRs is well over $250 million. The panel realizes this is a preliminary estimate and may need to be increased as better data become available once the competitive program is operating.

C. Proposed Qualifying Criteria for University Nuclear Reactors

The panel would propose the following criteria to qualify university nuclear reactors for research support from the Department of Energy Office of Nuclear Energy under the proposed competitive peer-reviewed program for research, training and outreach.

- The university reactor must demonstrate an acceptable operational and safety record over the last five years.

- The university reactor must demonstrate that it contributes to the educational infrastructure of a suitable degree program(s).
- The university reactor must demonstrate that substantial financial support comes from the university and will continue through at least the program support period.
- The university reactor must have a commitment from the appropriate university official for its continued operation through at least the program support period.

IMPROVEMENT OF UNIVERSITY—DOE LABORATORY INTERACTIONS: RECOMMENDATIONS

The first of the current DoE National Laboratories were created, staffed and managed by university personnel following World War II. Thus, these laboratories began with intimate ties to universities, and substantial interactions have continued between the laboratory and university communities. The panel surveyed several DoE Laboratories and the survey indicated unanimous agreement that university interactions are beneficial and should be expanded.

There are a host of ways the laboratories and universities can continue to build upon their interactions, including collaboration on papers, student internships at labs, research subcontracts from labs to universities, large collaborative research projects (for example funded by NERI program), and many others. All of these are important and beneficial; however, the panel believes the most important interaction mechanism is to increase the engagement of faculty members (and thus their graduate students) in funded research that is of programmatic interest to the laboratories. Research funding in line with laboratory objectives is by far the best way to attract both faculty and laboratory interest; programmatic relevance ensures short-term benefit to the lab and produces graduates that are interested and expert in laboratory problems (which is a long-term benefit).

The panel examined several specific approaches that could increase collaboration between universities and laboratories. Some of these strategies have a common theme that would require exercising some level of central authority within the DoE.

- Increased Nuclear Engineering and Health Physics Fellowships: These are an excellent means of interacting with top graduate students, since these students are required to spend an intern period at the DoE national laboratories. And this is directly in accord with our proposed increase of graduate student fellowships.
- Increased personnel exchanges between Laboratories and Universities: Laboratories could create programs such as a "Distinguished Visitor Program," under which university faculty could spend extended periods (e.g. sabbaticals) at laboratories. Laboratories could encourage its staff to give seminars and/or spend time as visiting faculty at universities.
- Designated University Awards: Universities provide largely untapped resources that could participate more fully in DoE applied and basic research programs. To take more advantage of this resource, DoE could negotiate a financial incentive for subcontracting a certain percentage of the laboratory's budget to universities. Laboratory management could also require individual programs (or divisions or directorates) to subcontract a set amount or percentage to universities each year.

SENATE BILL 242: UNIVERSITY NUCLEAR SCIENCE AND ENGINEERING ACT

I have read Senate Bill 242 in detail and am very supportive of its elements. It addresses all of the issues that I have outlined previously. It realistically augments the current DoE University Programs budget in a phased-fashion, and it is responsive to the needs of assuring a future that nurtures the human resources nuclear energy will need. Let me conclude my comments in support of S. 242 with two major points that I would like to emphasize:

- An important aspect of Senate Bill 242 is that it provides for the enhancement of the human resource that nuclear science and engineering will need to continue to contribute to the common good of this nation. This "people-focus" supports all aspects of nuclear science and engineering as the industry decides to pursue additional nuclear electrical generating capacity or the medical community uses new advances in medical imaging and cancer treatments.
- In addition, Senate Bill 242 provides the infrastructure support for the necessary facilities for the education of future scientists and engineers. This support will provide undergraduates and graduate students with an otherwise unobtainable "hands-on" educational experience, allowing for understanding of nuclear fission-reactor processes and interaction of radiation with matter.

Therefore, I fully support the authorization of $30 million in FY2002 with increased funding in a phased manner to $64 million by FY 2006.

SENATE BILL 472: SUPPORT FOR CONTINUED USE OF NUCLEAR ENERGY

I have also read Senate Bill 472 in some detail and although I do not consider myself an expert in all of the aspects of this omnibus bill, I am quite supportive of its general approach and many of its specific recommendations, as well as the funding needed to accomplish these tasks. Let me provide comments on significant items:

1. Support for Nuclear Energy

a. Renew Price-Anderson: This legislation provides the essential liability coverage for nuclear activities. It has been and continues to be a rational and reasonable way to assure for compensation from accidents if needed.

b. Assistant Secretary for Nuclear Energy: This is necessary since it elevates the Director for Nuclear Energy to a position held in prior administrations.

c. Nuclear Engineering Educational Support: I have commented on this.

d. Nuclear Engineering Efficiency Improvement: This provision would provide funding for incentives to utilities to make capital investments that would increase the electricity output of nuclear power plants. In this time of rising energy costs and electricity shortages, such a provision provides a needed mechanism to rapidly provide more electrical power with this economic, safe and reliable technology.

e. Nuclear Generation Study provides a status of new and re-licensed plants.

2. Encourage New Nuclear Power Plant Construction

a. Completion of Unfinished Plants: This is a mechanism that can provide for the industry to bring unfinished nuclear power plants on-line by the end of 2004, following a careful review of their viability and reliability.

b. Generation IV Reactor Program: This is an important program that will allow the DoE to develop a program plan with the needed industrial input and guidance. The program provides a roadmap for new evolutionary plant designs, research and development to supply future electrical energy needs, with improved economics, safety and sustainability.

c. Early-site Permit Demonstration Program: This is an interesting concept to provide a "bank" of locations that are pre-approved by the Nuclear Regulatory Commission for nuclear power plant sites. This has the potential of taking several years off of the construction time for nuclear power plants and making them more economic.

3. Assure a Level Playing Field for Nuclear Power

There are numerous improvements being proposed that will improve the competitive aspects of nuclear power production. I would endorse many of these; e.g., qualification for environmentally preferable purchase programs, consumer information disclosure standards, no discrimination for international programs.

4. Improve Nuclear Regulatory Commission Regulations

Once again there are numerous improvements that need to be implemented, which will not compromise the general public health and safety, but are needed for process enhancement. I would also endorse many of these; e.g., remove duplicative antitrust review requirements, simplify hearings for licensing actions, give the NRC authority over decommissioning obligations of non-licensees.

5. Development of Nuclear Waste Solutions

The stalemate over disposal of high-level waste that has existed for over three decades is totally unacceptable. This is one of the most important areas that require legislative attention to assure continued use of nuclear power in the 21st century. It is my view that this is primarily a political rather a technical issue. To quote a former governor and a former Secretary of the Interior, Bruce Babbitt, the disposal of nuclear waste is "almost entirely a political issue. There is not much left to quarrel about" at Yucca Mountain, Nevada, the site of the proposed repository for spent nuclear fuel. The former Secretary of the Interior called the site "safe and solid" at a recent Nuclear Energy Assembly Conference on May 22nd, 2001. Former Secretary Babbitt said that the political nature of waste disposal "stems from the inability to appreciate the reality of geologic time and how stable land forms are over relatively short times geologically speaking." I am also aware that the proposed Yucca Mountain repository siting decision is being delayed due to political reasons. Therefore, I fully support the concept of an Office of Spent Nuclear Fuel Research as a backup. This proposal has as its charter, the development of a national strategy for spent fuel. This was part of the Title III interim storage bill proposed during the 106th Congress.

In summary, the omnibus Senate Bill 472 has my full support.

The CHAIRMAN. Thank you all very much. I think all the testimony has been very useful. Let me just ask a very few questions here and then we have one additional panel. Dr. Holdren, let me start with you. One of the things you focused on in this 1997 PCAST report was, or at least one of the things you raised there, was the role of government in commercializing these high public benefit energy technologies. Could you elaborate a little bit as to what you see as the appropriate governmental role in this?

Dr. HOLDREN. Yes, I can do that, although to do so I will have to go somewhat beyond what the PCAST study 1997 itself addressed because our mandate was to look at research and development and not at demonstration and deployment. We went a little bit beyond that mandate in suggesting that in cases where there is a very high public benefit associated with a new technology, the Government's investment in research and development should be added to by an investment at the demonstration stage and perhaps in efforts to buy down the costs of the new technology to the point of commercial competitiveness with the justification that the high public benefit not realized in private returns justifies the Government's moving beyond R&D. In those kinds of cases, one could imagine, for example, a situation where you have a new technology whose cost would fall rapidly if you could get the total quantity of production up a bit. But there is this barrier to be overcome. The production will not rise under market conditions if the initial price is too high to compete with what else is out there. So, you get the Government involved, and there are various ways to do this, in subsidizing the incremental cost required to get production to the level where the new technology becomes competitive, and again the reason for it is the public benefit. For example, in reduced emissions of air pollutants, greenhouse gases, reduced dependence on foreign oil, and so on and so forth, a wide array of public benefits that might justify that sort of involvement.

The second PCAST study in 1999 on international cooperation looked at this in more detail because it did have a mandate to look beyond R&D toward demonstration and deployment. It did look in more detail at specific mechanisms for doing this and also looked in more detail at the circumstances under which it would make sense.

The CHAIRMAN. Let me ask Dr. Moniz a question that I asked Mr. Blake a little bit earlier. This whole problem of measuring, or metrics, in the expenditure of R&D funds—what do you believe the pitfalls are in going down that road? I mean I am concerned, I guess, that building too many metrics into this system can cause us to make some very shortsighted decisions, and I would just be interested in any comments you have as to how we avoid that.

Dr. MONIZ. Well, Mr. Chairman, I think the physicist's response is always, to quote Einstein, "not everything that can be counted counts and not everything that counts can be counted." And I think that does apply to much of the research enterprise. Indeed, in 1996, I would just observe when I was serving at OSTP we did a multi-agency study of metrics in the GPRA context for basic research. And I think that report raises many of the cautions that you elude to. Indeed, it is complex analysis involving, as Bob said, both retro-

spective and prospective issues but when all was said and done, certainly especially in the research phase, we emphasized that there was simply no replacement for forums of merit review and peer based review to evaluate particularly prospective investments.

Now, having said that, we certainly do not argue that R&D investments are somehow immune from accountability, from using measures. I believe the Academy report, for example, the matrix that Bob referred to, is the kind of approach which clearly has some subjective judgments in filling in the boxes which is very, very important and a way to go. It is also a case that when one takes a sensible system, and I will just finish with one example, that one has in some sense a mixed kind of approach appropriate to the job. It is not one size fits all. Let's take for example a major investment, and I will just pick an example. Let's say, at Fermilab to explore the Higgs boson. There are clearly very quantitative metrics that should be applied to the issue of building the facility on time, on schedule, on costs, et cetera. But those same metrics cannot sensibly be applied to the actual research outcome because the outcomes themselves are of course what you are trying to learn. So, the issue would be, and I would refer back to, and I would be happy to explain, at some other time, go into more detail, in the 1996 report together with the National Academy report. I believe it maps out what is fundamentally a sensible way of evaluating research programs and looking at progress.

The CHAIRMAN. Well, I could ask questions here for several more hours and I am sure you folks could educate me on a lot of things, but let me just stop with that. And thank you very much for coming. We will take your testimony and do our best to learn from it and incorporate the lessons into what we wind up legislating here. Thank you very much.

Let's take a 5-minute break and then we will do the third panel.

[Recess.]

The CHAIRMAN. If we go ahead with the third panel. We have three witnesses here in this third and last panel on reprocessing of nuclear fuel. First, Dr. Tom Cochran who is a senior scientist and nuclear program director with the NRDC here in Washington. Mr. Jacques Bouchard who is with the French Atomic Energy Commission. Thank you very much for being here. And Dr. Greg Choppin, who is with the Department of Chemistry at Florida State University in Tallahassee. Thank you very much for being here. Dr. Cochran, why don't you go ahead. And the full statement of each of you will be included in the record. If you could take just 5 or 6 minutes and summarize your main points, we would appreciate it.

STATEMENT OF THOMAS B. COCHRAN, PH.D., DIRECTOR, NUCLEAR PROGRAM NATURAL RESOURCES DEFENSE COUNCIL

Dr. COCHRAN. Thank you, Mr. Chairman. My name is Thomas B. Cochran. I am director of nuclear program at the Natural Resources Defense Council. I am a member of the Department of Energy's Nuclear Energy Research Advisory Committee but I am testifying today on behalf of NRDC and not the advisory committee. I am pleased to be here today to testify about U.S. nuclear energy policy and proposals for funding, research and development by the

Department of Energy's office of nuclear energy. My testimony will focus on research and development of advanced fuel processing technologies and whether the United States should abandon its long-standing nonproliferation policy and promote the development and deployment of pyroprocessing and transmutation technologies.

Let me begin with a few general observations. Civilian nuclear activities have directly and indirectly contributed to the spread of nuclear weapons. In my written testimony I've given you several examples. Several non-weapons States have pursued nuclear weapons primarily through the plutonium production and reprocessing route. And again in my written statement I've given you the example of Taiwan's covert nuclear weapons program that was conducted under the cloak of its civilian nuclear energy program. Unfortunately, the nuclear nonproliferation threat stemming from civilian nuclear power technologies is still alive today as evidenced by Iran's pursuit of a nuclear weapons option by purchasing nuclear expertise and dual use technology from Russia.

Because of the real proliferation risk associated with the separation of plutonium by reprocessing, the U.S. Government has long taken the position that it does not encourage the civilian use of plutonium and accordingly does not itself engage in commercial plutonium processing. The United States has also recognized as far back as the Ford administration, and largely because of the work of Mr. Fri who was on the previous panel, that the closed nuclear fuel cycle with reprocessing in plutonium separation and recycling is uneconomical and presents an unacceptable proliferation risk.

Unfortunately, while the United States has actively sought to limit reprocessing in some regions of proliferation concern, it regrettably has taken the position that it will honor its existing commitments with regard to the use of plutonium in civilian nuclear programs in Western Europe and Japan, thus establishing an unworkable double standard in dealing with global nuclear weapons proliferation and leading to the stockpiling of huge quantities of weapons usable plutonium in Western Europe and Japan. Large reprocessing plants, plutonium stockpiles and advanced research on new fuel processing technologies in non-weapons States provide an ideal cover for nascent nuclear weapons States to pursue a nuclear weapons option while claiming their programs are entirely for peaceful purposes. Advanced reprocessing research even in weapons States provides the necessary justification for the nascent nuclear weapons States to pursue similar research ostensibly for peaceful purposes.

The Bush administration's national energy policy has recommended that the United States should reexamine its policies to allow for research and development and deployment of fuel conditioning or reprocessing technologies such as pyroprocessing.

In my view, implementation of the Bush plan and the supporting legislative proposals would be a grave mistake. Let me explain why.

First, reprocessing light water reactor spent fuel is uneconomical today and will remain so for the foreseeable future. The issue then is whether there are new reactor concepts using new fuel cycles that are cheaper and more proliferation resistant than the light water reactor once-through fuel cycle. The simple answer is that

there are no known fuel cycles that are cheaper, and no known fuel cycles that rely on reprocessing that are more proliferation resistant than the once-through fuel cycle. In fact, neither pyroprocessing nor any other reprocessing scheme proposed to date is cleaner, less waste intensive or more proliferation resistant than the once-through fuel cycle, that is, direct disposal of spent fuel, the practice planned for use in the United States today.

I will not go into the history of the pyroprocessing program. It is in my written remarks. The claim that pyroprocessing, which is an electro-refining technique, the claim that it is proliferation resistant is misleading. Pyroprocessing is less proliferation resistant than the once-through fuel cycle in use today. It is more proliferation resistant than aqueous reprocessing, which the United States abandoned commercially more than 20 years ago because it was uneconomical and because it carries a high proliferation risk. Pyroprocessing appears less risky than aqueous reprocessing because the plutonium is not completely separated from other radioactive actinides and therefore an additional processing step is needed to obtain weapons-usable plutonium. This would make it very difficult for terrorists to steal the plutonium from a pyroprocessing plant or the Integral Fast Reactor fuel cycle which relied on pyroprocessing.

However, the most serious nonproliferation threat associated with reprocessing technologies is not the terrorist threat, but the so-called State threat. The Integral Fast Reactor concept and the pyroprocessing technique that it utilized offers little in the way of reducing this State threat. If pyroprocessing facilities are located in non-weapons States, these States will have cadres of experts trained in plutonium chemistry and metallurgy along with hot cells and other facilities that can be readily used for the recovery of plutonium for weapons. In this regard, pyroprocessing cannot meet the so-called timely warning international safeguards criterion.

In one respect, pyroprocessing is actually worse than aqueous reprocessing in terms of their respective proliferation risks. Pyroprocessing involves access to technologies for working with plutonium in metallic form, the form that is used for weapons. What is more, engaging in pyroprocessing research now will encourage or provide an excuse for non-weapons States to do the same, thus giving these States yet another avenue to get closer to a weapons option without declaring their true intention. No one would want to see Iran engaging in pyroprocessing research associated with the Bushehr reactor now under construction.

Another problem with pyroprocessing, and this is the Achilles heel, is that there are no known fuel cycles that rely on pyroprocessing that show any promise of being economical in the foreseeable future. For the United States to pursue an expensive pyroprocessing R&D effort at this stage is simply a waste of taxpayers money.

Now, I wish to turn to the issue of accelerator transmutation of waste.

The CHAIRMAN. Could you do that fairly quickly for us, please?

Dr. COCHRAN. Yes. The argument for transmutation of waste is that you will select out certain isotopes, burn them in accelerators or fast reactors, and thereby reduce the long-term health effects

from radioactive release from a geologic repository and reduce the uncertainty in the long-term dose assessment as well.

This proposal sounds worthy in theory but in practice, it is a ridiculous proposal. First, it is extremely expensive. The Department of Energy estimated that the life cycle cost would be something on the order of $280 billion. Secondly, even if you did not go back and process all of the existing spent fuel but say only process future spent fuel, you would only reduce the dose from the geologic repository, for example, Yucca Mountain, by a factor of 2. So, you would be paying hundreds of billions of dollars to reduce the dose tens of thousands or hundreds of thousand of years from now by a factor of 2. The argument is even worse in that there is not a shred of evidence in any of the accelerated transmutation of waste proposals that the collective dose reductions associated with the geological repository will in fact be less than the collective dose from operating all of the reprocessing facilities in transmutation facilities. So, in fact you would be spending tens to hundreds of billions of dollars most likely to give people more cancer rather than less.

In closing, NRDC does not object to continued support of university nuclear research programs or the Department of Energy's Nuclear Energy Research Initiative or the study of Generation IV reactors and fuel technologies. Research on advanced fuel cycle technologies should be limited to paper studies until there is clear evidence that the new technology is cheaper, inherently safe and more proliferation resistant than the light water reactor operating on the once through fuel cycle. At this time, Congress should reject any legislative proposals to fund dual use technologies such as power processing and accelerated transmutation of waste beyond such paper studies. Thank you, Mr. Chairman.

[The prepared statement of Dr. Cochran follows:]

PREPARED STATEMENT OF THOMAS B. COCHRAN, PH.D., DIRECTOR, NUCLEAR PROGRAM NATURAL RESOURCES DEFENSE COUNCIL

My name is Thomas B. Cochran. I am the director of the Nuclear Program and hold the Wade Greene Chair for Nuclear Policy at the Natural Resources Defense Council (NRDC). I am a member of the Department of Energy's (DOE's) Nuclear Energy Research Advisory Committee (NERAC), but I am testifying today on behalf of NRDC, not NERAC. I am a fellow of the American Physical Society and the American Association for the Advancement of Science. I received my Ph.D. in nuclear physics from Vanderbilt University, where I also did my Masters research thesis in radiation chemistry. I was an AEC Health Physics Fellow at Vanderbilt and spent one month training at a pilot nuclear fuel reprocessing plant at Oak Ridge National Laboratory. I am the author of *The Liquid Metal Fast Breeder Reactor: An Environmental and Economic Critique* and co-author of several books on nuclear weapons and the nuclear weapons programs of the United States and the Soviet Union/Russia.

I am pleased to be here today to testify about U.S. nuclear energy policy and proposals for funding research and development by the DOE' Office of Nuclear Energy. My testimony will focus on research and development of advanced fuel processing technologies and whether the United States should abandon its longstanding nonproliferation policy and promote the development and deployment of pyroprocessing and transmutation technologies. Let me begin with a few general observations.

Civilian nuclear activities have directly and indirectly contributed to the spread of nuclear weapons. India's first nuclear weapons test in 1974, for example, used plutonium produced in a Canadian-supplied research reactor using U.S.-supplied heavy water as a moderator, and the plutonium was separated in a reprocessing plant built from blueprints supplied by an American firm, Vitro International. This plant was nominally part of India's civilian breeder reactor research and development program. Between 1955 and 1974, Argonne and other DOE national laboratories trained some 1100 Indian scientists and engineers in nuclear fuel cycle tech-

nology, including techniques for plutonium separation. Some nations have established nominally civilian nuclear programs as a pretext to acquire technologies for military programs or have acquired materials, equipment, technologies or technical personnel from the civilian sector for their nuclear weapons programs. Israel's plutonium production reactor and reprocessing plant at Dimona were provided by France ostensibly for civilian purposes, but were actually used for military purposes.

Several non-weapon states have pursued nuclear weapons primarily through the plutonium production and reprocessing route. For example, Taiwan's covert nuclear weapons program was conducted under the cloak of its civilian nuclear program. Under intense pressure from the United States Taiwan's program was shut down in the 1970s, restarted in the 1980s, and shut down a second time under pressure by the United States. In the 1970s the United States had provided a small amount of plutonium to Taiwan for research purposes and some was fabricated into metal in what was claimed to be a civilian facility. Evidence strongly suggested that Taiwan planned to divert the plutonium from its safeguarded facility for weapons research. Subsequently, Taiwan provided assurances to the United States that it would not reprocess, dismantled its reprocessing research facility and sent the separated plutonium back to the United States. Similarly, South Korea began a secret nuclear weapons program based on plutonium production and reprocessing. Under pressure from the United States South Korea agreed to end its program.

Unfortunately, the nuclear nonproliferation threat stemming from civilian nuclear power technologies is still alive today, as evidenced by Iran's pursuit of a nuclear weapons option by purchasing nuclear expertise and dual-use technology from Russia.

Because of the very real proliferation risks associated with the separation of plutonium by reprocessing, the United States government has long taken the position that it does not "encourage the civil use of plutonium and accordingly, does not itself engage in plutonium processing." The United States has also recognized as far back as the Ford Administration that the closed nuclear fuel cycle with reprocessing and plutonium separation and recycling, is uneconomical and presents unacceptable proliferation risks. In fact it was the Ford Administration, not the Carter Administration, which stopped commercial reprocessing in the United States by refusing to subsidize the completion of the Barnwell reprocessing plant in South Carolina. For existing light water reactors the closed fuel cycle has been, continues to be, and in the foreseeable future is projected to be more expensive than "once-through" utilization followed by direct disposal of spent fuel.

Unfortunately, while the United States has actively sought to limit reprocessing in some regions of proliferation concern, it regrettably has taken the position that it will "honor its existing commitments regarding the use of plutonium in civil nuclear programs in Western Europe and Japan,"[1] thus establishing an unworkable double standard in dealing with global nuclear weapons proliferation and leading to the stockpiling of huge quantities of weapon-usable plutonium in Western Europe and Japan.

Large reprocessing plants, plutonium stockpiles and advanced research on new fuel processing technologies in non-weapon states provide an ideal cover for nascent nuclear weapon states to pursue a nuclear weapons option while claiming their programs are entirely for peaceful purposes. Advanced reprocessing research, even in weapon states, provides the necessary justification for nascent nuclear weapon states to pursue similar research ostensibly for peaceful purposes. It is primarily for these reasons that NRDC believes the better course is to oppose all commercial use of nuclear weapon-usable materials, including separated plutonium and highly enriched uranium, and oppose the research, development and commercialization of nuclear fuel reprocessing technologies.

The Bush Administration's National Energy Policy has recommended that ""the United States should reexamine its policies to allow for research, development and deployment of fuel conditioning methods [i.e., reprocessing] (such as pyroprocessing) that reduce waste streams and enhance proliferation resistance," and "[t]he United States should also consider technologies, in collaboration with international partners with highly developed fuel cycles and a record of close cooperation, to develop reprocessing and fuel treatment technologies that are cleaner, more efficient, less waste intensive, and more proliferation resistant." Some of the legislative proposals being considered by the Senate are designed to implement the Bush Administration proposal. In my view implementation of the Bush plan and these legislative proposals would be a grave mistake. Let me explain why.

First, as noted above, reprocessing light water reactor spent fuel is uneconomical today and will remain so for the foreseeable future. The issue then is whether there

[1] White House National Policy Statement of September 1993.

are new reactor concepts using new fuel cycles that are cheaper and more proliferation resistant than the light water reactor once-through fuel cycle. The simple answer is that there are no known fuel cycles that are cheaper, and no known fuel cycles that rely on reprocessing that are more proliferation resistant, than the once through fuel cycle. In fact, neither pyroprocessing nor any other reprocessing scheme proposed to date is cleaner, less waste-intensive or more proliferation-resistant than the once-through fuel cycle, i.e., direct disposal of spent fuel, the practice planned for use in the United States today.

Why is there so much interest in pyroprocessing in the United States? Pyroprocessing is an outgrowth of the failed Liquid Metal Fast Breeder Reactor (LMFBR) program. After the Clinch River Breeder Reactor Demonstration Reactor was cancelled in 1983 in response to criticisms that the Liquid Metal Fast Breeder Reactor fuel cycle would have produced huge quantities of separated plutonium and posed a significant proliferation risk, Argonne National Laboratory began promoting the Integral Fast Reactor (IFR) concept. The IFR concept relied on pyroprocessing, an electro-refining technique, instead of aqueous reprocessing, the traditional method for separating plutonium from spent fuel. Also the IFR concept envisioned that a pryroprocessing facility would be located at each fast reactor site. The IFR concept, like its LMFBR predecessor is grossly uneconomical. When IFR R&D was terminated, the proponents of pryprocessing used the excuse that this was the best methodology for processing and disposing of EBR-II spent fuel. Now that this program has run its course Argonne and Argonne-West are seeking additional Congressional funding to preserve their program by suggesting that pryroprocessing R&D could be continued for some illusory "proliferation-resistance" benefit.

The claim that pyroprocessing is "proliferation resistant" is misleading. Pyroprocessing is not more proliferation resistant than the once-through fuel cycle in use today. It is more proliferation resistant than aqueous reprocessing, which we abandoned more than 20 years ago because it was uneconomical and because it carried a high proliferation risk. Pyroprocessing appears less risky than aqueous reprocessing because the plutonium is not completely separated from other radioactive actinides and therefore an additional processing step is needed to obtain weapon-usable plutonium. This would make it very difficult for terrorists to steal the plutonium from the IFR fuel cycle. However, the most serious nonproliferation threat associated with reprocessing technologies is not the terrorist threat, but the so-called "state threat." The IFR concept and the pyroprocessing technique offer little in the way of reducing this threat. If pyroprocessing facilities are located in non-weapon states, these states will have cadres of experts trained in plutonium chemistry and metallurgy along with hot cells and other facilities that can be readily used for the recovery of plutonium for weapons. In this regard pyroprocessing cannot meet the so-called "timely warning" international safeguards criterion.

In one respect pyroprocessing is actually worse than aqueous reprocessing in terms of their respective proliferation risks. Pyroprocessing involves access to technologies for working with plutonium in metallic form, the form most often used for weapons.

What is more, engaging in pryroprocessing research now will encourage or provide an excuse for non-weapons states to do the same, thus giving these states yet another avenue to get close to a weapon option without declaring their true intention. No one would want to see Iran engaging in pyroprocessing research associated with the Bushehr reactor now under construction.

Another problem with pyroprocessing is that there are no known fuel cycles that rely on pyroprocessing that show any promise of being economical in the foreseeable future. For the United States to pursue an expensive pyroprocessing R&D effort at this stage is simply a waste of the taxpayers money.

In sum, pyroprocessing R&D is a waste of money and an unnecessary proliferation risk. It is being promoted by entrenched interests that have lived off the taxpayer for decades and are now engaged in a last ditch effort to preserve their existence without substantive justification.

I now wish to turn to the issue of accelerator transmutation of [nuclear] waste (ATW). This program has been combined with accelerator production of tritium, a proposal to develop a backup method for producing tritium, under a budget category called "Advanced Accelerator Applications." The argument for transmutation of waste is that by reprocessing spent fuel, separating out selected isotopes and transmute these isotopes with accelerators and/or fast reactors, the long-term health effects from radioactivity released from a geologic repository can be reduced and the uncertainty in the long-term dose assessment would also be reduced. The proposal sounds worthy in theory, but in terms of practicality it is a ridiculous proposal. First, to have any significant impact on the first geologic repository, all the existing spent fuel would have to be reprocessed. This is such an extremely expensive propo-

sition that it simply not credible. DOE estimated the life-cycle cost of the ATW program at approximately $280 billion![2]

There are about 40,000 tonnes of power reactor spent fuel spent fuel in storage in the United States. Over the future lifetime of existing reactors another 40,000 tonnes or so will be generated. Even if only the future waste were transmuted, the theoretical impact at the geologic repository—at Yucca Mountain if it is licensed—would be to reduce the long-term dose from those isotopes transmuted only by about one-half. It is ridiculous to suggest that we should spend hundreds of billions of dollars today to reduce the radiation dose to people living tens to hundreds of thousands of years from now by a factor of two or less.

It the arguments get even worse. There is not a shred of evidence in any of the ATW proposals that the collective dose reductions associated with the geologic repository, assuming ATW is implemented, will be less than the collective dose from operating the reprocessing facilities and the transmutation facilities. In fact everything we know about these facilities today suggests the opposite—ATW would result in a higher collective radiation dose to people than they would receive if ATW were not implemented. We should not spend hundreds of billions of dollars to give more people cancer. Finally, ATW provides yet another cover for non-weapon states to engage in reprocessing and the study of plutonium and actinide chemistry and metallurgy. It is a serious proliferation risk.

With regard to backup tritium production, this apparently is not a request coming from the Administration. Rather, this request comes from a Los Alamos accelerator group which lost a bid to produce tritium for weapons when the Administration decided to qualify TVA reactors for this purpose in the event that the pace of nuclear arms reductions lags behind the decay curve of tritium. If the United States needs a second backup method for tritium production, we should use another reactor alternative. Reactors have reliably produced tritium for weapons for 40 years.

The NRDC does not object to continued support of university nuclear research programs, the DOE Nuclear Energy Research Initiative (NERI), and the study of Generation IV reactor/fuel cycle technologies. Research on advanced fuel cycle technologies should be limited to paper studies until there is clear evidence that the new technology is cheaper, inherently safe, and more proliferation resistant than the LWR operating on a once-through fuel cycle. At this time Congress should reject any legislative proposals to fund pyroprocessing or ATW R&D beyond such paper studies.

COMMENTS ON SPECIFIC LEGISLATIVE PROPOSALS BEFORE THE 107TH CONGRESS, 1ST SESSION

S. 193 Department of Energy Advanced Scientific Computing Act. (Bingaman, et al.)

The Department of Energy is already subsidizing the supercomputer industry through the Accelerated Strategic Computing Initiative (ASCI) program to the tune of some $5.2 billion for fiscal years 1992-2004. It should be made clear that funding under S193 should be for non-defense work, i.e., other than ASCI and other National Nuclear Security Administration (NNSA) activities, and that it should be accommodated by drawing down the ASCI weapons computing program to a more sensible level of funding. GAO has demonstrated in several reports that DOE is able to effectively utilize only a fraction of the new computing capacity it is rushing to install.

S. 242 Department of Energy University Nuclear Science and Engineering Act. (Bingaman, et al.)

I concur that university nuclear science departments are on the decline. Because of the wide range of nuclear activities in the United States, including environmental cleanup of sites contaminated by radioactivity, nuclear medicine and nuclear related national security programs, as a general matter university nuclear programs could benefit from federal support. Due to the lack of U.S. student interest in nuclear engineering, U.S. nuclear engineering departments are increasingly relying on foreign students to fill the student ranks in these departments. The Congress may wish to consider restrictions on nuclear training of foreign nationals, particularly in cases where the students are from countries that do not share U.S. nonproliferation policies and objectives. Consequently, I recommend that the undergraduate and graduate fellowships and faculty grants under this proposed legislation be limited to the support of U.S. citizens.

[2] DOE, "A Roadmap for Developing Accelerator Transmutation of Waste (ATW) Technology," October 1999, p. E-2.

S. 259 National Laboratories Partnership Improvement Act of 2001. (Bingaman, et al.)

This legislative proposal should be rejected in that it is an unwarranted subsidy for small businesses that meets vague criteria, e.g., work that can "support the missions of the National Laboratories or facilities," or encourage "the exchange of scientific or technological expertise."

S. 388 National Energy Security Act of 2001. (Murkowski, et al.)

SEC. 106. Nuclear Generation Study—An NRC report on the state of nuclear power would be useful. As a regulatory agency NRC at least should maintain the semblance of independence and not take positions for or against the relicensing of nuclear power plants.

SEC. 107. Development of a National Spent Nuclear Fuel Strategy and Establishment of an Office of Spent Nuclear Fuel Research—This legislative proposal should be rejected. To a large extent this proposal is an unnecessary duplication of the work of the DOE Office of Civilian Radioactive Waste Management. There is no evidence that reprocessing of spent fuel is economical so there is no merit to this aspect of the proposed activities. Moreover, establishment of this office and carrying out recycle research activities would be counter to the nonproliferation interest of the United States for reasons given in my general comments above.

SEC. 410. Nuclear Energy Research Initiative—The NERI program of the department is a good program and deserves the support of the Congress

SEC. 411. Nuclear Energy Plant Optimization Program—Plant optimization is in the interest of the nuclear industry. Congress should not subsidize a mature industry to do what is in their economic interest to do without federal subsidization.

SEC. 412. Nuclear Energy Technology Development Program—A roadmap to design and develop a new energy facility is premature. There is nothing coming out of the NERI studies or GEN IV programs that is commercially attractive and justifies federal support at this time.

SEC. 420. Nuclear Energy Production Initiatives—Congress should not subsidize a mature industry to do what is in their economic interest to do without federal subsidization.

SEC. 830. Emission Free Control Measures Under at State Implementation Plan—Sec. 830 offers unwarranted federal subsidies to nuclear power plant operators in the form of emission credits, since the facilities do not emit air pollution causing acid rain (sulfur dioxide), ozone smog (nitrogen oxide), or mercury as do many fossil fuel-fired power plants. Under the Clean Air Act, fossil fuel-fired power plants are offered economic incentives to adopt the most efficient pollution control measures available for sulfur dioxide and nitrogen oxide emissions by requiring operators to have emission allowances equal to the amount of pollution emitted at each fossil fuel-fired power plant. This section would undermine the reductions in acid rain and ozone smog pollution achieved under these Clean Air Act programs at fossil fuel-fired power plants by giving nuclear power plant operators emission allowances that would flood the market, significantly lower the value of banked allowances and discourage continued investment in pollution control measures at fossil fuel-fired power plants. This is an unjustified and damaging federal subsidy.

S. 472 Nuclear Energy Electricity Supply Assurance Act of 2001. (Domenici, et al.)

Title I—Support for Continued Use of Nuclear Energy

Subtitle A—Price Anderson Amendments

The Price Anderson Act should not be renewed. This is an unwarranted federal subsidy to a mature industry. Moreover, the industry and its supporters cannot have it both ways. They cannot claim nuclear reactors are safe, and that Generation IV reactors will be even safer, and then claim that Price Anderson is necessary. Asserting a requirement for Price Anderson coverage of supposedly "inherently safer" Generation IV reactors is disingenuous and unwarranted. The single criterion that will do most to insure that Generation IV designs are safe is for the Congress to explicitly exclude any Price Anderson coverage of new nuclear power plants.

Subtitle C—Funding of Certain Department of Energy Programs

SEC. 122. Nuclear Energy Research Initiative—The NERI program of the department is a good program and deserves the support of the Congress.

SEC. 123. Nuclear Energy Plant Optimization Program—Plant optimization is in the interest of the nuclear industry. Congress should not subsidize a mature industry to do what is in their economic interest to do without federal subsidization.

SEC. 124. Uprating of Nuclear Plant Operations—Whether to increase the power at a nuclear power plant is a decision to be made by the plant owner and the Nu-

clear Regulatory Commission. Congress should not by subsidizing a mature industry to do this.

SEC. 125. University Programs—See comments under S. 242 Department of Energy University Nuclear Science and Engineering Act. (Bingaman, et al.) above.

SEC. 126. Prohibition of Commercial Sales of Uranium and Conversion Held by the Department of Energy Until 2006—This legislative proposal should be supported so as not to jeopardize the HEU Purchase agreement with Russia.

SEC. 127. Cooperative Research and Development and Special Demonstration Projects for the Uranium Mining Industry—This appears to be a sweet heart deal for Rio Algom and possibly other uranium mining companies. Congress should not by subsidizing the uranium mining industry which has been in business in the United States for more than 50 years.

SEC. 128. Maintenance of a Viable Domestic Uranium Conversion Industry—This appears to be a sweet heart deal for Converdyn, owned by Honeywell and General Atomics, to make them more profitable. General Atomics has been surviving off of this type of special interest legislation for 30 years. Congress should not by subsidizing General Atomics or the uranium conversion industry, a mature industry.

SEC. 129. Portsmouth Gaseous Diffusion Plant—First Congress privatized the domestic uranium enrichment industry and is now stepping in to subsidize the maintenance of the Portsmouth gaseous diffusion plant. This has more to do with job security than nuclear energy security.

SEC. 130. Nuclear Generation Report—An NRC report on the state of nuclear power would be useful.

Title II—Construction of New Nuclear Power Plants

SEC. 203. Early Site Permit Demonstration Program—This is an unwarranted federal subsidy of the nuclear industry, a mature industry

SEC. 204. Nuclear Energy Technology Study for Generation IV Reactors—The Generation IV studies deserve support. The primary goal should be to identify reactor concepts that are economically competitive, inherently safe and more proliferation resistant than light water reactors operation on a once through fuel cycle. The following goals should be deleted:

(3) substantially reduce the production of high-level waste, . . .;
(5) sustainable energy generation . . .
(6), substantially improve thermal efficiency . . .

These goals will generally conflict with, the goals related to economics, safety and proliferation resistance, and have no independent utility

Title III—Evaluations of Nuclear Energy

SEC. 302 offers unwarranted federal subsidies to nuclear power plant operators in the form of emission credits, since the facilities do not emit air pollution causing acid rain (sulfur dioxide), ozone smog (nitrogen oxide), or mercury as do many fossil fuel-fired power plants. Under the Clean Air Act, fossil fuel-fired power plants are offered economic incentives to adopt the most efficient pollution control measures available for sulfur dioxide and nitrogen oxide emissions by requiring operators to have emission allowances equal to the amount of pollution emitted at each fossil fuel-fired power plant. This section would undermine the reductions in acid rain and ozone smog pollution achieved under these Clean Air Act programs at fossil fuel-fired power plants by giving nuclear power plant operators emission allowances that would flood the market, significantly lower the value of banked allowances and discourage continued investment in pollution control measures at fossil fuel-fired power plants. This is an unjustified and damaging federal subsidy.

Title IV—Development of National Spent Fuel Strategy

This legislative proposal should be rejected. To a large extent this proposal is an unnecessary duplication of the work of the DOE Office of Civilian Radioactive Waste Management. There is no evidence that reprocessing of spent fuel is economical so there is no merit to this aspect of the proposed activities. Moreover, establishment of this office and carrying out advanced fuel recycle research activities would be counter to the nonproliferation interest of the United States for reasons given in my general comments above.

Title V—National Accelerator Site

There is no redeeming social merit to this legislative proposal for reasons given under my general remarks above.

S. 597 Comprehensive and Balanced Energy Policy Act of 2001. (Bingaman, et al.)

Title XIV—Research and Development Programs

SEC. 1405. Enhanced Nuclear Energy Research and Development—The goals are very general authorization of appropriations lacks specificity. With respect to the goals see comments under S. 472 Nuclear Energy Electricity Supply Assurance Act of 2001. (Domenici, et al.), Sec. 204 Nuclear Energy Technology Study for Generation IV Reactors, above.

The CHAIRMAN. Thank you very much. Mr. Bouchard, why don't you go right ahead.

STATEMENT OF JACQUES BOUCHARD, DIRECTOR, FRENCH ATOMIC ENERGY COMMISSION, NUCLEAR ENERGY DIVISION, PARIS, FRANCE

Mr. BOUCHARD. Mr. Chairman, thank you very much for giving me the opportunity to testify on the important issue of reprocessing for the future of nuclear energy. There are few doubts today that nuclear fission will still play a role in the satisfaction of future energy needs all around the world. It is among the solutions that are proposed in the recent NEPD report and it has been mentioned by both your President and your Vice President and it was also an important point of the European Union green report issued last November as well as it is part of the future plans for energy in Asian countries, in particular Japan and China.

The results obtained with the 400 existing nuclear reactors show that nuclear electricity production is today economically competitive and with a very low impact on the environment. The safety records for the last 15 years are most satisfactory. The only problem that remains a real difficulty in some countries, France in particular, is the management of highly radioactive wastes. For most of the people, the actual concern is the long term behavior of long lived radioactive elements. In this respect, reprocessing of spent fuels is a key point as it allows a strong reduction of both the volume and the long term radio toxicity of wastes.

Historically, reprocessing of spent fuels, followed by recycling of valuable materials, that means uranium and plutonium, was intended to increase the use of natural resources. It was part of a scheme which included breeders in order to extract most of the energy contained in the natural uranium. That remains a clear objective for the future. With existing light water reactors, we burn only 1 percent of the natural uranium and we let aside 99 percent either in provisional storage or in waste disposal. If we don't improve the situation, with increasing energy needs, we shall exhaust in a few decades the uranium resources, at least those which can be recovered at a reasonable price. Thus, reprocessing is a cornerstone for satisfying future energy needs.

In shorter terms, it is also a key point for waste management. In any other activity, a good waste management policy includes selection of various types of wastes, recycling of what can be reused and disposal solutions adapted for each kind of product. Nuclear wastes should not be an exception to this basic rule.

For France, we consider that nuclear spent fuel is not even a waste as it still contains a huge amount of energy valuable products. The way we treat it at the output of the reactor is of major importance for the waste management policy. With present tech-

nologies, the fuel unloaded from reactors still contains 95 percent of uranium and 1 percent of plutonium and it contains also four percent of actual wastes, fission products and minor actinides.

Reprocessing allows us to separate uranium and plutonium from the actual wastes and then, with the vitrification process, to put these wastes in a robust containment for long term storage or final disposal. It is basically a wise policy for waste management. The main argument often opposed to this policy has been that by extracting the plutonium, we could open various possibilities of diversion and thus we may create a weakness in the nonproliferation policy. Let me try to bring some consideration in this discussion.

First, we are certainly not underestimating the risk of proliferation and we're fully sustaining the various measures which are taken on an international basis to try to avoid this risk. The plutonium coming from light water reactors, a large majority of existing production facilities, is not at all suitable for nuclear weapons, but we agree on the fact that we cannot completely exclude a wrong use of it, even if it will be much more difficult than other proliferation routes. A reasonable way to limit the risk, while taking benefit of reprocessing, is to burn the plutonium as soon as possible after extracting it from spent fuels. It is what we are doing in France. The plutonium extracted at La Hauge is used to fabricate MO_X fuels and we have presently 20 reactors loaded partially with MO_X fuel. That means that, except for the necessary hold up for recycle management, we have no plutonium on shelves.

Therefore, the diversion risk is limited to the operations themselves, output of the reprocessing plant, transportation and fuel fabrication. There, we have very strict domestic and international controls, and we are fully convinced that they are suitable to avoid any significant diversion.

Last but not least, we consider that from the nonproliferation point of view, it is better to burn plutonium rather than to keep it in store, even if it will be quite difficult to recover from stored spent fuel with existing technologies. In other words, we think it would not be easy to explain to French people, for instance, that we should have to dispose of hundreds or thousands of tons of plutonium underground somewhere in the country.

Now, looking at the future, assuming that nuclear energy will still be needed, and very probably on a larger scale than presently, reprocessing will more than ever be necessary for both economy of resources and waste management. The existing technology of which we have now a large industrial experience—I recall that we have reprocessed more than 18,000 tons of spent fuel in La Hauge—has proved to be efficient and economic. But progress should be made and we are working on it in the same way as we are working on future reactor designs.

Taking the present concern on waste management, while assuming the problem of plutonium is completely solved by reprocessing and recycling, we should consider the possibility of destroying the other actinides, the so-called minor ones, neptunium, americium, et cetera. Several countries have important R&D programs on partitioning and transmutation. We have already succeeded in developing complementary processes which could be implemented in reprocessing plants to extract those minor actinides. We know how

to burn them, either in reactors or in accelerator driven systems. For the future, we should try to develop an integrated approach based on the recycling of all the actinides in such a way that the actual wastes to be definitely disposed will only be the unavoidable fission products, the amount of which is directly related to the energy production.

Other improvements should be considered. One, for instance, will be to limit as much as possible the transportation of radioactive materials. And there, an objective could be to have reprocessing and fuel fabrication on the same site and not too far from the reactors. Anyway, technical solutions can be developed, either improvement of existing technologies of reprocessing or developments of new ones such as, for instance, dry processing or pyroprocessing which has been successfully tested in your country in the frame of the Integral Fast Reactor studies developed by Argonne National Laboratory.

Mr. Chairman, as a conclusion, I would say that reprocessing will be, in our view, sooner or later a necessity for use of nuclear energy as sustainable development. It is already an efficient tool for waste management and in some countries an industrial reality. It can certainly be improved to be still more efficient, more proliferation resistant and cheaper.

Thank you for your attention.

The CHAIRMAN. Thank you very much. Dr. Choppin, why don't you go right ahead.

STATEMENT OF DR. GREGORY R. CHOPPIN, FLORIDA STATE UNIVERSITY, DEPARTMENT OF CHEMISTRY, TALLAHASSEE, FL

Dr. CHOPPIN. Thank you. A variety of radionuclides are present in the fuel elements of nuclear reactors after their irradiation. Many countries process this spent reactor fuel to recover the unburnt uranium and the plutonium that has been produced for recycle in a reactor for future power production. The United States has followed a "once-through" policy under which the spent fuel of power reactors is considered as waste for direct disposal without processing.

The United States did develop aqueous processing systems in connection with the weapons production of the cold war. The spent fuel, whether from reactors for plutonium weapons production or for civilian power production is treated by the aqueous PUREX process in which solvent extraction removes the uranium and plutonium from the fission products. This is a primary international process for treatment of irradiated fuel for the recovery of these elements at present. Many of these radiochemical separations developed for processing and recovery of plutonium for weapons can be used in the treatment of the waste to minimize the amount that must be placed in permanent, long term storage.

Our national policy of direct disposal was based on a concern over other nations recovering the plutonium from the irradiated fuel of their power reactors and using it to produce weapons. Unfortunately, this policy was not adopted by any other nation, so the nonproliferation intent of the policy must be considered a failure. A disadvantage of the direct disposal system is that it may result in the creation of repositories which can be mined in the future for

the recovery of the plutonium for use as weapons material. Processing schemes that do not remove all the fission products from the uranium and plutonium to be recycled to power reactors for further burning can be a more effective nonproliferation approach than direct disposal.

New aqueous technologies for handling spent fuels have been developed but have only been demonstrated in the laboratory or at the pilot plant level. While these new systems serve to complement the PUREX process, they do not overcome some of the disadvantages of that processing technology, such as a large amount of secondary waste that requires repository disposition. It is unlikely that any large scale processing of nuclear spent fuel will, in the future, be based on aqueous systems. Non-aqueous processes being developed as replacements on properties such as differences in the volatility of the compounds being separated or differences in the oxidation-reduction behavior in molten salt media. The advantages of non-aqueous processing are that they have a much higher radiation resistance, use more compact equipment, produce smaller amounts of secondary waste volume, and are more proliferation-resistant than aqueous processes. The disadvantages of non-aqueous methods are the greater difficulty of conducting the separations and the smaller decontamination factors, in general, than aqueous processes.

Based on the gaseous diffusion process, which uses the volatility of uranium hexafluoride for separation of the uranium isotopes, volatility techniques with fluorides have been studied for separation of uranium and plutonium from irradiated fuel. This separation is limited by the fact that volatile fluorides are formed by several fission products. Research continues on evaluation of volatility processes for uses in practical full scale separations. Greater interest in non-aqueous systems has been focused on the use of pyrochemical processes in which molten salts are used as the solvent systems. Such processes have been investigated for the treatment of the spent fuel from molten salt breeder and light water power reactors. The inherent radiation resistance of molten salts allows the processing of spent fuel after relatively short cooling periods. This is a major advantage in the consideration of processing methods that might be used in connection with transmutation of nuclear waste by irradiation in reactors or accelerators to destroy the longest lived nuclides.

The electrometallurgical separation process for spent fuel developed at Argonne National Laboratory is based on a molten salt system that has been used successfully in a demonstration project in which stored experimental breeder reactor fuel is processed. It is also being studied as the processing system for use should the United States proceed with an accelerator transmutation program for the destruction of long lived isotopes and fission projects to reduce concerns over long term repository safety.

There are problems with the application of non-aqueous systems to the legacy weapons wastes in this country because of the huge volume of these wastes. The millions of gallons of wastes stored in underground tanks at Department of Energy sites have high salt concentrations that make the application of non-aqueous systems much more difficult. Modifications of the PUREX-type solvent ex-

traction system are likely to be the technologies used for these systems. However, for spent fuel from civilian reactors and the stored spent fuel from former weapons production, non-aqueous systems have many advantages and are expected to be the base for the next generation of technologies. An apparent disadvantage of the non-aqueous systems, their lower degree of separation of uranium and plutonium from some fission products is, in fact, an advantage since it leaves the separated uranium and plutonium with a higher level of residual radioactivity, reducing the possibility of its diversion by theft for clandestine weapons production.

Thank you.

[The prepared statement of Dr. Choppin follows:]

PREPARED STATEMENT OF DR. GREGORY R. CHOPPIN, FLORIDA STATE UNIVERSITY, DEPARTMENT OF CHEMISTRY, TALLAHASSEE, FL

A variety of radionuclides are present in the fuel elements of nuclear reactors after their irradiation. Many countries process this spent reactor fuel in order to recover the unburnt uranium and the plutonium that has been produced for recycle in a reactor for further power production. The United States has followed a "once-through" policy under which the spent fuel of power reactors is considered as primary waste for direct disposal without processing.

The United States developed aqueous processing systems in connection with the weapons production of the cold war. This processing resulted in the production of very large quantities of nuclear wastes which now require attention for final disposition. Many of the radiochemical separations developed for processing and recovery of the plutonium for weapons can be used in the treatment of the waste to minimize the amount that must be placed in permanent, long-term storage. The usefulness of such separation processes and the operating parameters for their optimum performance are strongly dependent on the concentration of the components to be removed, the physical state of the material, the availability of the processing agents, the nature and quantity of the secondary waste streams produced, and the capital costs. In a processing approach, the radionuclides in the waste can be separated into fractions for permanent storage, for use in industry, medicine, etc., or for transmutation by further irradiation into non-radioactive or short-lived nuclides, reducing concerns over the safety of repository disposition which must extend into the far future.

Our national policy of direct disposal was based on a concern of other nations recovering the plutonium from the irradiated fuel of power reactors and using it to produce weapons. Unfortunately, this policy was not adopted by other nations, so the non-proliferation intent of the policy must be considered a failure. A disadvantage of the direct disposal system is that it may result in the creation of repositories which could be mined in the future for the recovery of plutonium for use as weapons material. With time, such mining would get progressively simpler as the radioactivity level decreases greatly over the first 300-1000 years, while the plutonium can be considered to be useful by recovery over a period of about a quarter of a million years. Processing schemes that do not remove all the fission products from the uranium and plutonium to be recycled to power reactors for further burning can be a more effective non-proliferation approach than direct disposal. A strong interest in Europe in transmutation of the longest-lived nuclides, including plutonium, requires processing in order to separate these nuclides prior to the destruction in either an accelerator or a reactor. A further disadvantage of the direct disposal policy is that it isolates the United States from other nuclear countries which employ processing and, consequently, reduces our influence on their national policies in relation the handling and disposition of potential weapons material.

Now I discuss separation technologies and my view of the direction in which the development of such technologies should proceed. Dissolution of the spent fuel, whether from reactors designed for plutonium weapons production or from civilian power production, utilizes concentrated nitric acid systems. These aqueous solutions, since the late 1940's, have been treated by the PUREX process, which uses a solvent extraction system to remove the uranium and plutonium from the nitric acid solution in which the fission products remain. The uranium and plutonium are extracted into an organic solvent and subsequently, back-extracted into a second aqueous solution for further purification and separation of the uranium and plutonium. The PUREX process was developed in connection with the weapons program of the Man-

hattan Project in the United States and has remained the primary international process for treatment of irradiated fuel for the recovery of the uranium and plutonium.

A variety of new aqueous technologies for handling spent fuel materials have been developed, both in the United States and in Europe. Thus far, most of those processes have only been demonstrated in the laboratory or at the pilot plant level. In many cases, the processes are designed primarily to improve the separation of specific fission product elements in order to allow separation of the shorter-lived radionuclides from the longer-lived ones. The shorter-lived elements could then be disposed of in short-term repository systems, and the longer-lived elements reserved for the million-year repository. While these new systems serve to compliment the PUREX process, they do not overcome some of the disadvantages of that processing technology. A major disadvantage of the PUREX and associated aqueous-based technologies is the large amount of secondary waste that is produced and which requires repository disposition, either for the short term (hundreds of years) or long term (hundreds of thousands of years).

It is my strong conviction that any large scale processing of nuclear spent fuel will not use, in the future, a primary technology based on aqueous systems. This conviction has been formed as a result of interactions and collaborations with nuclear scientists and technologists in Europe, Russia, Japan and elsewhere. British Nuclear Fuels Ltd. is a leading processor of spent nuclear fuel, not only for English power plants, but also for those of several other nations. Frequent contacts with BNFL personnel over the last 5-6 years have involved discussions of their future processing plans, which emphasize non-aqueous systems. Similarly, there is extensive research being conducted in Japan and in France on non-aqueous systems as the main basis for future processing plants. It should be noted that the United States has been active in this field, and in particular, Argonne National Laboratory which completed last year a successful four-year demonstration program of the application of its electrochemical, molten salt technique to the processing of a quantity of spent fuel from the former Experimental Breeder Reactor in Idaho.

Non-aqueous processes have been extensively used for uranium isotope enrichment in this country and elsewhere, and for electrorefining of plutonium metal and production of metallic fuel for advanced nuclear reactors. Such non-aqueous processes are based on properties such as differences in the volatility of the compounds being separated or the differences in the oxidation-reduction behavior of actinide elements in molten salt media. The advantages of non-aqueous processes are that they have a much higher radiation resistance, use more compact equipment, produce smaller amounts of secondary waste volume, and are more proliferation-resistant than aqueous processes. The disadvantages of non-aqueous methods are the greater difficulty of conducting the separations and smaller decontamination factors, in general, than aqueous processes. Most of these non-aqueous processes are very sensitive to even small amounts of moisture and/or oxygen, and must be operated in isolated cells under inert atmospheres.

Based on the gaseous diffusion process, which uses the volatility of uranium hexafluoride for separation of the uranium isotopes, volatility techniques with fluorides have been used in test demonstrations for separation of uranium and plutonium from irradiated fuel. Volatility techniques were also studied for use in fuel processing in the molten salt reactor project at Oak Ridge National Laboratory. The separation of uranium and plutonium from the fission products in irradiated nuclear fuel is limited in these processes by the fact that volatile fluorides are formed by several fission products (e.g., iodine, technicium). Other volatile systems, which might be adaptable to use in the separation of actinides from other radioactive elements, are not as well developed as the fluoride volatility systems. Research is continuing in a number of national laboratories on evaluation of these volatility processes for use in practical full-scale separation systems.

Greater interest in non-aqueous systems has been focused on the use of pyrochemical processes in which molten salts are used as the solvent systems. Such processes have been investigated for the treatment of the spent fuel from reactors such as the Liquid Metal Fast Breeder Reactor and the Experimental Breeder Reactor, as well as spent fuel from light water reactors. The inherent radiation resistance of molten salts allows the processing of spent fuel after very short cooling periods. This is a major advantage in the consideration of processing methods that might be used in connection with transmutation of nuclear waste to destroy the longest-lived nuclides.

The electrometallurgical separation process for spent fuel developed at Argonne National Laboratory is based on a molten salt electrochemical system. In this direct transport process, uranium fuel is anodically dissolved as U^{3+} from a pool of molten cadmium into a molten salt, where it is transported through the salt to a cathode

where it is deposited as metallic uranium. As mentioned earlier, this system has been used in a demonstration project to process a portion of the stored Experimental Breeder Reactor fuel. It is also being studied presently as the processing system for use should the United States proceed with an accelerator transmutation program for the destruction of long-lived isotopes and fission projects. The transmutation concept has aroused considerable interest in Europe where an accelerator system is under serious study as part of a European Union research project. In the transmutation systems, it is important to be able to recycle the irradiated material repeatedly with relatively short intermission times between the cycles as only a small fraction of the long-lived radioactive nuclides are destroyed in a single cycle. The requirement for short times between the irradiation cycles essentially eliminates aqueous processes for processing the irradiated targets between the successive irradiations to isolate the long-lived nuclides for production of the target for the next irradiation cycle.

There are problems with the application of non-aqueous systems to the legacy weapons wastes in this country because of the huge volume of those wastes. The many millions of gallons of wastes stored in the underground tanks at the Savannah River and Hanford sites have very high salt concentrations which would make the application of non-aqueous systems much more difficult. For these wastes, it would seem that modifications of the PUREX-type solvent extraction systems would remain the more useful technologies. However, for spent fuel from civilian reactors and the stored spent fuel from former weapon production, non-aqueous systems have many advantages and most likely will be the base for the next generation of technologies. An apparent disadvantage of the non-aqueous systems, their lower degree of separation of uranium/plutonium from some fission products, is, in fact, an advantage since it leaves the separated uranium and plutonium to be recycled into fuel with a higher level of residual radioactivity, reducing the possibility of its diversion by theft for clandestine weapon production.

The CHAIRMAN. Thank you very much. Let me just ask a couple of questions here. Dr. Cochran, I take it that your view is that in addition to all the nonproliferation concerns that you folks have about opening this area up again, you think that there's just no evidence that it is economical to go forward with any of this reprocessing or to go forward with any of this transmutation of nuclear waste. Is that the bottom line from your perspective?

Dr. COCHRAN. That is correct. These are dual-use technologies that can be used for civilian and weapons purposes and none of them have a shred of a chance of being economical. Mr. Bouchard claims that reprocessing in France is economical. What is true, what I would agree is that COGEMA could make a profit on reprocessing foreign spent fuel because countries such as Japan and Germany had either legal impediments to continuing to use nuclear powerplants or public opposition that forced them to seek a reprocessing option as a solution to their legal or political problems. That allowed France and also the U.K. to make money on reprocessing other people's fuel. However, that fuel cycle is not less expensive than the once-through fuel cycle. The United States uses the cheaper fuel cycle and even in France today they are recognizing that the cost of reprocessing is more than the once-through fuel cycle and there is pressure on the French to back off on reprocessing at least the domestic fuel.

The issue before this committee is whether we should promote dual purpose technologies and you will be promoting this around the world by bringing in nuclear programs in other countries, nonweapons countries, whether we should be promoting this when there's not a shred of a chance of it ever being economical. If Mr. Bouchard is right that reprocessing is economical, give him all of our excess plutonium from weapons. Give it to him for free. He will

not take it because it is not economical even to make the plutonium into MO_X if it is given to him. It is more expensive.

The CHAIRMAN. Now, when you are saying is non-economical, you mean that in comparison to the direct deposit.

Dr. COCHRAN. Exactly. Now, take the pyroprocessing, the fuel cycles that use pyroprocessing are really fast reactor fuel cycles. That means you have to have a reactor hooked up to this fuel cycle. It is like the liquid metal fast breeder reactor that we started to build here and they built in France and it turned out to be all over the world uneconomical. The electricity price from operating that reactor and that fuel cycle on a commercial basis would have been two and a half, three times what it would be to operate an existing light water reactor fuel cycle on the once through test.

Mr. Bouchard also made another statement about running, if we expand nuclear power in the future, and there's no evidence that it is expanding on a global basis, but if we did, we would run out of low cost uranium. He and many people in the nuclear industry do not understand some fundamental concepts about mining metals, minerals. Historically, the increasing efficiency in the extracting of metals has always outpaced the depletion, the increase in price due to the depletion of the low cost resources. Uranium today on the global market is one-third in today's dollars of what it was when the AEC started the uranium industry by offering people $7 a pound to go out and discover and produce yellowcake uranium, even after running the nuclear industry for the entire life of most of the reactors in this country. We now are relicensing for another 20 years. After running the entire life of the industry, the price of uranium has gone down even though we mine the low cost resources. It goes down; it doesn't go up. It is true of every mineral resource.

The CHAIRMAN. You are saying there's plenty of the resource particularly as you get better systems for refining.

Dr. COCHRAN. For extraction. That is the history of every gold, platinum, iron, you name it. Go to Resources For The Future, over on Massachusetts Avenue and ask them, give us the history of mineral prices in constant dollars. Look at all of them. It goes down; it does not go up.

The CHAIRMAN. Let me ask if Mr. Bouchard wished to make any comment, or Dr. Chopin.

Mr. BOUCHARD. Yes, thank you Mr. Chairman. I would like to comment on the economy. In fact, let me say, that it is best is to look to the figures and we have first, an OECD report which is not very old. It is 2 years ago which made the comparison on an international business between the cost of reprocessing and recycling as compared to a direct cycle and for the part of the cost which is related to the end of the cycle, they got 0.21 cents, U.S. cents, for the reprocessing and recycling and 0.13, thirteen, for the direct cycle. So, it is clear that there is a difference. That does not mean it is exactly equivalent but the difference is quite low as compared to the cost of the kilowatt hour. There are more recent studies in France which has been done by Mr. Charpin deChapella and at least two of them are not well known as in favor of nuclear energy.

So, let me say that they got similar figures and in the case of the recycling and reprocessing story, they go through all the end

of the recycle cost 0.23, which is close to the 0.21 of the OECD study. There is only a small difference on the perimeter of the account. And this is compared to a cost of a kilowatt hour, which is around 2 cents, U.S. cents, which is what we got presently in France. And so, we have a difference which is between the reprocessing and recycling scenario and the direct cycle. We have a difference, which is on the order of five percent of the cost of the kilowatt hour. But, but we know everything on the reprocessing and recycling scenario because we applied it every day. We have reprocessed a lot. We have recycled all of the plutonium we got from the reprocessing and so we know completely all the figures. We know everything.

It is not the same under the direct cycle. We have not yet solved the problem of direct final disposal of spent fuel and in our country we are considering today that it will be a dead end. We have no real solution to a direct final disposal of the spent fuel. So, in fact, I think that for the economy, there is no matter today to discuss. We can discuss 0.01 cents on something. It is not the main problem. The problem is what do we do with the spent fuel; what do we do with the plutonium and when Dr. Cochran said that we cannot avoid to recycle and we can use for a long time, very long times, only 1 percent of the natural uranium, I say that we don't solve the problem in fact. Not only, we don't use the resource. But we keep the plutonium and recoup the plutonium as Dr. Choppin said as a mine. If we put it in the underground, we keep the plutonium as a mine for the future.

So, it is certainly not the solution we would prefer on our side. So, it is clear that on both economy and in the use of the resources, it is for us, there is no real discussion today on what is important or what is the benefit. I agree on the fact that we can discuss some of the values and techniques according to their proliferation resistance and so on. This is a matter for development, clearly.

The CHAIRMAN. Let me defer to Senator Domenici here. This is an issue he's spent a lot of time on. Go right ahead.

Senator DOMENICI. Thank you very much, Mr. Chairman. And I first apologize for the lateness and I will not take a lot of time. I want to thank you for the kinds of hearings you are holding. I've looked at the areas you are covering and I commend you. It is kind of boring when everybody tells you what you ought to be doing and then when you do it, nobody shows up. If there were a few of my brethren here on this side, I would say that also in front of them. In any event, you are bound and determined to get the witnesses to tell us about these issues, and I want to say to the three witnesses, we are glad to have you here.

Mr. Bouchard, I want Senator Bingaman to know that I have been to your country and you were my host and Senator it was truly an experience to see how France is treating nuclear power and the waste that comes from it. I am reminded that somebody in high offices in France just recently lectured our President about Kyoto and it was interesting as I listened to the exchange. Our President seemed to be asking if the great leader from France understood that we don't have 75 percent of our electricity produced by nuclear but rather we have a great deal of it produced by coal and by sources that pollute the air.

Maybe it would be easier to comply with Kyoto if we had 70 or 80 percent of our powerplants nuclear. On the other hand, to see their reprocessing and the way they handle the entire cycle caused me to conclude first, Mr. Chairman, that there is no real urgency that we immediately find a way to permanently dispose of nuclear waste. I mean, the nuclear waste in this country is a small quantity, I am led to believe, that it is about an American football field, 8 foot high, and that is the whole thing. That is the whole accumulation. And I would hope that as a result of these hearings and your bill that we would say we ought to proceed with ways to resolve this problem and it might take a little while to do it but in the meantime, we ought to explore the value of another generation of nuclear powerplants because they are on the horizon.

And I would hope that soon, Dr. Cochran, you will be able to sit down with those who are thinking of a small reactor modular in form and easily licensable because of a duplication capability that would change dramatically the physical premise upon which it is built so you can't have a meltdown and a lot of other things that are going to be happening. And I would hope we would look at those and say, maybe the world could use those so we don't have to worry about global warming. And I note that your organization is concerned occasionally about growth in the world, economic growth and the production of more energy, and I commend it for those stands. But I do believe that we must proceed on both fronts, that is the non-nuclear and the nuclear in an effort to help really solve the problem of economic growth and jobs for poor countries and rich countries. So, let me say to you, or ask you, Mr. Bouchard, in a brief summary, what advice do you give us with reference to a spent fuel program?

Mr. Bouchard. Thank you, Senator. I do not think I have to give advice. I should only say that at the present time once more we have had some experience with reprocessing in several countries now. We know the limit and the advantage of the present technology. It can be used and it is used on an industrial basis already. And we also see what kind of new developments can be done in the future. That there is room for R&D it is clear, room for R&D both on the reactors and on the fuel cycle which is used with these reactors and I mentioned in my presentation one or two routes or one or two axis which seems to us important for the future. One is to try to have a more integrated fuel cycle, the other reactor, and the other the fabrication, everything if possible on the same site.

And this is clearly an objective. Another one is to limit the definite disposal of waste to only that which is completely unavoidable. That means the fission products themselves. But to try to recycle everything else, that means uranium, plutonium and other actinides. And these are roots for the future. I think that we have a program of development on that and we are ready to cooperate. We have already had some discussion with the Department of Energy and we are ready to cooperate on such programs with your country, clearly.

Senator DOMENICI. Let me be a little specific. I think we all understand that in 1977 the then-President of the United States, President Carter, halted by executive decree United States efforts to reprocess spent fuel and developed mixed oxide MO_X for our ci-

vilian reactors on the ground that plutonium could be diverted and eventually transformed into bombs. He argued that the United States should halt its program of reprocessing as an example to the world to follow. Now, as I understand it, I am not criticizing what the President did all those many years ago but the truth of the matter is, the world did not follow the example and proceeded with reprocessing such that France, Great Britain, Japan and Russia all now have some kind of MO_X fuel program. So, it would seem to me that those countries, including yours, do not believe that reprocessing is a serious adjunct to proliferation. Would you address that?

Mr. Bouchard. Yes, certainly. I am considering that in the proliferation route itself it is certainly not the way to a reprocess light water reactors and to use the plutonium coming from there. It is certainly not the best proliferation route. Nevertheless, we have to take precautions to avoid, as I said, the diversion of plutonium even if it's not good plutonium, the diversion of plutonium from any step. But the best way for that is to burn it and there is a reason why we have MO_X fuel. There is a reason why we try to fabricate the MO_X as soon as possible after the reprocessing of the spent fuel in order to avoid to avoid to keep plutonium on shelves. It is clear. So, we have only to consider as a risk the diversion during the operations themselves. And as matter of fact we have done this, since the time of the decision you mentioned 25 years ago. Now, there has been no case of diversion which has been observed on any reprocessing route, civilian, reprocessing business. So, I mean we have an experience which is showing that the risk is not so big and we have many, many controls organized both on domestic and on international business to be sure that we are following every gram of plutonium everywhere on the route. So, I mean we certainly can still improve the situation but it is clear that we have a solution today which is quite robust and it is clear, as you said, that if we reprocess, we have to fabricate MO_X fuel as soon as possible in order to burn the plutonium.

Senator DOMENICI. I just want to make one more point and I will ask you all three on the environment on the issue of plutonium. Let me talk for just a minute and ask you a question, then I will ask Dr. Cochran a question. Testimony before the committee seems to try to maintain that reprocessing is not economic. I am fully aware and the chairman asked the right question a while ago. Uranium is very cheap and as a consequence at this particular time in our history if we just took this reprocessing all by itself, it probably would not be economic. But let me just say I think there's a debate on the floor of the Senate right now that talks about the fact that we have spent $9 billion and have collected $21 billion from ratepayers to try to establish a permanent underground storage facility at Yucca Mountain. Now, we cannot discard that as a cost of a policy that says the only thing we ought to do is bury it forever. That has got to be built in or it has to be built in on the other side of the ledger in terms of reprocessing and what reprocessing does to simplify the waste disposition issues. So, could I ask you, Dr. Bouchard, and then I will yield to you on all three questions, Doctor. Does not reprocessing if it is part of a country or an international approach, doesn't it simplify the waste disposition

issue if you had before that only considered permanent storage of the total spent fuel content as they come out of the reactor?

Mr. BOUCHARD. You're right. Let's say first that reprocessing simplifies the waste management because it reduces both the volume, both the volume and the radiotoxicity, the long-term radiotoxicity of waste and the reason is simple. In the spent fuel, the main contributor to the long-term radiotoxicity is the plutonium itself. And so, if you extract the plutonium and burn it, you have reduced what you have to put in the waste. It is clear. And on the other hand, as I said, we are more and more convinced that the final disposition of spent fuel is not at all easy to manage. Besides the drawback I mentioned on the creation of the mining of plutonium, there is also the practical aspect of who will accept to put all these fuels underground in the final repository. It is not at all the position in our country, by the way.

Senator DOMENICI. Now, Dr. Cochran, if you would like to address the three things that have come out that I've asked about, we'd be pleased to hear you.

Dr. COCHRAN. Yes, I would like to elaborate on the history that you began with President Carter. In fact, Mr. Bob Fri, who was on the previous panel, previously served under the Ford administration at ERDA, and it was in fact the Ford administration, and Bob Fri played an important part in this, that stopped the reprocessing industry in the United States when the Ford administration, after India exploded its first nuclear test in 1974 and Taiwan had been conducting its covert nuclear weapons program with reprocessing, decided not to subsidize the completion of the Barnwell plant in South Carolina. So, you should always give the Ford administration at least equal credit for foreseeing the problems, the economic problems and the nonproliferation problems associated with reprocessing in this country.

Senator DOMENICI. If you would permit me, I will correct the record and say that both the Carter administration and the Ford administration did it, and I will add to that I think even though there were two, they both made a mistake.

Dr. COCHRAN. That is where you and I would disagree. Now, you mention France, the U.K. and Russia. I would think you would join me in advocating a moratorium on reprocessing in Russia and in fact in the last administration, Dr. Moniz, also on the previous panel, tried to get a 20 year moratorium and actually got Minister Damov, the Minister of Atomic Energy, to agree to a 20 year moratorium but the deal fell through over the Iranian problems. The reason you should join me in seeking a moratorium on reprocessing in Russia is, in fact, first the Ministry of Atomic Energy is like our old AEC and military plutonium production and materials production and weapons production and civil programs are entirely integrated both in terms of their management and in terms of their facilities. And it is not in the U.S. national security interests for Russia to continue a large commercial reprocessing program at their military facilities.

Secondly, they are awash in excess plutonium and as you know they have 30 tons of plutonium from civilian reprocessing which they could not use, recycle, unlike the French program, and it is in storage with inadequate physical security. There was a state-

ment about reprocessing simplifying the waste disposition issue. That is extremely misleading. First of all, you do not create less waste by reprocessing in terms of shear volume of materials because you create a lot of other waste streams in the process. Secondly, you do not reduce the problems associated at the repository in any significant extent other than delaying when you have to build a repository. The French still have to bury their spent fuel and in fact they are behind the United States in siting and building a repository. They simply do not have a site yet. We at least have Yucca Mountain site. So, they have a lot of fission products. They are stuck in a vault and they're forcing air over them to cool them because they do not have a solution to their waste problem.

Now Mr. Bouchard says, you take the plutonium out and burn it. In fact, he's going to take the plutonium out and burn from the first cycle but the economics gets progressively worse on recycling and he has no plans to continue to recycle and so forth. And so all of the plutonium doesn't come out of his waste and he still puts plutonium in the mines. He mentions that light plutonium from light water reactor fuel is not so good for weapons. In fact, maybe he does not know it, the French tested a nuclear weapon with reactor grade plutonium and in fact it is useful for weapons. It is just not as good for weapons programs but it was good enough for the Taiwanese. It was good enough for the South Koreans and that is why they sought a reprocessing facility.

In fact, the French tried to sell South Korea a reprocessing plant in 1975 and the United States shut that program down for national security reasons. So, the issue here is very simple. We are talking about dual use technologies that can be used for weapons and for civil research. The civil aspects look sort of interesting but the weapons aspects look very dangerous and before you embark on bending metal and building R&D facilities you ought to think very hard about the implications of spreading this technology around in non-nuclear weapons States. I totally agree with you. We should support university nuclear programs. They are in decline. We have a lot of use for nuclear engineers and scientists because of our waste programs, our national security programs, our medical programs. I support R&D on Generation IV technology. Let's do the paper studies. But let's don't go out and promote these programs like pyroprocessing at Argonne which are totally uneconomical and frankly I do not support your constituents at Los Alamos developing accelerator transmutation of waste.

I mean, most of us think that that program is being pushed by people who lost their bid to get the tritium production facility and they're looking for jobs and they're promoting this technology as a way to maintain their accelerator program at Los Alamos and it is an uneconomical program. It will never go anywhere, Senator, and you should not support it despite the fact that they're your good friends and constituents. Thank you very much.

Senator DOMENICI. Well, let me make sure that for the record and that you know I am not supporting it for the reasons you have talked about. I thank you very much for attributing my tremendous concern for my constituents. But frankly I think it is a rather exciting idea and you and I will disagree. But actually, all waste produced in these various processes is not the same waste. Waste pro-

duced by reprocessing is not the same waste that we are contemplating burying at Yucca Mountain.

Dr. COCHRAN. It is pretty close.

Senator DOMENICI. It is less toxic than what we are going to put underground and plan to leave there for 10,000 years. There is no question about that and transmutation not only yields a less toxic but it is so less toxic that there's no problem with disposing of the residual waste from transmutation. It is very simple to do. Now, I know we disagree. I can make my statement and then we will hear you as an expert. I do not want to leave in any antagonistic mode because I am thrilled to hear that we ought to proceed with third and fourth generation nuclear reactor research. I think that we ought to take the lead in saying that America should do that with the world and I told my friend, the chairman, I think America with the world on that would be talking about a post-Kyoto environment that would permit us to no longer worry about global warming. It would be a rather exciting concept.

Now, let me ask—there's been a synthesis on the economy. And I think we have to look at the other issues. For example, if you look at the fuel cycle, the most dangerous for the general public, the most dangerous part of it is the uranium mining. So, that if we do not reprocess, we will have more uranium mining, not in the United States for quite a while, maybe 300 years, but eventually. But in the rest of the world, they will have it right now because they have to keep mining to produce it and therefore you are exposing the public to more danger than you are by reprocessing and storing in a repository.

In our country, we have to look at the fact that we have one heck of a lot of uranium 235 and plutonium 239. Now, what are going to do with it from the weapons? We can bury it, and how do we know what kind of government we will have in a thousand years, 300 years, ten thousand years. We are burying stuff that is going to be a tremendous mine. They could go up and they can start making weapons and devastate the world. And we are leaving that for a future generation. I do not think that is moral even. So, we want to burn it. Well, how are we going to burn it? By making MO_X fuel and that requires fabrication. It requires some kind of recycling. We can also involve the transmutation. I was on the stats committee that looked at transmutation sometime ago in the United States. We recommended against it. Since that time, there have been better developments, better methodologies. I was on the international committee that the Department of Energy had 2 years ago to re-look at the issue.

I have also been very involved in European meetings and so forth, and I still have concerns about transmutation. I am not sure it is a proper process but I think it deserves extensive study and extensive investigation because it could certainly reduce the long-term problem. It could also reduce the stored plutonium and uranium problem. And I do not think as the United States is involved we can ignore those. So, we have a little different problem. One other aspect, I think that is important in the question of reprocessing, is that if we reprocess, we are in line with the rest of the world and therefore we then can interact and influence their policies. What we have done with the direct once-through process is to iso-

late ourselves from the rest of the world and have no impact on their national policies with regard to reprocessing and disposition. So, I think, again for our national welfare independent of economics, we should be involved to a sufficient extent to share with them and participate in their discussions. Thank you.

Senator DOMENICI. Mr. Bouchard, you were shaking your head negatively while Dr. Corcoran was speaking with reference to what kind of waste comes out of this stream if you reprocess. Would you care to express your view in words because we cannot record your head shaking?

Mr. BOUCHARD. Thank you very much. I apologize because in the written testimony we gave some figures with some graphs showing what happens, but we had no time to prepare the necessary presentation for the audition. But, if you have time to look to the written testimony, you will see that we have put one graph, which is the volume of waste produced by the reprocessing and comparing the volume of waste for direct cycle with the various types of waste we create at the reprocessing and the main part, which is the high level waste, for those who contains most of the fission products corresponds to something which is approximately 8 percent of the volume of waste of the direct cycle. And in addition to that, we create two other kinds of waste which are less toxic as you said, Senator, and which are still in low volume. I can show the figure to Dr. Corcoran, which are still in low volume as compared to the direct fuel cycle. We have made progress during the last 10 years as you can see on these figures.

Senator DOMENICI. Mr. Chairman, I want to thank you very much for staying over and taking this time to let me ask a few questions. I would make one observation and share it with you with reference to Russia. This same visit that I spoke of in France took me to Russia and the result of that trip was that the U.S. Government put up $2 million within 6 months in the supplemental appropriation at the request of myself and Senator Stevens to begin implementing an agreement with Russia so that the plutonium that they had which was unstored and was available far more than any of us would ever think should be the case. And we have started down a path of using that money to see if we cannot turn that plutonium into something that could not be used for weapons again.

But I would tell you, what you learn in the meantime is that you are going to wait for a new generation of Russian leaders, if ever, to agree with us with reference to the value of spent fuel. It is valuable to them. They are not one, they're not even a miniscule interested in getting rid of it. They want to keep it because they're going to use it. And you do not have any of their leaders that look at like we do, that wouldn't it be nice to put in the ground for 10,000 years. They're saying if you want to be crazy, you be crazy. We are not going to do that. In fact, they wonder why we do not go to the breeder reactors. That is what they think about nuclear activities.

So, I do not think we can stop them from doing what you suggested we stop them from doing. But I think we have a very big obligation to work to try to get some of that plutonium that is part of their military converted and stored so it can never be used. But to ask for a moratorium there in that country that would not

produce plutonium from reprocessing and the like, I really do not believe. In many things we ought to try to get agreements. That one would not work.

And could I close by saying to Dr. Cochran, I do appreciate your statements. I do not appreciate very much the insinuation, which you said with a smile on your face, which I will now record with my words, that I am for transmutation because of Los Alamos. I am for a lot of things as Los Alamos is for. I am for a lot of things Sandia is for and Argonne and our great laboratory in California, but essentially I think the contribution to this very onerous problem by Los Alamos in looking at transmutation is a good contribution, and it may not come out as the technology but I believe the scientists are doing some real thinking when they work on that. Thank you very much, Mr. Chairman. It is good to be here.

The CHAIRMAN. Thank you very much. Let me thank all three witnesses very much and indicate that we will keep the record open on this hearing through next Tuesday to permit anyone to submit an additional statement if they have a statement to make or any additional information they think we should be aware of. Thank you very much for testifying. The hearing is concluded.

[Whereupon, at 12:35 p.m., the hearing was recessed, to be reconvened on July 19, 2001.]

APENDIXES

APPENDIX I

RESPONSES TO ADDITIONAL QUESTIONS

STATE OF NEW HAMPSHIRE,
GOVERNOR'S OFFICE OF ENERGY & COMMUNITY SERVICE,
August 2, 2001.

Hon. JEFF BINGAMAN,
Chairman, Committee on Energy and Natural Resources, Dirksen Senate Office Building, Washington, DC.

Re: Response to Questions—July 13, 2001 Hearing

DEAR CHAIRMAN BINGAMAN: On behalf of the National Association of State Energy Officials (NASEO), the following constitutes my response to the questions provided in your letter of July 20, 2001.

LIHEAP (Questions 1 and 2)

Senator Murkowski's question concerned the appropriate split between base and emergency funding for LIHEAP. The National Energy Assistance Directors' Association (NEADA) will be responding to this question on behalf of the states. As a general matter, both the approach of Senator Murkowski ($3 billion base funding and $1 billion emergency funding) and your approach ($3.4 billion base funding and $600 million emergency funding) would be a tremendous step in a positive direction. LIHEAP funds are vastly insufficient to respond to the needs of the public at this time. In general, the states have strongly supported significant increases in the base funds, with advanced funding to enable the states to efficiently plan for the upcoming heating/cooling season. Emergency funds are also critical. We look forward to the opportunity to work with the Committee to ensure that appropriations for LIHEAP are significantly increased, consistent with the proposed authorizations.

STATE ENERGY PROGRAM FUNDING (Questions 5 and 6)

In response to both questions 5 and 6, NASEO and the state energy offices are strongly supportive of regional energy planning efforts. With increasing funds regional efforts could expand and permit more creative solutions to our energy problems. Language on regional efforts included in Senator Murkowski's bill and in Chairman Bingaman's bill recognize the importance of these regional efforts. While, in many cases, states are undertaking activities within their own borders, this would permit the expansion of those efforts. As you know, many of our energy markets are not limited to the borders of our own states.

Increased funding would enable states to expand efforts in energy emergency preparedness. Last December, my office sponsored a meeting in Manchester, New Hampshire, between all the Northeastern and Mid-Atlantic states with all relevant industry representatives and federal agencies (e.g., Coast Guard, Department of Energy, Department of Transportation, Environmental Protection Agency) to discuss our response efforts and coordinated pre-planning. In light of increasing price and supply volatility of critical fuels these regional efforts need to be expanded.

We have begun to integrate our energy and environmental efforts at the state and regional level, bringing together NASEO representatives with those of the National Association of Regulatory Utility Commissioners (NARUC), Environmental Council of the States (ECOS state environmental commissioners), State and Territorial Air Pollution Program Administrators/Association of Local Pollution Control Officials (STAPPA/ALAPCO), to jointly work on policies, programs and regulations. This type

of regional activity will be supported by expanded SEP funds. For example, the Western Regional Air Partnership, being led by Utah, is attempting to respond to the requirements of the Grand Canyon Visibility Task Force, in a creative and cost-effective manner, by utilizing energy programs to help deal with environmental imperatives. This involves both supply-side and demand-side responses. The state energy offices in the western states, working together and with the Western Interstate Energy Board and the Western Governors' Association, are attempting to help the region address complicated siting issues for energy infrastructure and coordinate transmission and generation issues. This requires extensive regional cooperation.

In the Southeast, the energy offices working with the Southern States Energy Board and the Southern Governors' Association are attempting to develop unique programs on such issues as alternative fuels, siting, etc. In my region, we are working together with our environmental officials and our utility commissioners on technical standards for distributed generation. In each of the regions we are attempting to learn from each other and coordinate our efforts in expending our public benefits funds. State Energy Program funds help facilitate these efforts. They need to be expanded.

One of the great benefits of SEP funding is the enormous leverage provided from both private and non-federal public funds. Greater expansion of program funds will allow even more leverage. For example, most of the state energy offices facilitate private financing of energy projects both in the public and private sectors. Our most recent estimates are that the energy service company industry conducts up to $1.5 billion/year in energy efficiency projects. The energy offices facilitate these efforts. We hope, in the future, to expand the regional efforts to embrace greater cost-effectiveness and reduce transaction costs in project implementation.

In short, the state energy offices are planning on expanding regional cooperative efforts. We look forward to working with the Committee in providing creative solutions. We hope this is responsive to your questions.

Sincerely,

MARYANN MANOOGIAN,
Director.

MAINE STATE HOUSING AUTHORITY,
ENERGY AND HOUSING SERVICES,
Augusta, ME, August 2, 2001.

Senator JEFF BINGAMAN,
U.S. Senate, Committee on Energy and Natural Resources, Washington, DC.

DEAR SENATOR BINGAMAN: The purpose of this letter is in response to your letter dated July 20, 2001, regarding follow-up questions based on my testimony for the Committee on Energy and Natural Resources on July 13th.

On behalf of the National Energy Assistance Directors Association, I have responded to questions 1 through 4 regarding the Low Income Home Energy Assistance Program, (LIHEAP) and Weatherization Assistance Program, (WAP) submitted by the Office of Senator Murkowski.

If you have any other questions or concerns, please feel free to call me at (207) 624-5708 or by email at jchoate@mainehousing.org. Thank you for inviting me to speak before the committee.

Sincerely,

JO-ANN L. CHOATE,
LIHEAP Manager.

Question 1. What is the virtue of increasing the base LIHEAP funds—which get distributed to states using a formula—verses increasing the emergency funds which can go to where they are most needed?

Answer. Formula grant funds and emergency funds serve different purposes. Formula grant funds are used to provide planned direct assistance to approximately 5 million households per year. These are very low-income households that need program assistance on an ongoing basis to pay their heating and cooling bills. Emergency funds are primarily designed to offset higher that expected demand as a result of lower than average temperatures during the winter months and warmer than average temperatures during the summer months. In addition, funds are also used to offset higher than expected energy prices due to changing market prices.

Question 2. Given that most LIHEAP funds have been spent in regional areas that experienced extreme weather, wouldn't it make more sense to set aside more funds for emergency programs?

Answer. While emergency funds are needed to address changes in temperature and price spikes in energy prices, formula grants are needed to address on-going needs of low-income households to pay their home energy bills. As such, setting aside more funds for emergency programs at the expense of the regular grant program would cause reduced funding for millions of low income households in areas that did not experience severe temperature or price increases.

Question 3. Given the wide variance in percentage of households served by existing LIHEAP funds, doesn't this suggest the need for a change to the allocation formula?

Answer. The intent of the current law formula is to distribute a higher relative percentage of funds to states with relatively colder temperatures when the appropriations level is less than $1.975 billion. At higher funding levels, funds shift to warmer weather states. As result, as shown in the following table, at a funding level of $3.4 billion, the total allocation for Maine would increase by 43.9%, while the allocation for Alabama would increase by 379.2%. A copy of the allocation table is attached.

Question 4. How much funding would it take to fully fund all needs under the LIHEAP program—and how many of those homes could be Weatherized for the same amount of money?

Answer. The LIHEAP program is currently serving approximately 5.0 million households or about 17% of the eligible population. Assuming that program assistance was expanded to serve 50% of the eligible population at the current basic level of $225 per household, the total cost would be approximately $6.6 billion per year.

The weatherizing of homes does not eliminate the need for LIHEAP. Even if program funds were quadrupled to $612 million, at an average cost of $1,750 per unit, total funding would only serve 300,000 households or about 6% of total eligible LIHEAP households. At the same time, by targeting WAP funds to households with the highest energy burdens and energy consumption levels, the program helps to reduce a household's energy burden, thereby reducing a least a portion of the family's need for energy assistance.

The Oak Ridge National Laboratory report entitled "State Level Evaluations of the Weatherization Program in 1990-1996: A Meta-evaluation That Estimates National Savings" found that the WAP has significantly improved its energy savings results during the past several years. In 1996, WAP showed savings of 33.5 percent of gas used for space heating—up from 18.3 percent savings in 1989. The increase in savings was based in large part on the introduction and use of more sophisticated diagnostic tools and audits.

Each family receiving weatherization services can reduce their energy use by an average of 22 percent, making their energy costs more affordable. By reducing energy use, each family can realize average savings of $300 or more each year. More importantly, these savings will occur each year for several years after the weatherization work has been provided. The savings achieved as a result of this year's investment will reach more than $369 million during the life of the conservation services installed in the homes. More than $72 million is expected to be saved this year alone in those households weatherized using DOE and other leveraged funds.

The Oak Ridge Meta-Evaluation report also concluded that the WAP possessed a favorable cost-benefit ratio of 2.40 to 1.0. Simply stated, the federal funds provided to support the Program have a 140% return on investment or nearly $2.50 in benefits for every dollar invested. This positive ratio of benefits continues to increase as state and local agencies integrate advanced technologies and constantly improve their return on investment.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION,
Rosslyn, VA, August 3, 2001.

Hon. JEFF BINGAMAN,
Chairman, Committee on Energy and Natural Resources, Dirksen Senate Office Building, Washington, DC.

DEAR CHAIRMAN BINGAMAN: Thank you for the Committee's thoughtful questions on our testimony forwarded with your letter of July 20, 2001. Attached are the responses to the questions you submitted for Senator Murkowski.

We look forward to working with you, the Committee, and Committee staff in the months ahead as energy efficiency legislation and legislation on the electric transmission infrastructure proceed through the Senate. We believe our members, the manufacturers of electrical products for our homes, commerce and industry, are

stakeholders that provide unique and valuable perspectives on our Nation's technology needs.

Sincerely,

MALCOLM E. O'HAGEN,
President.

[Attachment.]

NEMA RESPONSES TO ADDITIONAL QUESTIONS SUBMITTED BY SENATOR MURKOWSKI

Question 9. You mentioned in your testimony that NEMA generally favors market mechanisms—and favors standards only on a case-by-case basis. How, then, would you respond to Dr. Nadel's call to broaden the standards process to include more appliances?

Answer. NEMA supports the National Appliance Energy Conservation Act (NAECA) requirements to set efficiency levels for covered products at the level that is technologically feasible and economically justified, Under existing law, the Secretary of Energy has the authority to add additional types of consumer products to the list of products for which mandatory energy efficiency standards are required under the NAECA and the Energy Policy and Conservation Act. Specifically, section 322(b) of EPCA authorizes the Secretary of Energy to classify a consumer product as a covered product, and therefore subject to efficiency standards requirements, if the Secretary determines that such a classification is necessary or appropriate in carrying out the purposes of the Act and that the product in household use consumes at least 100 kilowatt hours of electricity. Similarly, section 341(a) of EPCA authorizes the Secretary, by rule, to include additional types of industrial equipment as covered equipment to be subject to energy efficiency standards requirements if doing so is necessary to carry out the purposes of the Act.

Voluntary, consensus-driven codes and standards will achieve the greatest level of cooperation and distribution of energy efficient technology in the marketplace. Industry consensus energy efficiency standards offer an important, cost-effective alternative to government-imposed standards and provide for more rapid introduction of compliant technologies. An excellent example is the NEMA Premium™ motors program, which illustrates the efforts already undertaken by industry to accelerate the market penetration of highly efficient motors. Under the NEMA Premium™ program, highly efficient motors of up to 500 horsepower that can comply with stringent energy efficiency standards receive the NEMA Premium™ designation.

The NEMA Premium™ program was a collaborative effort with the Department of Energy, motor manufacturers end electric utilities. It has broad support, and has been endorsed by the Consortium for Energy Efficiency. When compared to existing Federal regulations, NEMA Premium™ covers a broader range of motors than do minimum Federal energy efficiency standards (up to 500 horsepower, where Federal standards apply only up to 200 hp). Moreover, NEMA Premium™ is a far more exacting technical standard, determined by using NEMA MG1 standards, which include over 30 critical motor operating characteristics in addition to motor efficiency. Introduction of NEMA Premium™ motors in the agricultural and commercial sectors would save 5.8 gigawatts of energy and prevent the release of nearly 80 million metric tons of CO_2 over 10 years.

These and similar market based solutions should be relied upon wherever possible to expedite the introduction of the most highly energy efficient equipment. The Federal government can play an important leadership role and take advantage of the work done to produce the NEMA Premium™ standards, by acquiring only motors that have the NEMA Premium™ designation, and by assuring that failed motors are not rewound, but are replaced with motors that have the NEMA Premium™ designation.

Before expanding mandatory standards requirements, Congress should consider carefully DOE's existing workload in the standards-setting area and the availability of resources. Recognizing that its statutory mandates exceed the resources available, the Department of Energy has adopted a prioritization process for meeting its regulatory responsibilities. NEMA believes that the priority setting process is a reasonable response by the Department to the many demands it faces. Expansion of mandatory standards requirements would necessarily impose additional burdens on the Department of Energy. Congress should be sure that DOE can meet its existing responsibilities in a timely manner before increasing those responsibilities.

In all cases, before Congress mandates the issuance of test procedures, labeling requirements or efficiency standards for any additional products, it should be assured that such standards are technically and economically feasible and would contribute to substantial energy savings. Before new standards are required a study of the need for such standards should be conducted by the Secretary of Energy.

Question 10. What other options would you suggest to improve the rate at which out appliances become more energy efficient? "Smart" technology?

Answer. Appliances on the market now are vastly more efficient than in the past. The appliance industry is highly competitive, and extremely responsive to consumer demand. Therefore, if consumers place a value on the energy efficiency of a product, industry can be expected to respond.

Developing a market demand for energy efficient products has long been the challenge. With the experience of the State of California in these last months, the marketplace may be primed to consider energy efficiency in purchasing decisions. Consumer education and increased energy efficiency awareness among the general public are essential to take advantage of this opportunity.

The replacement of older, less efficient appliances with new efficient ones will save significant amounts of energy. Congress may wish to consider encouraging the voluntary retirement of less efficient appliances through the Weatherization program or the Low Income Home Energy Assistance program. Federal housing programs also should emphasize early changeout of high energy consumption appliances. For the public at large, consideration might also be given to a collaborative incentive program with industry.

Question 11. I was intrigued by a number of your suggestions on the appropriate Federal role in energy efficiency and energy policy in general. How many of your suggestions can be accomplished through administrative action as opposed to legislation?

Answer. A blend of legislative and administrative action is necessary. For example, DOE can, and does, promote user education on energy efficiency under its existing authorities. DOE also can, and does, support energy efficiency upgrades through programs such as FEMP. There is widespread agreement, however, that some of these programs will be more effective if certain changes are made to the underlying statutes, such as the extension and clarification of energy saving performance contracting authorities. And there are other areas where statutory limitations, suck as spending limits in the Weatherization program, may limit the effectiveness of Federal programs in stimulating the deployment of energy efficient technologies, and need to be reexamined.

DOE promotion of economically sound energy efficient consumer products and systems, particularly in collaboration with industry, is possible under existing authorities, but may be enhanced through statutory changes, such as the formal authorization of the Energy Star program and provisions for allocation of responsibilities for this program between DOE and the Environmental Protection Agency.

NEMA believes that further legislative direction to increase energy efficiency in Federal facilities is necessary. Many of the existing federal building energy efficiency authorities date from the Energy Policy Act of 1992 and before, and need refreshing. With respect to the procurement of energy efficient products, for example, the Federal government should lead by example, and specific statutory directives to assure that the government seeks out the most efficient products on the market are appropriate. An example is the NEMA Premium™ program for motors. NEMA recommends that Congress require the Federal government to use the NEMA Premium™ standard as the specification for the acquisition of new motors, and require that failed motors not be rewound, but be replaced with motors meeting carrying the NEMA Premium™ designation.

Statutory requirements to increase Federal building energy efficiency would be more effective in achieving results than Administrative directives or even Executive Orders issued by the President. While important in expressing the commitment to and establishing the framework for Federal government energy conservation efforts, these have not in the past always produced concrete results. For example, NEMA has recommended specifically that Federal facilities should be required by law to achieve the Energy Star building rating. The Department of Energy's Energy Star Buildings Program has made significant advances in improving the efficiency of commercial buildings. However, the vast majority of Federal facilities have not yet achieved the Energy Star rating, a classification given only to the top 25% of buildings in terms of watts used per square foot. It is time to assure that Federal facilities measure up. A statutory mandate would be critical to assuring that agencies treat this as a priority and devote the necessary resources to implementing all practical efficiency upgrades.

DOE already has statutory responsibilities with respect to the adoption and updating of Federal building energy codes, and in rendering determinations about the energy efficiency of code updates that then trigger responsive action by the States. NEMA has proposed that new construction or buildings that undergo major renovation or remodeling should adhere to the most current consensus energy efficiency standards, as contained in ASHRAE/IESNA 90.1-1999. An explicit direction from

Congress to the Department of Energy to update the Federal building energy code to reflect the latest standard update would be beneficial in expediting the Federal code revision process.

DOE also is required to make a determination as to whether the ASHRAE/IESNA Standard 90.1-1999 will save energy in commercial buildings. The issuance of this determination triggers important requirements that states review and update their building codes accordingly. Congress should direct DOE to issue this determination immediately. The 1999 update was developed over 10 years through a process involving all interested stakeholders. It is ready for consideration by the states, and that consideration should be expedited.

With respect to the process by which appliance standards are set, as indicated in the written testimony, NEMA believes that is essential that DOE closely follow the "process improvement rule" in every standards-setting activity. The energy efficiency standards program was stalled for several years before the process improvement rule was issued in 1996. Since that time, and pursuant to the process improvement rule, consensus has been reached and new standards promulgated for products including clothes washers and ballasts. If the process improvement rule is not utilized and applied fully to every consumer, industrial and commercial product, however, there is a risk that the gridlock that characterized the standards program prior to 1996 will return. Direction from Congress to DOE to formally incorporate the process improvement rule into the department's regulations would provide additional assurance to industry that the requirements of the rule would be strictly enforced, and thereby lay the groundwork for further consensus standards development activities.

GOODMAN MANUFACTURING COMPANY, L.P.,
Houston, TX, August 3, 2001.

Hon. JEFF BINGAMAN,
U.S. Senate, Committee on Energy and Natural Resources, Dirksen Building, Washington, DC.

Re: Committee Hearing held July 13, 2001

DEAR SENATOR BINGAMAN: Recently, I received your request, to respond to follow-up questions from the July 13th hearing before the Energy and Natural Resources Committee submitted for the record by the office of Senator Murkowski. Please see my responses to Senator Murkowski's questions below.

Questions for Third Panel—Air Conditioning Standard

Mr. Parks—you indicated that Goodman supports the 13 SEER standard

Question 5. Given your market share and status as the second largest U.S. manufacturer, wouldn't the 13 SEER standard put you at a significant advantage relative to your smaller competitors?

Answer. Goodman does not have a significant advantage given the 13 SEER air conditioner is manufactured today and has been for almost 15 years by virtually all manufacturers. 13 SEER technology has been available to both large manufacturers like Goodman and to small manufacturers like Goetl Air Conditioning for approximately 15 years. The Air Conditioner and Refrigeration Institute's own data shows that virtually all manufacturers including small and large produce 13 SEER equipment today and most have been for several years. Thus, all manufacturers would certainly be capable of continuing to produce 13 SEER equipment five years from now when the rule would go into effect.

In addition, we believe that everyone stands to gain from adopting 13 SEER as the new standard. Lower electricity bills for the consumer, less electricity consumption relieving some of the pressure on utility companies, our environment gets a break and the HVAC industry has the opportunity to better meets the needs of our customers. In fact, raising the minimum efficiency standard to 13 SEER is goad for our industry because we believe consumers will begin replacing older, lower efficiency air conditioning units before they break down in order to save money on their electric bills. When production volumes increase due to market demand for a higher SEER product, consumer prices for those units will come down.

Question 6. Given a 12 SEER standard, wouldn't there still be significant demand for 13+ SEER units among those consumers who benefit?

Answer. Most often consumers opt to purchase the lowest minimum energy efficiency product they can find. This is especially true in the case of property owners that are not responsible for monthly utility costs leaving the renter with no choice in the matter. As a result, often those who can least afford it are most effected by

high utility costs. "We did sell a 10 SEER [current minimum SEER] unit to a lady with a rental unit. She didn't care if it was a 10 because she wasn't paying the electric cost." This is a quote from a recent article discussing the importance of increased energy efficiency standards for air conditioners, the *Dallas Morning News,* June 19, 2001.

Rather than a select few, Goodman believes that persons of all income levels should enjoy this benefits by owning the most efficient equipment available at a reasonable price. The 13 SEER equipment translates to a 30 percent savings over present standards on consumers' air conditioning bills and would prevent the need to build at least 53 (400 megawatt) power plants by the year 2020, thereby improving air quality across the nation.

Establishing a 13 SEER standard is the most cost-effective way to reduce harmful emissions, keep electric bills more affordable and reduce the need for new generating plants—all accomplished with technology that has been available for several years and is in use today.

On behalf of Goodman Manufacturing, I hope this information is useful as you consider the role of energy efficiency as part of the nation's energy solution. We hope you will consider the significant benefits associated with increased energy efficiency standard for air conditioners and urge Congress to strengthen air conditioning efficiency standards to the 13 SEER level. Please feel free to contact me if you have any further questions.

Sincerely,

DAVID R. PARKS, PH.D.,
President.

AIR-CONDITIONING & REFRIGERATION INSTITUTE,
Arlington, VA, August 3, 2001.

Senator JEFF BINGAMAN,
Chairman, Senate Energy and Natural Resources Committee, Washington DC.

DEAR MR. CHAIRMAN: Enclosed please find a copy of my responses to your questions on the National Appliance Energy Conservation Act rulemaking covering residential central air conditioning and heat pump products. I appreciate the opportunity to add to the Senate Energy Committee's record on this important subject.

If you or your staff have any further questions, please do not hesitate to contact me.

Thank you.

Very sincerely,

CLIFFORD H. "TED" REES, JR..
President.

[Enclosure.]

RESPONSES OF CLIFFORD H. "TED" REES, JR., TO QUESTIONS FROM SENATOR BINGAMAN

Question 1. Why, then, would we require a less cost-effective 13 SEER standard, particularly when those consumers who need a more efficient air conditioner can go out and buy one?

Answer. There are customers for whom a 13 SEER product makes good economic sense. They are primarily in the southern half of the country, particularly in southern Florida and the southern tip of Texas, where air conditioning is needed virtually all year. Many of the members of ARI market 13 SEER products—they are more expensive, and for good reason—they cost more to make. And there certainly would be economic benefits for those manufacturers who make 13 SEER products to sell more of them. But those short-term benefits would be outweighed in the long run by a reduction in overall sales because the 13 SEER standard does not make good economic or energy efficiency sense for the vast majority of the country. A 13 SEER standard is simply not a reasonable national standard.

I should point out, contrary to what the Committee has been told, that nearly half of the original equipment manufacturers in the United States today do not make 13 SEER equipment, and risk being put out of business if a 13 SEER minimum is imposed. The Department of Justice expressed particular concerns about the anticompetitive impact of such a standard on smaller manufacturers.

But, as the question suggests, consumers can purchase 13 SEER equipment today—as well as 14, 15, and 16 SEER products—if they can afford it and if they believe it makes economic sense. To impose a 13 SEER standard on all American consumers, however, would cause profound and disproportionate hardship on lower

income consumers, the elderly on fixed incomes, and smaller equipment manufacturers, without justifiable energy savings.

Question 2. Doesn't it make sense to spend some time reviewing why the previous Administration despite all advice for a 12 SEER standard—changed to a less-economic 13 SEER standard at the last minute?

Answer. One of the legal challenges raised by ARI to the last-minute 13 SEER standard (which was sent to the Federal Register on the last day of the previous Administration and published on January 22, 2001) is that there was not sufficient time to analyze and respond to the purported support for a 13 SEER standard. And this is one of the primary reasons that the current Administration withdrew the rule published on January 22, 2001—to take the appropriate time to analyze the potential energy savings and the technological feasibility and economic justifications for a 13 SEER standard, as DOE is required to do under the applicable statute. Upon reviewing the millions of dollars of data in the record at DOE relating to a new SEER standard, DOE has issued a supplemental proposed rule in the Federal Register on July 25, 2001 which would increase the SEER by 20 percent to a 12 SEER. It is apparent from the DOE notice of July 25, 2001, that after a more thorough review DOE believes that there is economic justification in the record to support raising the standard to a 12 SEER, not a 13 SEER. Our analysis agrees with their conclusion.

Question 3. Why should consumers in Alaska or Minnesota—where payback period is more than 20 years—be forced to purchase an uneconomic air conditioner or heat pump?

Answer. Consumers in most of America—not just Alaska or Minnesota—should not be forced to purchase a 13 SEER air conditioner. The attached map of the United States demonstrates that the payback for such equipment does not make economic sense in energy costs savings in most of the country. There are other methods of achieving energy savings without penalizing the customer. For example, ARI members, except for one, have developed and participated in the North American Technician Excellence program, which is a program to improve installation and service of air conditioners and will increase efficiency enormously. Additionally, service maintenance contracts would assure continuing efficiency of installed equipment.

Question 4. Wouldn't it be more prudent to promote the 12 SEER standard, and let consumers in Texas and Florida purchase a more efficient air conditioner based on their needs?

Answer. Yes. The cost differential between a 12 and 13 SEER product is simply too extreme to impose the 13 standard on everyone. Although one manufacturer has claimed that the cost differential between the 2 standards is only $100.00, that estimate was based on a very limited survey of 3 contractors from 2 states. ARI's estimates, which are based on variances in equipment costs and nationwide surveys, demonstrate that the average differential between a 12 and 13 SEER product is $407.00. (For example, the differential between the installed price from a contractor in Dumfries, Virginia and one in Riverdale, New Jersey is $2,577.00!)

Moreover, some critics of the proposed 12 SEER standard allege that ARI's predictions of increased costs are inflated because predictions of cost increases in 1992 when the 10 SEER standard was imposed were not accurate. There is a significant difference in the 1992 predictions and the current ones, however: (1) in 1992, compressor manufacturers, independently—as a result of long standing research—introduced a new scroll compressor technology, at very little cost; and (2) the average product shipped in 1987 (when the rule was first drafted) was approximately a 9 SEER product, only one point below the proposed 10 SEER standard; whereas, in the current situation, there is no compressor technology on the horizon to provide efficiency gains at minimal cost, and the average product shipped today is close to an 11 SEER product which is two points below a 13 SEER.

And finally, advocates for a 13 SEER standard have claimed that ARI had inaccurately predicted a $700 increase in cost in 1992 when the 10 SEER standard was imposed, but as the attached transcript of the DOE's November 16, 2000 hearing clarifies, Steven Nadel of the Association for Energy Efficiency Economy admits that the $700 ARI estimate pertained only to a California Energy Commission rulemaking as an estimate for a California only standard.

In short, the 12 SEER standard is economically justifiable after taking into appropriate account the climatic, regional and economic differences in our nation, whereas a 13 SEER minimum standard would impose unjustifiably harsh punishment on certain consumers and regions of our country.

2 Attachments: 1. Cooling Hours Payback Map, and 2. Nov. 16, 2000 DOE Hearing Transcript have been retained in committee files.

NATIONAL ENERGY MANAGEMENT INSTITUTE,
Alexandria, VA, July 31, 2001.

Hon. JEFF BINGAMAN,
Committee on Energy and Natural Resources, U.S. Senate, Washington DC.

DEAR SENATOR BINGAMAN: I have just arrived back in town and am in receipt of your letter dated July 20, 2001 relating to Senator Murkowski's questions.

As I reviewed the list of questions asked by the Senator, I realized they were out of the scope of my testimony. I have no further comment on the issues he proposed.

Sincerely yours,

ERIK S. EMBLEM,
Executive Director.

RESPONSES OF STEVEN NADEL, AMERICAN COUNCIL FOR AN ENERGY EFFICIENT ECONOMY TO QUESTIONS FROM SENATOR MURKOWSKI

Question 1. The 13 SEER standard will save 4 quads of energy at a cost of $4 billion to consumers; the 12 SEER standard will save 3 quads of energy at a cost of $1 billion to consumers. In other words, the 12 SEER standard gives consumers 3/4 of the energy savings at 1/4 the cost. Why then would we require a less cost-effective 13 SEER standard, particularly when consumers who need a more efficient air conditioner can go out and buy one?

Answer. This question contains points about energy savings, costs, and net financial savings. I will attempt to answer each of these. Regarding energy savings, according to DOE's analysis, a 12 SEER standard will save 2.9 quads, a 13 SEER standard 4.2 quads, so a SEER 12 standard will have 69% of the savings of the 13 SEER standard. Or stated another way, a 13 SEER standard will increase savings 45% relative to a 12 SEER standard. Regarding costs, according to DOE's analysis, for the most common unit (a split air conditioner), 12 SEER has an incremental cost to the consumer of $213 and 13 SEER has an incremental cost of $335, so 12 SEER is 64% of the cost of 13 SEER, not 1/4 of the cost. I am not clear what the $4 billion figure is you refer to, but the $1 billion I believe is the net savings (benefits minus costs) for 13 SEER. According to DOE's analysis, the comparable figure for 12 SEER is $2 billion. In the opinion of my organization, ACEEE, DOE's estimates of net savings are unrealistically low for both 12 SEER and 13 SEER and in fact net savings for both standards will be significantly higher (our rationales are briefly explained below in my response to question 3).

The reasons to require 13 SEER in our opinion are several-fold. First, when the economic analysis is corrected, benefits for consumers are greater at 13 SEER than 12 SEER. Second, energy savings are 45% higher for 13 SEER than 12 SEER, and given the energy problems facing the U.S., we need to pursue all cost-effective energy savings. Third, there are very substantial peak demand savings associated with the increase from 12 to 13 SEER. Reducing peak demand will improve system reliability and will reduce summer electricity prices for all consumers (reduced peak demand increases supply relative to demand, reducing market-clearing prices). Fourth, the larger energy savings from 13 SEER translate into larger emissions reductions from the new standard, helping to reduce the cost of Clean Air Act reforms for "3 pollutants" and for likely eventual steps to reduce greenhouse gas emissions.

Question 2. Doesn't is make sense to spend some time reviewing why the previous Administration despite all advice for a 12 SEER standard—changed to a less-economic 13 SEER standard at the last minute?

Answer. In our opinion, given the energy problems facing the country and the need of the nation to both improve energy efficiency and increase energy supplies, available Congressional and DOE time should be devoted to these endeavors and not to a look back at actions that have already been taken. For example, in the National Energy Policy, the President has directed that DOE look into opportunities for setting new standards that are technically feasible and economically justified. In an effort to help achieve this objective, in my testimony I suggested a look forward to investigate ways to make the standards-setting process more effective in the future.

Regarding the statement in the above question, I would like to note that advice went both ways. Relative to the original proposal for a 12 SEER air conditioner standard and a 13 SEER heat pump standard, some parties advocated a weaker standard (e.g. 12 SEER on both products) and some a stronger standard (e.g. 13 SEER on both products). The final rule was based on comments on the draft rule. It is fairly common for a final rule to include changes from a draft rule; if changes weren't sometimes made, then the final hearing and comments would be a charade.

Also, this rulemaking took 7⅓ years, and under DOE procedures there was no proposed rule until more than 7 years had passed, so even the proposed rule was relatively "last minute" with the final rule following three months later.

Question 3. As the chart shown by Mr. Rees tells us, there are vast parts of the country where the payback period for a 13 SEER air conditioner will be too long to allow the consumer to recover their extra costs. Why should consumers in Alaska or Minnesota—where the payback period is more than 20 years—be forced to purchase an uneconomic air conditioner or heat pump?

Answer. There are several responses to your question. First, the data provided by Mr. Rees are based on ARI cost estimates and are higher than the incremental cost of these products in many markets today, even though SEER 13 is presently a niche product today and not a mass-market product. For this reason, DOE has de-emphasized use of the ARI cost estimates. Using the DOE cost estimates, payback periods in northern states would be lower than shown by ARI.

Second, even the DOE analysis doesn't account for two very important factors: (a) the fact that past experience shows that the actual cost of standards, once implemented, are substantially less than a priori DOE estimates; and (b) the fact that summertime electricity prices (when air conditioning is used) have risen substantially since 1996 (DOE's analysis is based on summer 1996 electric bills). These issues were discussed in my written testimony. When we correct for these two factors, even a 13 SEER air conditioner used only 300 hours per year (a typical figure for the far-north) will have a payback period of approximately 8 years relative to a 12 SEER unit.

Third, in the far north relatively few homes have central air conditioners, so relatively few homes are affected relative to the much larger number of homes in warm climates that have central air conditioners.

Fourth, there are benefits for northern regions in addition to direct consumer benefits. These benefits include reduced summertime peak demand, reduced summertime electricity prices for all consumers (due to the effect of reduced demand on market prices), and reduced emissions of air pollutants from power plants. For example, there is strong support for the 13 SEER standard in Oregon and Washington due to the impacts of reduced peak demand on summertime electricity prices and because freeing up power in Oregon and Washington allows them to sell excess power to California at a profit. And finally, under the federal standards program as currently implemented, there is a single national standard, that applies equally in every state. For most products this works fine, but for climate-sensitive products such as air conditioners and furnaces, there is always a need to compromise given substantially different energy use in the northern and southern states. For these products, it might make sense to split the country into two regions and set separate standards for each.

Question 4. Wouldn't it be more prudent to promote the 12 SEER standard, and let consumers in Texas and Florida purchase a more efficient air conditioner based on their needs?

Answer. Under standards, consumers are always free to buy more efficient products than the standards require. However, experience shows that most sales are at or near the standard level and only a limited number of consumers buy more efficient products due to the many market barriers that led to the establishment of standards in the first place. Currently, 13 SEER units have only about a 5% market share nationally, and while the market share for 13 SEER is higher in Florida and Texas, my understanding is that even in these states 13 SEER accounts for a minority of product sales. By setting the federal standard at 13 SEER, the market share of these units will be much higher, increasing energy savings, peak demand savings and net economic benefits (the latter is true with reasonable economic assumptions). Looked at another way, my understanding is that sales of 12 SEER (but not 13 SEER) units are already quite high in Florida and Texas, so without a 13 SEER standard, these states will not receive significant benefits. One possible compromise might be to set a 12 SEER national standard but permit warm states to set higher standards. However, for this option to work, manufacturer support will be needed, as manufacturers have traditionally opposed such arrangements, insisting on a uniform national standard.

Question 7. Mr. Nadel, you made several recommendations as to other appliances that could be covered by an expanded appliance standard process. Some of your recommendations follow standards adopted by the California Energy Commission—did they evaluate the costs to consumers and impacts on consumer choice in setting their standards?

Answer. Yes, California evaluates both of these factors in setting state standards. The California process to set these standards includes (1) an initial hearing and data collection/analysis; (2) publication of draft standards, an energy savings and

economic analysis, and a hearing on these materials; (3) publication of revised materials and a hearing on these materials; and (4) publication of a final proposal, a hearing on this proposal, and adoption of a final standard. At this point steps 1-3 are completed and the final step is scheduled to take place shortly. In general, the California standards are set at levels that many existing products can meet since the California market is much smaller than the national market and because the California standards are typically scheduled to go into effect one year after adoption rather than the 3 years typically used for federal standards.

Question 8. Will your upcoming report on the effects of these standards also evaluate consumer costs and other market impacts in addition to energy savings?

Answer. Yes, our report will fully evaluate consumer costs and benefits. In the table on the next page I provide our preliminary results. In addition, we look at other market impacts by reviewing available data and interviewing industry experts.

ESTIMATED NATIONAL SAVINGS FROM STANDARDS ON PRODUCTS NOT COVERED BY EXISTING FEDERAL STANDARDS

Products	Effective date (year)	National energy savings in 2010		National energy savings in 2000		NPV for purchase thru 2020 ($)	Benefit-cost ratio
		(Twh)	(Tril. Btu)	(Twh)	(Tril. Btu)		
Torchieres	2005	28.8	293.9	52.4	522.0	22,789	4.4
Ceiling fans	2008	12.0	122.6	48.1	479.1	15,953	4.7
Furnace and heat pump fans	2008	9.2	94.0	46.1	459.0	20,658	6.5
Electronic equip. & power supplies	2005	22.5	229.3	28.6	285.1	13,822	5.0
Unit and duct heaters	2005	NA	53.1	NA	149.7	4,241	6.2
Dry type transformers	2005	1.9	19.7	5.4	54.1	2,796	5.8
Vending machines	2008	1.2	12.1	4.0	40.0	1,198	4.5
Commercial refrigerators & freezers	2005	1.9	19.9	3.2	31.8	1,375	6.8
Traffic lights	2005	0.3	3.6	2.6	26.2	710	2.6
Exit signs	2005	0.8	8.5	2.3	23.3	1,179	7.5
Commercial clothes washers	2008	0.7	6.8	2.1	21.3	2,000	6.7
Beverage merchandisers	2008	0.6	6.1	2.0	20.2	621	5.1
Ice-makers	2005	1.1	10.9	1.7	16.5	564	3.0
Packaged large HVAC	2008	0.3	2.9	1.4	14.2	387	3.4
Total		81.4	883.2	199.9	2,142.4	88,293	5.0

[Senator Larry E. Craig submitted the following technical response of Argonne National Laboratory to the testimony of Thomas B. Cochran and asked that this response be printed in the hearing record.]

ARGONNE NATIONAL LABORATORY

RESPONSES TO THE TESTIMONY OF THOMAS B. COCHRAN

Cochran. "My testimony will focus on research and development of advanced fuel processing technologies and whether the United States should abandon its longstanding non-proliferation policy and promote the development and deployment of pyroprocessing and transmutation technologies."

Response. The United States government position that it does not ". . . encourage the civil use of plutonium and accordingly, does not itself engage in plutonium processing" is based on proliferation risks associated with the separation of pure plutonium by reprocessing. The pyroprocess is an advanced technology that cannot separate pure plutonium. In fact, the product of the pyroprocess is a highly radioactive mixture of uranium, plutonium, minor actinides, and some fission products. This material is not suitable for use as weapons materials. The implication that promoting development and deployment of pyroprocessing and transmutation technologies is abandonment of longstanding nonproliferation policy is false. Indeed, pyroprocessing provides a proliferation resistant alternative to traditional PUREX reprocessing that-strongly supports U.S. nonproliferation objectives.

Cochran. "Civilian nuclear activities have directly and indirectly contributed to the spread of nuclear weapons.

. . .

Unfortunately, the nuclear nonproliferation threat stemming from civilian nuclear power technologies is still alive today, as evidenced by Iran's pursuit of a nuclear weapons option by purchasing nuclear expertise and dual-use technology from Russia."

Response. In the history of more than 50 years of civilian nuclear energy deployment, neither a single commercial electricity generating reactor plant nor any commercial reprocessing facility has been utilized to obtain weapons materials. In all cases, the weapons materials were acquired through uranium enrichment or from plutonium produced in special purpose small reactors.

In countries that do not already nave nuclear weapons, all commercial nuclear facilities are under the international safeguards regime. The economic penalty and the energy security compromise resulting from safeguards violations are so great that these commercial nuclear facilities would not be the choice for weapons materials production, even in the future.

Cochran. "Advanced processing research, even in weapon states, provides the necessary justification for nascent nuclear weapon states to pursue similar research ostensibly for peaceful purposes. It is primarily for these reasons that NRDC believes the better course is to oppose all commercial use of nuclear weapon-usable materials, including separated plutonium and highly enriched uranium, and oppose the research, development and commercialization of nuclear fuel reprocessing technologies."

Response. If a nascent weapons state wishes to produce weapons material, relatively straightforward chemical reprocessing methods are already available. Research on advanced technologies such as pyroprocessing does not increase the already existing proliferation risks. In fact, developing proliferation-resistant alternatives to replace already existing aqueous reprocessing will support the U.S. nonproliferation policy goals.

Since current commercial reactors produce about 40% of their energy over the life of the fuel by fissioning plutonium, opposing all commercial use of nuclear weapon-usable materials requires elucidation. Plutonium is, in fact, simply a natural part of nuclear energy, even in the once-through uranium fuel cycle. Further, fissioning plutonium in a fast reactor will reduce the inventory of plutonium already contained in spent LWR fuel.

Worldwide, nuclear power deployment and R&D is driven by a need for energy. History has shown that we can guide development in other countries through technical leadership, but that trying to lead by abstinence has failed.

Cochran. "The simple answer is that there are no known fuel cycles that are cheaper, and no known fuel cycles that rely on reprocessing that are more proliferation resistant, than the once-through fuel cycle."

Response. The once-through fuel cycle may not be cheaper in the long run if the waste management implications are factored in. The once-through fuel cycle would add to the accumulation of plutonium contained in the spent fuel at the rate of about 80 tons of plutonium per year around the world indefinitely, and at a greater rate if nuclear enegy expands as expected. After long cooling period, the plutonium contained in the spent fuel can be more easily accessed, creating real proliferation concerns, or worse, creating a source of plutonium that is not a concern because it has been forgotten by the international community.

Cochran. "However, the most serious nonproliferation threat associated with reprocessing technologies is not the terrorist threat, but the so-called 'state threat.' The IFR concept and the pyroprocessing technique offer little in the way of reducing this threat."

Response. This argument is irrelevant to the merits of the IFR concept and pyroprocessing. Having decided to become a weapons state, a country would pursue facilities and technologies relevant to that end, not those that are irrelevant. The IFR has features that ameliorate, and in large measure eliminate, concerns about nuclear proliferation. Advantages for nonproliferation are, in fact, a major asset of the IFR.

The IFR is compatible with the most rigorous safeguards provisions, and it provides a basis for dealing with the most egregious concerns about safeguards: excess weapons plutonium and the long-term accumulation of plutonium, both separated and in waste inventories. IFR technology does not involve separating plutonium. The IFR pyroprocess that separates fission product wastes cannot produce pure plutonium. Plutonium is always codeposited with other actinides (neptunium, americium, curium) and uranium. The product carries enough highly radioactive fission products to necessitate remote handling of even the refabricated fuel. All processing steps, including fuel fabrication, are conducted remotely in a small hot cell. Unauthorized access is impossible and any attempt would be easy to detect. The compactness of the fuel cycle facility means that transportation of spent fuel and refabricated fuel can be eliminated by locating the facility at the power plant site. IFR products would still need aqueous reprocessing for any use other than in the IFR (e.g., after covert diversion), just as does spent LWR fuel. Furthermore, IFR can consume stocks of plutonium that currently are increasing daily. And finally, by integrating the latest safeguards technologies into the IFR fuel cycle, an unprecedented level of nonproliferation transparency can be achieved.

Nations that choose to pursue nuclear reprocessing presently have one technology available, called PUREX. This technology was designed specifically to produce highly purified plutonium for the construction of nuclear weapons. Introduction of IFR technology would provide a proliferation-resistant alternative that strongly supports U.S. nonproliferation objectives.

Cochran. "In one respect pyroprocesing is actually worse than aqueous reprocessing in terms of their respective proliferation risks. Preprocessing involves access to technologies for working with plutonium in metallic form, the form most often used for weapons."

Response. This assertion is not true. In the aqueous reprocessing, plutonium is recovered as plutonium nitrate, which is easily converted to plutonium metal. In pyroprocessing, pure plutonium metal is never produced. The product is a highly radioactive mixture of uranium, plutonium, minor actinides and some fission products, that is unsuitable as weapons material.

Cochran. "There is not a shred of evidence in any of the ATW proposals that the collective dose reductions associated with the geologic repository, assuming ATW is implemented, will be less than the collective dose from operating the reprocessing facilities and the transmutation facilities. In fact everything we know about these facilities today suggests the opposite—ATW would result in a higher collective radiation dose to people than they would receive if ATW were not implemented."

Response. The radiological toxicity of the spent fuel consists of two components: fission products which decay to the background radiological toxicity level of the original uranium ore in about 300 years, and actinides which have long half lives and hence take millions of years to decay to that extent. With pyroprocessing, the actinides are recovered collectively and can be transmuted or fissioned in the ATW or in the fast reactor. The dose from operating the transmutation facility is the same as the standard nuclear power plant. The dose from operating a pyroprocessing facility is expected to be a small fraction of that from a power plant.

On the other hand, the benefits of removing actinides from the repository are tremendous and would allow the following specific contributions toward a solution to the nuclear waste problem:

- Removal of actinides, which have long half lives hence long-term radiological toxicity, from the waste, thereby reducing the effective lifetime of the waste from hundreds of thousands of years to a few hundred years. Actinides can be recycled as fuel in the fast reactor.
- Since the source for long-term radiological release from the repository is essentially eliminated, the EPA standard for long-term release and NRC regulatory requirements can be met more easily.
- The amount of waste stored in the repository can ue increased by a factor of about 10 because the long-term heat source is eliminated.
- The lower heat source leads to a cooler repository resulting in higher confidence in superior repository performance modeling involving ground water movement.

Pyroprocessing does not obviate the need for the Yucca Mountain repository. The above technical attributes will allow the technical performance requirements for such a permanent repository to be met more easily and reduce the burden of long-term stewardship, resulting in significant improvements in the licensing process and economics.

As for the transmutation, it can be done more effectively and economically in fast reactors because the engineering complexity and cost penalties associated with the accelerator driven spallation neutron source are eliminated. Furthermore, actinides are valuable resources for electricity generation. Current commercial reactors utilize less than 1% of uranium resources. Fast reactors can accomplish a full utilization of uranium resources increasing the nuclear energy potential by a factor of 100. This will enable nuclear energy to have a significant impact on reducing the greenhouse gas emission.

In fact, the fast reactor with pyroprocessing is the only advanced reactor concept that can answer all of the five crucial questions raised by the New York Times editorial on May 29, 2001, namely: (1) impact on global warming, (2) weapons risks, (3) waste disposal, (4) rector safety, and (5) economics.

APPENDIX II

Additional Material Submitted for the Record

STATEMENT OF CHEVRON ENERGY SOLUTIONS

Chevron Energy Solutions appreciates the opportunity to discuss the need for energy efficiency in our country, and barriers we have encountered in trying to do business with the Federal government to increase energy efficiency in public buildings. We believe that some small, but critical changes to current law would help increase the use of Energy Savings Performance Contract provisions which we, as well as many others, believe are underutilized. These changes would help both public officials and contractors cut through the "red tape", and get the job done of increasing energy efficiency in our public buildings.

By way of background, Chevron Energy Solutions is an energy services company headquartered in San Francisco, California, with 12 offices nationwide. In July 2000, Chevron acquired the retail energy services business of PG&E Corporation, and integrated the expertise into Chevron's own proven capabilities in this area. Chevron Energy Solutions has programs for energy management, energy efficiency, power quality, and power reliability to meet the ever-changing and growing demand of both private companies and public agencies. With the Federal government, over the past several years, we have done and continue to do a substantial amount of contract work for the Department of the Navy and other Federal agencies (many high security agencies) in both energy efficiency and infrastructure improvement upgrades. In the State of California alone, we have implemented energy performance contracts for community colleges and school districts, municipalities and other government agencies in an effort to assist them in meeting the challenges associated with energy shortages and escalating energy costs. We are also under contract with the Metropolitan Washington Council of Governments to make energy performance contracts available to their member agencies and departments throughout the greater metropolitan Washington area.

Energy Savings Performance contracts are an important and innovative tool for government agencies to fund energy efficiency measures. We estimate a savings of over $175 million in energy costs could be saved in Federal buildings alone under existing law—and substantially more if some changes are made to existing law. Government facilities represent a significant opportunity to help us meet our national energy goals. Our experience has shown that many of these facilities have aging and energy inefficient equipment and infrastructure that requires modernization to allow them to operate at peak efficiency. To help address these needs, and provide a financial mechanism to obviate the necessity of a large capital outlay, Congress included "performance contracts" as part of the Energy Policy Act of 1992 to allow energy upgrades to be paid for through savings obtained through energy efficiency.

We are very supportive of the energy contracting provisions in current law, but we have learned that "one size does not fit all", and increased flexibility is needed. We strongly advocate that changes be made in existing law to provide for some of this additional flexibility. If these changes were made, we believe that these provisions would be more workable and utilized by more Federal departments and agencies and could result in energy cost savings of greater than $500 million. In addition, State and local government agencies are adopting and implementing similar provisions, which mirror the Federal statute.

The focus of current law is on "cost savings" and not necessarily on "energy savings"—and it is important that we also address conservation as a means to help us meet our national energy goals. Reducing energy use does not always correlate with cost savings, although in many instances it does. The rising cost per unit of energy may also mean that a performance contracting initiative may result in a reduction in the total amount of energy consumed, yet there may be no cost savings at all.

Therefore broadening the scope of the law is not only desirable, but it is entirely appropriate.

We would recommend that the following changes be made to existing law and added to the Senate bill S. 352:

(1) Broaden the definition of energy savings measures to include infrastructure improvements that contribute to energy conservation, including operational efficiency of building heating, ventilation and air conditioning systems, lighting systems, building envelopes, domestic and hot water systems, measures that result in verifiable operational efficiencies within the building, and other comparable measures. Certainly, these measures should be a part of the overall definition because they represent the breadth of what energy efficiency is about—that certainly operational changes are key to achieving this goal. Efficiencies do not arise solely from one piece of equipment within a facility, but from the interrelationship of systems within the facility.

(2) Allow for a single contract to cover work that is related to implementing energy efficiency measures. In order to install energy efficiency measures, often times other incidental work must be done first. For example, asbestos may need to be removed prior to revamping a building's electrical system or a roof repaired prior to revamping the heating system. Under current law, the agency must let a separate contract for this work although the work is related to installation of the energy efficiency measures. This work could very well be done, and should be done by the same contractor. If the Federal agency had the option to provide one umbrella contract for all work related to implementing the energy savings contracts, then this would eliminate "red tape", and the energy efficiency measures could be installed faster and less expensively. In addition, Federal agencies should have the option to finance these costs from their capital budgets.

(3) Expand provision to cover "energy usage" as a factor that can be counted in determining the "savings." This would provide incentives for conservation, and not restrict the "savings" solely to costs. We recommend that changes would provide for being able to account for a corresponding reduction or change in energy use. With rising energy costs, there may be no decrease in funds but yet energy is being conserved.

(4) Provide incentives and educate school districts regarding performance contracting. Public schools are continually plagued with aging inefficient energy systems, and lack funds up front to pay for the upgrades. Performance contracting is a tool that would allow public schools to do the necessary upgrades without expending capital funds up front. We recommend that DOE and the Department of Education work together to develop incentives for public schools to use performance contracts.

(5) Provide some flexibility in the methodology in how the energy savings are verified. In current law, an "annual energy audit" is required. An "annual audit" is not always necessary because energy efficiency standards are in place and the use of these conventional standards (which have already been verified) is accurate measurement. For example, if there is a lighting retrofit, the specifications for those lights include energy use and costs—therefore, "an annual energy audit" performed by the contractor to verify energy savings is unnecessary and redundant.

Again, we appreciate the opportunity to submit testimony for the record and believe that these changes are needed to add flexibility to this provision so that it will be more fully utilized and ultimately increase energy efficiency at our government facilities. We are hopeful that Congress will include these changes in the energy legislation now being considered.

Thank you for your consideration.

STATEMENT OF CRAIG G. GOODMAN, PRESIDENT, NATIONAL ENERGY MARKETERS ASSOCIATION

I. INTRODUCTION

My name is Craig G. Goodman. I am submitting this testimony as President of the National Energy Marketers Association (NEM). NEM is a national, non-profit trade association representing a regionally diverse cross-section of both wholesale and retail marketers of energy and energy-related products, services, information and technology throughout the United States. NEM members include: small regional marketers, large traditional international wholesale and retail energy suppliers (as well as wind and solar power), billing and metering firms, Internet energy providers, energy-related software developers, risk managers, energy brokerage firms, information technology providers and manufacturers and suppliers of ad-

vanced distributed generation. Membership includes both affiliated and unaffiliated companies. Affiliated and independent marketers have come together under the NEM auspices to forge consensus and to help eliminate as many issues as possible that would delay competition.

NEM members urge lawmakers and regulators to implement: 1) laws and regulations that open markets for natural gas and electricity in a competitively neutral fashion; 2) rates, tariffs, taxes and operating procedures that unbundle competitive services from monopoly services and encourage true competition on the basis of price, quality of service and provision of value-added services; 3) standards of conduct that protect consumers; and 4) policies that encourage investments in new technologies, including the integration of energy, telecommunications and Internet services to lower the cost of energy and related services.

As a national trade organization, NEM brings a wide range of experiences, as well as broad perspectives to its testimony in this proceeding that should aide the United States Senate Committee on Energy and Natural Resources and enhance the quality of the record to be developed here. NEM currently participates in more than 50 restructuring proceedings around the country and at FERC. The testimony and recommendations presented here represent major issues and barriers to price competition that are most often confronted in proceedings around the country.

II. BACKGROUND

Electricity represents the last vestige of 60 years of the most complicated price and allocation controls known to man. The retail U.S. energy business is one of the largest single businesses in the world. It represents nearly a trillion dollars a year, of which, energy is only about $300 billion. Currently, however, utility bills include all manner of products, services, information and technologies which are truly separate and very competitive businesses.

In the U.S., there are very few true supply monopolies or demand monopsonies. But between competitive sources of supply and demand there are two, full-blown, government sanctioned monopolies. One is an interstate transmission monopoly, and one is a local distribution monopoly. Current rules governing these monopolies are incredibly complex, hard to audit and impose enormously unnecessary costs on consumers in many different ways.

To help consumers and to lower energy prices quickly, monopoly barriers to new energy supplies must be repealed, and aggressive conservation and load reduction incentives must be implemented immediately. At the same time, both state and federal policies must squeeze the monopoly profits out of the two monopolies between supply and demand so that more competitive supplies can meet demand at lower prices.

Utilities should not have a monopoly or competitive advantage to provide competitive products, services, information and technologies. Utilities should perform solely natural monopoly functions. Regulated utilities should sell transportation services on a "no frills" cost of service basis. Needed infrastructure investments should be given targeted, performance-based incentives. Regulations, tariff structures, interconnection rules, back up rates and operational protocols should be uniform and designed to permit competitive suppliers to provide all other energy-related products, services, information and technologies at competitive, not monopoly, prices.

III. RECOMMENDATIONS

There are a number of actions that federal and state governments need to take to encourage new investments in distributed generation technologies as an important part of the competitive restructuring of U.S. energy markets. NEM members operate in virtually every market that has opened for competition, and their broad base of experience was the basis for the attached document entitled, "National Guidelines for Implementing Distributed Generation and Related Services."* In this document, NEM recommends fair and uniform business practices for interconnection, reasonable regulation of emissions, balanced planning and distributed generation valuation, fair tariffs for regulated services, and the ability to sell excess power.

NEM also recommends the expansion of existing energy and environmental tax credits to include Qualified Restructuring Investments such as advanced metering, computer system upgrades, and distributed generation and the provision of tax and performance based regulatory incentives for infrastructure upgrades, congestion management, maintenance and streamlined interconnection procedures.

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*The document has been retained in committee files.

A. Implementation of Distributed Generation Technology

Electric demand is increasing as a result of economic expansion and the 21st century digital revolution. As congestion on the existing grid mounts, investment in distributed generation can provide significant relief to consumers quickly and cost effectively. Accordingly, NEM urges the adoption of five principles to encourage implementation of distributed generation.

As a general matter, regulators should unbundle and redesign distribution rates, eliminate penalties, redundant charges, and barriers to entry and implement tariffs that encourage investments. As currently designed, utility tariffs represent significant economic barriers to consumers that wish to invest in distributed generation and related technologies. NEM maintains that utility tariffs, operating practices and procedures must be rewritten to recognize that distributed generation can increase en orgy supplies, enhance system reliability and lower energy costs to both the utility and the consumer.

Utilities must provide equal, non-discriminatory access to markets for power and auxiliary services. Interconnection of distributed generation, in and of itself, does not provide distributed generation investors with equal and open access to either wholesale or retail markets. Distributed generation must have access to markets for the sale of generation and capacity as well as ancillary services. Distributed generators must also be able sell the output of their generation to the wholesale market and trade demand or energy reduction as a replacement for generation ("negawatt market"). Additionally, uniform and reasonable retail wheeling rates should be developed to maximize customer choice and permit a market for the local sale of power.

Federal and state governments must adopt uniform technical requirements and procedures for the interconnection of distributed generation technology. National, or at a minimum, statewide technical safety and reliability requirements, application procedures, forms, standards agreements, related testing and certification requirements and the elimination of existing penalties can reduce the costs and risks of investments by consumers in competitive new distributed generation technology. Uniform interconnection standards, policies and practices must be implemented to lower the costs of installation.

Consistent siting requirements and reasonable environmental permitting of distributed generation will reduce the cost and uncertainty associated with compliance for all parties. Similarly, local siting and environmental permitting requirements must allow investors in distributed generation technologies to comply in a realistic and timely fashion. At a minimum, emissions requirements should be phased in to provide manufacturers time to meet unrealistic or overly stringent emissions targets.

Finally, utilities should not be granted a monopoly or competitive advantage to provide competitive products, services, information or technology. Utilities should perform solely natural monopoly functions. Essentially, regulated utilities should sell regulated distribution services on a "no frills" cost of service basis. Regulations, tariff structures, interconnection rules, back-up rates and operational protocols should be designed to permit competitive, non-utility suppliers to provide each of the products, services, information and technologies that are not natural monopoly functions. The provision of distributed generation technology can and should be opened immediately to competition.

B. Federal and State Tax and Regulatory Incentives are Needed Immediately for Investments in New Energy Supplies, Conservation, Technology, and Infrastructure Immediately

The United States has entered the digital age with an energy infrastructure constructed for the industrial revolution. The United States is operating on a level of reliability that cannot support digital power quality needs. A flicker of the lights in Silicon Valley has global impacts.

One of the lowest cost, highest yield policy solutions is to create targeted tax incentives to encourage all forms of new energy supply, technology and conservation investments. This includes investments in new pipes and wires to reduce congestion, advanced metering systems, new computer systems, new energy supplies as well as distributed generation. Both the state and federal governments have powerful and effective tools to encourage new investments in energy supply and conservation. The federal tax code already contains a myriad of targeted energy, environmental and efficiency tax credits that should be updated to increase the supply of electricity and natural gas and reduce consumption. Either or both the existing energy tax credits contained in Section 48 of the Internal Revenue Code (IRC), or the existing credit for research contained in Section 41 of the IRC, could be expanded to include "qualified energy restructuring investments." The credit should be available to both regu-

lated and unregulated entities. To ensure that restructuring tax credits and regulatory incentives are targeted and effective, investments that are not "qualified" should also not qualify for stranded cost recovery.

CONCLUSION

Our country is urgently in need of new generation investments, and it is in the public interest that customers be incented to make these investments as soon as practicable. Toward that end, competitive barriers to entry must be removed to create a hospitable market for distributed generation investments including the adoption of uniform technical requirements and interconnection procedures as well as the elimination of redundant fees and charges. Furthermore, reasonable emissions standards and environmental permitting and siting requirements for distributed generation should be adopted.

At the wholesale level, distributed generation investors must have equal and open access to the markets for power and ancillary services. At the retail level, utilities' tariffs must be fully unbundled, and the utilities' role in the market should be defined as that of a no-frills, wires-only distribution company. All other competitive functions and products, including the installation and supply of distributed generation, should be provided by the competitive marketplace.

Additionally, existing tax and regulatory incentives must be expanded to encourage new investments in energy supply, technology and conservation. NEM experts are available to work with Committee staff to draft appropriate language to implement these recommendations.

STATEMENT OF RONE LEWIS III, SENIOR VICE PRESIDENT OF INGERSOLL-RAND (IR) AND PRESIDENT OF IR'S INDEPENDENT POWER SECTOR

Thank you for giving me the opportunity to submit for the Senate Energy and Natural Resource hearing record my testimony on the role of microturbine technology and distributed power generation in addressing America's growing energy crisis.

First, let me begin by giving you some background information on Ingersoll-Rand and its Independent Power Sector. Ingersoll-Rand is an $8.8 billion company with more than 50,000 employees operating in over 100 countries. We serve four major global markets: climate control, industrial productivity, infrastructure and security and safety. In the area of Industrial Productivity, I am president of IR's Independent Power sector, which focuses on identifying, developing and marketing alternative-power and energy-management solutions.

As you may be aware, Chairman Bingaman and Members of the Committee, a new type of electrical generator, called a microturbine, is rapidly becoming available to fit the electricity and heating needs of typical commercial buildings and industrial plants. About the size of a commercial refrigerator, microturbins hold great promise in supplying America's facilities with reliable and affordable power.

Microturbines are small combustion turbines that produce anywhere from 25 to 500 kilowatts of electric power. They burn a variety of fuels such as natural gas or diesel to produce the same kind of electricity provided by a utility electrical grid. Because the gas turbine engine has relatively few moving parts, it is quite reliable and can operate for long periods—typically 8,000 hours or more—with little maintenance. Microturbines produce very low emissions as they burn fuel. They are designed to easily meet stringent environmental regulations, including California's strict emission standards. Microturbines are also relatively quiet emitting low noise levels.

Our PowerWorks brand of microturbines, which has been in development for more than 10 years, will provide 70 kilowatts of energy to customers. They are designed to be placed in or near facilities such as hotels, supermarkets, hospitals, laundries, multi-family dwellings, schools and greenhouses, to name a few. These are locations that need a reliable, cost-effective and efficient energy source for electricity and heat.

A $1.4 million research grant from the U.S. Department of Energy contributed to the development of the PowerWorks microturbine, which is designed to meet the same high standards found in chillers, boilers and furnaces. Our microturbines are manufactured to operate for approximately 10 years under typical operating conditions. Through their cogeneration capability, the PowerWorks microturbines can also fulfill a facility's hot water and other heating requirements.

PowerWorks connects directly to the electrical distribution system of a facility to provide high quality electricity. Our microturbines work 24 hours a day, seven days a week for long periods with low maintenance. Designed to help satisfy electric

power needs by producing electricity at the point of consumption, the PowerWorks microturbine also supports peak shaving applications. This means that microturbines can enable businesses and consumers to reduce their reliance on the power grid, especially during costly peak use hours.

IR began the field-testing phase of its microturbine development program last fall in several kinds of facilities located throughout the United States. We plan to introduce our first commercial production units this fall.

There is no argument that this country's need for this type of energy is increasing at a steady rate. California's energy crisis underscores the need for increased energy efficiency, cleaner technologies and more reliable production. Deregulation, volatile energy pricing and tighter emission regulations have all prompted an interest in energy alternatives, such as "green" technologies like the microturbines. And there is probably no better way to get reliable and affordable energy than from your own, on-site generating equipment.

Distributed energy holds great promise in the United States for improving the generation of electricity. The report released this spring by Vice President Dick Cheney's energy task force revealed that this Administration is committed to the use of renewable and alternative energy, and specifically that "microturbines could easily capture a significant share of the distributed generation market."

Furthermore, the Cheney Report was absolutely accurate in noting several challenges to the use of distributed energy. First, there is a lack of national, uniform standards governing interconnection of distributed energy to the local power grids, which is hampering the roll-out of the technology into the local marketplace. The microturbine industry needs a consistent, reliable process for grid interconnection approval that focuses on practical and cost effective safety requirements; a timely approval process that prevents foot dragging on distributed power projects; and no punitive charges from the utility for either disconnecting from the grid or using the grid as a backup. The industry is also interested in support for selling unused power back to the power grid.

Long-standing regulatory policies that support monopoly supplies also must be reversed. This will increase competition, and encourage the development and environmentally-friendly alternative energy technologies. The Cheney Report correctly states, "The tools that form the necessary interface between distributed energy systems and the grid need to be less expensive, faster, more reliable and more compact."

We are pleased that the report recommends that the President direct Energy Secretary Abraham to focus R&D efforts on integrating current alternative technology programs regarding distributed energy, hydrogen and fuel cells. Fuel cell technology is of particular interest to IR because several of our industrial products currently utilize diesel engines. Fuel cell technology promises a more environmentally sound alternative and continued federal research programs can accelerate the development of these programs.

All developers of microturbine technology would be interested in Congressional and Administration support for tax credits for companies who install or use microturbine technology. Tax credits are essential to helping businesses finance their utilization of this technology, just as they have with other alternative energy sources, such as solar power. In addition, continued investment in our nation's natural gas infrastructure will help to ensure that a ready supply of natural gas is available.

We look forward to working with the Senate Energy and Natural Resources Committee, the rest of the Congress, and the Bush Administration to develop the necessary regulatory and legislative support that would make power from microturbine technology more readily available. We believe that once the technical, business and regulatory barriers are removed, distributed power generation will be able to fulfill its promise to America.

Thank you.

STATEMENT OF ROBERT C. RICHARDSON, CORNELL UNIVERSITY, CHAIR, PHYSICS POLICY COMMITTEE, AMERICAN PHYSICAL SOCIETY, AND MEMBER, NATIONAL SCIENCE BOARD

[DOE Science for the Future—A Discussion Paper]

INTRODUCTION

The role of science and technology in maintaining the well being of our nation is growing and changing rapidly. Because of the extent and speed of these changes, it is essential to reexamine the ways in which support for scientific research is organized within the U.S. government. The advent of a new Administration and Con-

gress provides an opportunity to address emerging problems in ways that may not be possible at other times.

We, the authors of this discussion paper, are especially concerned about the future of the scientific research supported by the Department of Energy. The DOE is the federal government's third largest sponsor of basic research, and the largest sponsor of research in the physical sciences.

The DOE Office of Science oversees outstanding national laboratories whose capabilities for solving complex interdisciplinary problems are not easily matched elsewhere. It also builds and operates large-scale user facilities of importance to all areas of science. In large part, it has been enormously successful in these efforts. Thus, the vitality of the U.S. scientific enterprise is strongly dependent upon DOE support.

For about a decade, however, DOE Science budgets have been declining in purchasing power, and have fared significantly less well than those of other agencies. These difficulties have been exacerbated by weakness in overall federal support for the physical sciences (as compared to biology and medicine) and by the perception of management and security problems throughout the Department.

The decline in funding for DOE Science implies that our nation has seriously underinvested in the research that it will need to sustain its health, security, and economic prosperity in the 21st Century.

We believe that this situation has reached crisis proportions, and that future U.S. leadership in many essential areas of science is in jeopardy. Our purpose in these remarks is to suggest actions to strengthen DOE Science that might be taken jointly by the new Administration and Congress.

We have considered alternatives ranging from keeping the status quo to major rearrangements of the existing science agencies. Of these various alternatives, we believe that two kinds of solutions to these problems—depending upon circumstances—may be feasible and effective.

THE PROBLEMS OF SCIENCE AT DOE

The DOE Science budget has stagnated and declined, in part, because the DOE roles in civilian basic research and in the support of university faculty and students are neither adequately understood in Washington nor appreciated by the public at large.

DOE as a whole has four main missions: national security, environmental restoration, science and technology, and energy. Its role in national security is to maintain our nuclear deterrent. The environmental role is to correct problems left behind under the pressures of the Cold War. The mission in science and technology uncovers new knowledge and propels the growth of our economy. The energy mission is to secure some degree of independence from fluctuations in the fossil fuel supply, and to develop environmentally sound energy technologies for sustainable development. In principle, the four missions can support each other.

It is inevitable in a complex national-security program as large as that of the DOE that there will be problems from time to time. It is also inevitable that new environmental problems will be uncovered. These problems in the DOE weapons and environmental programs have given the overall agency a negative image that, in practice, has proved damaging to all of DOE, including its missions in science and energy. In particular, DOE Science has not received the support that it badly needs.

The question of leadership is an essential part of the problem. The Director of the DOE Office of Science has responsibilities comparable to those of the director of the NSF and not very different from those of the directors of NIH and NASA; but he or she does not have comparable authority or visibility. Without that authority, it has become very difficult for DOE Science to make its case for necessary long-term investments in research.

In considering responses to this situation, we have agreed upon the following guidelines:

- The DOE missions in national security, environmental clean-up, science and energy are each important in their own ways. Any solution to present problems within DOE should tailor management, facilities, and budgets so as to optimize the performance of each of these missions rather than applying "one-size" solutions to all.
- Science and technology in the United States has prospered greatly from diversity of funding sources and modes of support. For example, the fact that the NSF differs from the mission agencies in both purpose and style has made it possible for U.S. scientists to take risks and tackle challenging and important problems. Similarly, the DOE has developed great expertise in building and op-

erating large facilities, and in overseeing important interdisciplinary national laboratories. That expertise has been extremely valuable throughout all of the U.S. scientific and technological community—in government, industry, and universities. The diversity of funding sources should be maintained.

- The primary responsibility of the DOE's science and energy programs should be to provide the new knowledge needed for ensuring the scientific and technological base of our nation's economic prosperity in the 21st Century. The mode in which those programs assume this responsibility should take advantage of the DOE's experience with large facilities and multi-disciplinary research efforts.

ALTERNATIVE STRATEGIES

Starting from these guidelines, we propose two alternative kinds of solutions, without indicating a preference for one over the other. Alternative A is a restructuring of the DOE based on the assumption that the Department will remain essentially intact in the next Administration. Alternative B is based on the assumption that it may become feasible or inevitable that some or all of the present responsibilities of DOE be shifted to other agencies. After discussing both of these alternatives, we mention, for the sake of completeness, two other strategies that we believe are highly undesirable.

Alternative A—Enhance the leadership and visibility of DOE science and energy by revising the management structure within the Department

One way to accomplish this goal would be to elevate the Director of the DOE Office of Science to the rank of Under Secretary for Science and Energy, with additional responsibilities as Science Adviser to the Secretary. This scheme would improve the visibility and influence of science in DOE, and would place the person in charge of science at a level above the large number of staff offices that are inevitable in such a complex agency. A primary objective would be to have a widely respected and influential scientist in a position where he or she can be an effective leader and spokesperson for DOE science and energy.

A variant of this scheme, which goes part of the way toward our more ambitious Alternative B described below, would be to remove some administrative and regulatory responsibilities from DOE and convert it into a subcabinet agency. The director of this agency, like the directors of NSF and NASA, would be chosen for scientific and technical leadership, and would have clear responsibility for guiding the agency in directions consistent with long-term national goals.

Alternative B—Combine DOE science and energy programs with NIST, NOAA, and possibly USGS to form the major part of a new 21st Century Department of Commerce

The idea here is to create a "National Institutes of Science and Advanced Technology" (NISAT) within a cabinet-level department in analogy to the Natibnal Institutes of Health within HHS. An alternative would be to combine these same entities; that is, "NISAT," into an independent sub-cabinet agency analogous to NASA in structure and governmental status.

The major feature of Alternative B is that it would simultaneously reorganize both DOE and DOC in a way that would be consistent with the scientific and technological challenges of the next decades. The new agency would be a visible recognition by the U.S. government that long-term research drives economic progress. Its primary mission would be the initiation and management of large-scale and/or multidisciplinary research.

While many of the specific responsibilities of this agency would be closely related to national needs, its style of operation would reflect our modern understanding of the essential connections between applications and fundamental new knowledge; thus this agency would support both basic and applied research. The existence of such an agency might provide a sharpened focus on the needs of the physical sciences in federal budgeting processes. As before, scientific leadership at the highest level would be necessary for the success of this new agency.

Finally, we mention two alternatives that have been suggested by others that we consider to be highly UNDESIRABLE.

Move DOE Science into NSF

Merging DOE Science and the NSF would double the size and complexity of the NSF. There would be a serious mismatch between the science and management activities, and it might be difficult to establish a culture that would maintain the strength of the national laboratories and that would allow both single-investigator "small science" and multidisciplinary, multi-investigator "big science" to thrive.

Whether this merger could happen without degrading what works very well in DOE or NSF is highly questionable. Diversity of funding sources for research would be substantially reduced. Many scientific fields would be limited to one possible federal funding source, and innovative scientists whose research projects did not fit into NSF programs would have no other sponsors to whom to appeal.

Most importantly, the NSF is the only federal agency whose sole responsibility is the support of science, unconstrained by specific missions. In its fifty years of existence, the NSF has served this nation extraordinarily well. We believe that it is essential to maintain the unique quality of this agency.

Create a Department of Science, including all Federal R&D programs

The creation of a federal Department of Science has been proposed several times in recent years as a means for concentrating federally funded research and development and making it easier to track and manage. Presumably, a Department of Science would be a civilian agency, perhaps including the 6.1, 6.2. and 6.3 programs of the Department of Defense. This consolidation would have the very major disadvantage of completely eliminating the diversity of funding sources as well as destroying the unique nature of the NSF. Other serious disadvantages have been discussed in previous analyses of this proposal.

STATEMENT OF ARPAD A. BERGH, PRESIDENT, OPTOELECTRONICS INDUSTRY DEVELOPMENT ASSOCIATION

On behalf of the Optoelectronics Industry Development Association ("OIDA"), I would like to offer support for a government-industry initiative to develop a new form of energy efficient lighting based on solid state optoelectronics. In particular, OIDA endorses legislation recently introduced by Senators Jeff Bingaman and Mike DeWine—S. 1166—that would establish a government-industry initiative to accelerate the development of solid state lighting.

The "Next Generation Lighting Initiative Act" would create a 10-year program for the Department of Energy and a consortium of the solid state lighting industry for the purposes of conducting the research and development necessary to enable solid state lighting to become a primary source for the nation's general lighting needs.

OIDA is a non-profit association of optoelectronics companies, national laboratories and universities established to strengthen and advance optoelectronics technology. OIDA members are leaders in the research and development of new enabling optoelectronics technologies for areas such as fiber optic communications, digital imaging, and optical storage.

Optoelectronics involves the merging of optics and electronics into various complementary devices and has become a strategic enabling technology in today's information-based economy. Optoelectronics applications extend broadly through society, including the fields of computing, communication, entertainment, education, electronic commerce, health care and transportation. Optoelectronics defense applications include military command and control functions, imaging, radar, aviation sensors, and optically-guided weapons.

OIDA urges the Congress to pass S. 1166 expeditiously in order to achieve the considerable benefits of energy savings, productivity gains, and consumer advancements that would come from full scale development of solid state lighting.

DOMINANT LIGHTING TECHNOLOGIES

Lighting technology is currently dominated by the incandescent light bulb and the fluorescent light tube. These two light sources are the primary means for general lighting in the United States and throughout the world. Despite the dominant role of these lighting technologies, neither has achieved significant advancements in energy efficiency over the past several decades. This is all the more noteworthy given that approximately 70 percent of the energy used by these lighting technologies is wasted as heat.

Incandescent and fluorescent lighting, as well as certain other forms of lighting currently available, are very energy-inefficient. These forms of lighting convert only a small portion of the consumed electric energy into visible light. A 100 watt incandescent light bulb, for instance, emits only 5 percent of the energy it uses as useful light, while the equivalent figure for the more efficient fluorescent tube is less than 30 percent. These inefficiencies are dictated by physics and are not subject to significant improvement.

Lighting consumes a significant portion of the energy generated in the United States—approximately 20 percent—and this share is growing. It is widely accepted that the United States must pursue strategies for limiting the growth of its energy

consumption devoted to lighting needs. Conservation and improved electronic controls alone will not be sufficient for limiting this energy need. The solution lies with new technologies, principally solid state lighting.

SOLID STATE LIGHTING

Solid state lighting technology utilizes inorganic and organic semiconductor devices known as light emitting diodes ("LEDs") and organic light emitting diodes ("OLEDs") to convert electricity to light. LEDs have existed for over 30 years and today are used in applications such as digital displays, instrument panel lighting, signage, and traffic signals. LEDs' primary advantages include significantly longer-life and energy efficiency. LEDs' use in highway signs and signals, for example, require 80-90 percent less energy than incandescent signals and have significantly longer running lives. It has been estimated that replacing all existing incandescent traffic signals in the United States with LED signals would save nearly 2.5 billion kilowatt hours annually. OLEDs have the promise of highly efficient low cost, large area, flexible light sources that can be mounted on walls and ceilings or even on furniture.

Unlike incandescent and fluorescent technology, solid state lighting technology is not subject to the same laws of physics that result in the conventional lighting sources' poor energy efficiency. In theory, solid state lighting could achieve near 100 percent electricity-to-light conversion ratio. While actual ratios for solid state lighting have not yet approached such high levels, technological advancements are consistently raising the energy efficiency of solid state lighting.

The adoption of solid state lighting for more general illumination, such as residential and office lighting, has been stymied by the inability to produce solid state "white light", the most common form of lighting used by the general public. This barrier, however, has now been overcome. Several types of white light LEDs have been developed and efforts are on-going to improve on existing white light technology for solid state applications. Nevertheless, the industry faces significant challenges in bringing to market cost-effective white light LEDs.

SOLID STATE LIGHTING AS A PRIMARY SOURCE OF GENERAL LIGHTING

Adoption of solid state lighting as a primary source of general lighting in the United States holds the promise of significant and far-reaching benefits:

Energy, Efficiency. It is estimated that significant adoption of solid state lighting over the next twenty years could reduce global electricity usage for lighting by 5O percent, and reduce total global electricity consumption by 10 percent. These changes equate to an overall reduction in annual global energy needs of 1,000 terawatt-hours.

Cost Efficiency. Solid state lighting using LEDs will be more cost efficient in terms of product maintenance and replacement. Unlike incandescent bulbs and fluorescent tubes, LEDs are durable, long-lasting, and easier to program and operate.

Environmental Impact. The energy efficiency of LEDs could translate into major cuts in carbon emissions if solid state lighting is adopted broadly. It has been estimated that the United States could avoid 276 metric tons of carbon emissions by 2020 if solid state lighting could garner a significant share of the general lighting market.

Economic Impact. A flourishing solid state lighting industry would have important economic benefits to the United States in terms of employment, growth in supplier and equipment industries, research and development and new applications. Furthermore, as solid state lighting becomes a leading source for general lighting outside the United States, the U.S. solid state lighting and related industries will reap expanded economic benefits for the nation.

Improved Quality and Flexibility. Solid state lighting promises better quality and more versatile sources of lighting, including the ability to tune colors to virtually any shade or tint. In addition, solid state lighting offers other desirable qualities, such as light-weight, thinness, flexibility in deployment, and compatibility with integrated circuits to produce "smart" light.

Based on these important qualities and benefits of solid state lighting, a government-industry solid state lighting initiative would be in the United States' economic and energy security interests. The United States would benefit not only from major energy and cost savings, improved quality, and a positive environmental impact, but also from the ability to enhance and maintain the competitiveness of the U.S. solid state lighting industry at a time when this technology is being aggressively pursued by other nations. These benefits represent a solid foundation and justification for proceeding with a solid state lighting initiative as set forth in S. 1166.

FOREIGN DEVELOPMENT EFFORTS AND THE CHALLENGE TO THE UNITED STATES

Efforts are underway in other countries to rapidly develop solid state lighting as a viable alternative to conventional lighting technologies. Government-sponsored industry consortia have been established in Japan, Europe, Korea, and Taiwan to develop more efficient solid state lighting technologies. It is generally believed that without a substantial government/industry commitment in the United States competitors such as Japan and Europe will come to dominate solid state lighting and become the standard-bearers of this important technology.

A national investment is necessary to further develop solid state lighting and to ensure that the United States can obtain a leadership position. This can best be achieved through the cooperation of industry, government, and academia.

The optoelectronics industry, the Department of Energy, and several National Laboratories have been working to develop a coordinated approach to solid state lighting. OIDA itself has put much effort into addressing the necessary requirements for full scale development of solid state lighting. These include much basic research, which is especially suited for universities, harnessing work at the National Laboratories, and the development of an infrastructure of supplier and equipment firms that can be available for the commercialization of this new technology.

The potential for solid state lighting was thoroughly reviewed this spring at a National Academies of Science workshop. Based largely on work from many sources, Senators Jeff Bingaman and Mike DeWine have formulated legislation that reflects the most promising approach to this type of broad-based technology development.

THE NEXT GENERATION LIGHTING INITIATIVE ACT—S. 1166

The Next Generation Lighting Initiative Act was introduced on July 11, 2001 and is designed to establish a national research and development infrastructure for bringing about the types of advances in solid state lighting that will allow this technology to become more broadly applied and eventually available as a primary source of general lighting.

The legislation would involve two types of funding for research and development on solid state lighting: 1) direct sponsored research from the Department of Energy, and 2) grants to universities, National Laboratories and infrastructure providers that would be administered by an industry-led consortium.

Industry Consortium. The "Next Generation Lighting Initiative Consortium" would be composed of companies, National Laboratories, and other research entities and would provide basic and manufacturing related research contracts. The consortium would be funded through both membership fees and Department of Energy grants. Entities receiving funding directly from the Department of Energy would obtain full intellectual property rights, while consortium members would have royalty-free access to research results from universities, National Laboratories, and infrastructure providers.

The consortium would provide the framework for the entire program in that it would coordinate with the Department of Energy in assessing technology requirements, maintain a technology roadmap, and administer the efforts of participating universities, National Laboratories, and supplier and equipment infrastructure firms. All efforts would involve cost sharing.

The consortium is to be broadly representative of entities engaged in solid state lighting research and development. It would have a participation agreement applicable to all members and would be open to all U.S. companies.

The initiative is designed to result in the commercialization of solid state lighting technology. As such, it would involve extensive industry participation. To facilitate such participation, the grants under the research and development funding program would not be subject to the Federal Acquisition Regulations, but rather subject to review by commercial auditors to ensure that funds are expended in a manner consistent with the program's objectives.

Planning Board. The initiative would also establish a Planning Board that would include seven members representative of solid state lighting activity generally. Four members would be appointed by the Secretary of Energy and three members would be nominated by the consortium. It is not intended that the Planning Board would function as a federal advisory committee. Rather, it would have a specific task of developing strategies for solid state lighting. These strategies would be made available to the Department of Energy, the consortium, Congress, and the public.

Annual Review. In addition, the initiative would be subject to an independent annual review by a federal advisory committee or under the auspices of the National Academy of Sciences. In particular, the Board on Science, Technology and Economic Policy of the National Academy of Sciences would be well qualified to conduct such annual reviews.

Funding. The Department of Energy Initiative would authorize up to $480 million in grants for solid state lighting research and development over a period of ten years. The objective of the initiative is to develop by 2011 white LEDs that, compared to incandescent lighting technologies, are longer lasting, more energy efficient, and cost-competitive.

Studies indicate that technology development necessary for commercializing solid state lighting could be achieved within ten years. To realize this goal, however, it will be necessary to make substantial investments in research and development. Based on the critical tasks identified in the solid state lighting industry's roadmaps, it appears that annual funding of approximately $50 million will be necessary to complement current industry efforts. Funding would not continue beyond the point at which this technology is readily avail4ble for broad-based applications.

OIDA strongly endorses the Next Generation Lighting Initiative Act and urges the Congress to enact this important technology development initiative. This legislation offers the best approach for combining the resources of industry, government, and academia in an effort to bring to the commercial marketplace the next generation of lighting technology and to maintain a leadership role for the United States in this important field.

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