

# OIL RESOURCE DEVELOPMENT

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## HEARING BEFORE THE COMMITTEE ON ENERGY AND NATURAL RESOURCES UNITED STATES SENATE ONE HUNDRED NINTH CONGRESS

FIRST SESSION

TO

DISCUSS OPPORTUNITIES TO ADVANCE TECHNOLOGY THAT WILL FACILITATE ENVIRONMENTALLY FRIENDLY DEVELOPMENT OF OIL SHALE AND OIL SANDS RESOURCES, AND TO ADDRESS LEGISLATIVE AND ADMINISTRATIVE ACTIONS NECESSARY TO PROVIDE INCENTIVES FOR INDUSTRY INVESTMENT, AS WELL AS EXPLORE CONCERNS AND EXPERIENCES OF OTHER GOVERNMENTS AND ORGANIZATIONS AND THE INTERESTS OF INDUSTRY

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APRIL 12, 2005



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## OIL RESOURCE DEVELOPMENT

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TUESDAY, APRIL 12, 2005

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

The committee met, pursuant to notice, at 10:04 a.m., in room SD-366, Dirksen Senate Office Building, Hon. Pete V. Domenici, chairman, presiding.

### OPENING STATEMENT OF HON. PETE V. DOMENICI, U.S. SENATOR FROM NEW MEXICO

The CHAIRMAN. We are going to get started. I think one Senator is here. He is talking in the back room with a representative from Canada. I think what we will do, if it is all right with Senator Bingaman—we have two visiting Senators who have other hearings. At least we are scheduled here. So why do we not just start?

As everybody knows, this is a hearing to get some kind of an overview about oil shale in the United States, and we all know that the Senators that are in front of us here, one from Utah and one from Colorado, represent States where most of the American shale is located. It is located more inland in America, but it is a different kind of shale and in proportion, it is a lot less than what is contained in your States.

We have some opening remarks here, but in deference to your time—you know the nature of the hearing. We have no idea what you all are going to talk about, other than we assume it will be about oil shale in your States.

Having said that, we will go with you, Senator Hatch, then Senator Allard.

[The prepared statement of Senator Bunning follows:]

PREPARED STATEMENT OF HON. JIM BUNNING, U.S. SENATOR FROM KENTUCKY

Mr. Chairman, I am pleased we are having this hearing today.

The United States is currently facing a tight reserve of oil. Our domestic supply is not enough to keep up with our demand and so we import more than 55% of the oil we use.

The price of oil has remained at over \$50 a barrel. OPEC estimates that within 2 years the price of oil could jump to \$80 a barrel.

These high prices mean we are just throwing money needlessly at other countries. We need to stop this. Our economic and national security depend on our ability to provide our own resources.

Using alternative fuels such as oil shale and tar sands is one good way for the country to increase its domestic supply of energy.

The hearing today will help us determine how to increase our energy independence by using these alternative fuels. I firmly believe that this will help move our country forward in the 21st Century.

I want to thank all the witnesses today for testifying on this important issue.

Thank you Mr. Chairman.

**STATEMENT OF HON. ORRIN HATCH, U.S. SENATOR  
FROM UTAH**

Senator HATCH. Well, thank you so much, Mr. Chairman and Senator Bingaman. We are grateful that you are so courteous to us.

Mr. Chairman, I want to thank you for holding this hearing today. I applaud you for your vision and leadership on energy policy issues in general and on oil shale and tar sands in particular.

I am a strong believer and a promoter of the use of alternative fuels, as you know. As the author of the CLEAR Act, which has been a part of every energy bill over the last 4 years, I have tried to promote a vision of a future that is less dependent on oil. The CLEAR Act has been an attempt to provide strong tax incentives for the use of alternative fuels, alternative fueling stations, and alternative and advanced car technologies. I still believe that alternatives are a critical component of our Nation's energy strategy. However, at the moment, our Nation continues to be dependent on a steady and cheap supply of oil. It is a fact I do not like, but it is a fact nonetheless.

Mr. Chairman, I congratulate you for recognizing the gigantic domestic energy resource that is waiting to be developed in the tar sands and oil shale found principally in Utah, Colorado, and Wyoming. There will be some numbers thrown around today that are mind-boggling. Who would have guessed that in just Colorado and Utah, there is more recoverable oil than in the Middle East, except that we do not count it among our Nation's oil reserves because it is not yet being developed commercially.

The government of Canada has recognized the potential for large tar sands deposits in the Province of Alberta, and they have developed a government policy to go promote their development. The result is that Canada has now increased its oil reserves by more than a factor of 10.

I find it disturbing that Utah imports oil from Canada tar sands, even though we have a larger tar sands reserve or, should I say, resource within our own boundaries that remains undeveloped.

Why has Canada moved forward in leaps and bounds while the United States has yet to take even a baby step in this direction? I believe the difference has been the government policies of the respective countries. I know, Mr. Chairman, that you are keen on changing that, and I fully support you.

I cannot sit by while gas prices are going through the roof and while I hear from constituent after constituent about the disastrous effect gas prices are having on their livelihoods and their businesses, farmers included.

As you know, I have been leading an effort by working with your staff and with the offices of Senators Bennett, Allard, Salazar to develop legislation that can be agreeable to all sides. We are in the early stages of our discussions, but I believe that with your leadership, we can change the mind set of our Government enough and open up a much more stable future in terms of our energy policy. So I commend you, congratulate you, and request your help in moving the United States forward in these great reserves that really

could be developed and certainly developed, in time, at a lesser cost than actual oil extraction from the ground.

So, thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Senator Hatch.

Senator HATCH. If you do not need me any further, I am going to head over to another—

The CHAIRMAN. Maybe you could stay just a moment. Can you?

Senator HATCH. Sure.

The CHAIRMAN. Senator Allard.

**STATEMENT OF HON. WAYNE ALLARD, U.S. SENATOR  
FROM COLORADO**

Senator ALLARD. Mr. Chairman, I want to commend you for your forward-looking efforts as far as our energy sources here in this country. I think you agree with me that we simply cannot ignore any potential source of fuel for this country because of the shortages that we are facing, particularly long term. I agree with my colleague, Senator Hatch, that we need to look at renewables, we need to look at those other sources that perhaps maybe we have not utilized as well as we possibly could, and I think we can do that and still protect the environment.

This hearing is on oil shale, and I have an opportunity to visit personally some of the new technology that is emerging. A lot of it is proprietary, so I do not think I can say too much about it other than the fact that I would just say that I feel oil shale is a promising fuel source and produces very light crude suitable to fill needs for jet fuel and similar pure fuels.

In the Rocky Mountain area, there lies an area with a very large oil shale deposit. In the last several years, a handful of companies have worked to develop technology that will allow for the economical development of this resource. Some of the resource lies under private lands, but much of it, certainly the richest deposit, is under Federal lands. This area, now under the purview of the BLM, was formerly known as the Naval Oil Shale Reserve.

In this discussion, we must remember that when my former colleague, Senator Ben Nighthorse Campbell of Colorado, authored the legislation to transfer the Naval Oil Shale lands into the keeping of BLM, the legislation specified that the resource remain available for development. Congress never intended to place the development of this resource off limits. Rather, Congress recognized that BLM was in a better position to manage publicly owned lands than was the Department of Energy.

Many on the Western Slope remember the bust associated with oil shale that occurred in the early 1980's, the height of which became known as Black Sunday. Higher priced crude made oil shale more attractive, and there was a real rush to develop the resource. When crude prices fell, companies pulled out of the area just as quickly, leaving many jobless. I want to assure those in Colorado who remember and who were affected by this time, there is no rush to develop this time around. There will be no quick peaks and falls. The companies involved and the Federal Government are moving at a much slower and more deliberate pace.

The legislation currently being drawn up allows for demonstration scale projects, as I understand it. These demonstration projects

will have to move themselves before full-scale projects can go forward.

Mr. Chairman, thank you for holding this important hearing. I intend to continue to work with you, Senator Hatch, and our colleagues to continue to develop this legislation to allow for deliberate and conscientious development of the resource. I am pleased that I have an opportunity to work with my esteemed colleague, Senator Hatch.

Thank you, Mr. Chairman. I look forward to working with you.

The CHAIRMAN. Let me ask both of you. From what we read, the experience that occurred heretofore kind of reminded people of a boom and bust, which put kind of a big shadow over shale and tar sands in your region. But it does seem that the price of oil has something to do with that. We were right down at the margins in terms of cost of oil. When the price of oil dropped, which they did back then, as you know, it obviously went from realistic to totally unreal, and out went the investment and the activity and down came the city or the communities and the jobs.

Might I ask, in terms of the attitude of people in your States, is it fair to assume that they are concerned about this potential for an expedited development hurry-up and then fall again, but there is a genuine, positive interest in our proceeding in a gradual and guarded way to see what can really happen up there? Senator Allard, Senator Hatch, whichever.

Senator HATCH. Well, let me say this, Mr. Chairman. Back when I was practicing law in Utah, I was the first attorney to obtain rights to mine the Saudi Arabia coal, the Kaiparowits Plateau. I also represented one of the top scientists in the world, Dr. Alex Oblad, who wound up at the University of Utah, who was developing systems for extracting oil from tar sands, and he believed that over time, they could do it as competitively with the then price of oil.

And now I am fully aware that we have come a long way in the ability to extract oil from not only tar sands, but also oil shale. We had abilities back then, but we are far advanced over those abilities today. And I think you will hear some of the leaders talk about that today.

But we can no longer sit back.

The CHAIRMAN. But, Senator, my question is, is there any reason for the people of your States to be opposed to this?

Senator HATCH. Not any reason at all, other than you might find a few environmental extremists who might try to give it a difficult time, but they should not because these are lands that long have been considered available for development of oil resources.

The CHAIRMAN. Senator.

Senator ALLARD. Mr. Chairman, I think you will find strong support in western Colorado. That is where all this oil shale is located. The community that originally was formed with the oil shale development has evolved into a retirement community now, and I suspect that there may be some opposition that would come from that. I suspect that the extreme environmentalists perhaps will try and raise some concerns in that regard.

But we have in the State of Colorado an organization called Club 20. It is made up of the 20 counties from the whole western part

of the State of Colorado. They have passed a resolution, I understand—and I was at their meeting just about 10 days ago—where they have endorsed an effort to try and see if there is not a way to utilize the oil shale that is in that area. So my impression at this point in time is that there is strong support through that resolution from the Club 20 counties, and they support the approach that Senator Hatch and myself are talking about where we look at it on a minimal basis and then let it prove itself and then move forward from there.

I have seen some of the technology, and I am convinced that the technology that I saw is not going to damage the environment.

The CHAIRMAN. Senator Bingaman.

Senator BINGAMAN. I have no questions, Mr. Chairman.

The CHAIRMAN. I just would like to say to both of you and for the record here, while you are still here, I think we do have in Canada an opportunity to learn so that we will not make as many mistakes up front as we might otherwise, and also with reference to the value of this being public land as compared with private ownership in terms of accessibility and control over leases and the like, it turned out to be a big positive up there. But they have taught us a few things in the few moments we have spent with them that we ought to take a look at.

Senator HATCH. I agree with that.

Senator ALLARD. I think that is important, Mr. Chairman. Again, I would just remind you that when this was set up, it was never designed—when we had the transfer from the Naval Oil Shale over to the BLM management, it was never intended that we preclude the ability to go ahead and develop those resources if technology was made available.

Senator HATCH. I might add that in eastern Utah, it would uplift that economy tremendously. I think people really want to develop these natural resources, and they want to do it not just for the betterment of our country, but for the betterment of their economy in that area as well.

The CHAIRMAN. Well, I want to thank you both. I also want to tell you, without you having to spend a lot of time—and your staff and you will because it is very important to your States—the one thing that is predominant in the Canadian experience is that they do not, up front, have a lot of government expenditure. To the contrary, they give a lot of tax benefits to involvement, but they did not have a plan to go out and spend a lot of money developing things. They left that up to companies that received the benefit through tax treatments and royalty treatments that I thought, in the brief discussions, we would need to look at for the tax committees. But I think it is a rather exciting approach. We will see if applies to shale. It applies clearly to tar sands. No question.

We thank you both.

Senator HATCH. Thank you, Mr. Chairman.

Senator ALLARD. Thank you, Mr. Chairman.

The CHAIRMAN. All right. Having said that, let me make my few remarks, and then I will yield to Senator Bingaman. I want to thank you, Senator Thomas, for coming today.

First, Congress has not passed comprehensive energy legislation since 1992, and it is the U.S. consumers, in my opinion, who are

paying for our failure to act. We are going to have to do something to show that we are seriously concerned about what is happening to our consumers and what is happening to our country's security by this growing dependence upon crude oil.

Over the last few weeks, Senator Bingaman and I have been working as hard as we can to try to draft the beginnings of a bill and the major portions of a bill so that we might move as rapidly as possible and have at least a significant portion of the bill that has been worked over by both sides and these two Senators and the legislative assistants of all the Senators. Hopefully, the bill is going to provide a comprehensive strategy to help produce more energy, conserve more, that moves us toward new, nonconventional energy sources, where we have the resources and technology to do so.

It is my intention to include language that would lead, hopefully, to the development of vast shale resources and tar sands in the United States. We have short notice on that, and we are clearly not going to hold up the bill until we learn everything about it, but we are going to do what we can from what we know.

There is no question in my mind that our Nation must, where economically and environmentally viable, maximize energy production as the outlook is not very bright for global oil prices falling at least dramatically very soon. In this country, we have a vast oil shale reserve. It is estimated to be 2 trillion barrels of oil from oil shale, and that is just an estimate, with nearly 80 percent on Federal lands. I expect that getting this oil is not going to be very easy. In fact, I expect that it is going to be very difficult, but I am very confident, that with the prices being what they are, that we will try to make it work. And I am hopeful that American companies will get more interested day by day than they have in the past 10 or 15 years.

We just had a brief meeting in the back room with the Canadian minister. He could not testify himself because of problems of comity that address his particular position in the country of Canada.

But today, believe it or not, Canada supplies more oil to the United States markets than any other country, and much of it comes from oil that is garnered from tar sands. Their experience up there in the north, which they have gained on this nonconventional oil source, is something that I think we could benefit from.

I note that in your State, Senator, there is also a very big inventory of this raw material, along with coal. You are very much like Alberta, in fact. You have both. You have all of those.

With the demand for energy increasing, the need for us to understand what it will take to encourage development of this resource is very important. Our witnesses today are going to share their perspectives on these challenges, and we thank those who are here to do that.

With that, I would yield to Senator Bingaman for his comments and then to you, Senator Thomas and Senator Salazar, and then we will proceed with the witnesses.

Senator Bingaman.

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

Senator BINGAMAN. Thanks very much, Mr. Chairman. Thanks for holding this hearing. Obviously, this is a very important issue. We do have a very large supply of oil shale and oil sands that we need to look to to see if we can develop these at a price that makes them competitive in the market today.

I do think the issue of technology development is absolutely crucial here, what point are we at in the development of the technology that will be needed to extract the oil from these resources, and then, of course, just the economics of producing oil from this source. Obviously, we are anxious to learn all we can about that and then try to understand whether there are incentives that we can provide that will encourage actual development in a way that is responsible and helps meet our energy needs.

Thank you very much for having the hearing.

The CHAIRMAN. Thank you, Senator.

Do either of the two Senators want to comment?

Senator Thomas, you are first. Senator Salazar, you follow.

**STATEMENT OF HON. CRAIG THOMAS, U.S. SENATOR  
FROM WYOMING**

Senator THOMAS. Thank you, Mr. Chairman. Very briefly, you all have covered I think where we are.

Certainly there is great potential in oil shale. Wyoming is in the triangle with Utah and Colorado and the opportunity there.

This, of course, was done some back in the 1970's, and there was quite an effort to do something with oil shale. It did not turn out to be economic at that time. Now I am anxious to hear whether the processes have changed, whether it is simply the values that are changed. But I think certainly we do need to go forward with this.

It is kind of interesting that DOE's oil gas research and development thing has been zeroed out, at a time when perhaps it is very useful.

I guess I would observe that in our last energy bill, we had a tremendous amount of financial incentive. I think it was something like \$30 billion over some time. That is not going to happen this time. I hope we have some incentives, but we are not going to be able to have that kind of money in there.

So it will be interesting to hear what the private sector feels in terms of making the kind of long-term investment that is going to be here. At the prices there are now, obviously it is a good deal. Whether those prices are going to be that way is another question.

So I am glad we are having this, Mr. Chairman, and I think it is one of the alternatives and one of the directions we need to be looking. It makes more sense that some of the kinds of sources that we talk about in my view. So thank you, sir.

The CHAIRMAN. Thank you.

Senator Salazar. I think before you came, Senator, Senator Al-lard was here. Did you catch him before he left?

**STATEMENT OF HON. KEN SALAZAR, U.S. SENATOR  
FROM COLORADO**

Senator SALAZAR. I caught him in the hallway.

Thank you very much, Senator Domenici. Let me just say, first of all, that there are a number of people from Colorado who we will hear from today, and I wanted to welcome them and I am sure we will all welcome them as a committee. But Russ George, a wonderful person from Garfield County, right in the heart of the oil shale capability in Colorado, will be here, as well as Jim Evans, who has worked on this issue for a very long time now, for some 30 years, and Steve Smith from The Wilderness Society, along with Steve Mut from Shell who has been working on the Mahogany Project. I just personally wanted to welcome them here as Coloradans.

I want to make one comment, Mr. Chairman, about oil shale because Colorado in the 1970's and the 1980's was probably at the focal point of the Nation in terms of the possibility of oil shale development. While times were good, it seemed that the Western Slope of Colorado and many rural communities were thriving on the potential for oil shale development only to end up in the mid-'80's, realizing that the billions of dollars that had been spent by private industry and by government ended up going nowhere. I still remember the unemployment rates in places like Mesa County, Garfield County, other counties on the west slope that went up to as high as 20 percent, as I recall, because we felt in Colorado that the rug had been taken out from under our feet as we were moving forward with oil shale development.

So as we look at the possibility of developing oil shale in the West, as part of the comprehensive energy package that Senator Domenici, Senator Bingaman, and the rest of this committee are working on, I would only urge some caution as we move forward. I believe that oil shale does create a potential opportunity and has great promise, but it is still a technology that needs to be tested to see how we can move forward with the development of oil shale.

So I would only say that as we move forward, hopefully we can recognize that the development of oil shale itself is not going to be the end all or all the answers that we need in this energy legislation, that it can be part of a much larger package. My hope is that we can move forward in a thoughtful process, more of a marathon as opposed to a sprint, in how we look at the development of this great energy resource in the West.

Thank you very much, Mr. Chairman.

The CHAIRMAN. Thank you, Senator.

Senator Murkowski, did you want to comment?

**STATEMENT OF HON. LISA MURKOWSKI, U.S. SENATOR  
FROM ALASKA**

Senator MURKOWSKI. Mr. Chairman, I just wanted to thank you for your ongoing series in the focus on different sources of energy. We have had some great briefings to this point in time. I am looking forward to the opportunity this morning to understanding a little bit more about the technology that is being utilized in the process as we derive significant quantities of oil from oil shale and oil sands. So just thank you to you, Mr. Chairman.

The CHAIRMAN. Thank you.

Senator Craig, do you want to comment? You are the last Senator here, and we will close the door after you.

**STATEMENT OF HON. LARRY E. CRAIG, U.S. SENATOR  
FROM IDAHO**

Senator CRAIG. Why do you not get your witnesses going? There is a lot more about this I need to know, but I am glad you are holding this hearing. I know it is critical, and these projects become more and more competitive. Let us get them on line and get them going.

The CHAIRMAN. Thank you.

We will get started now with the panel. Mr. Mark Maddox, Principal Deputy Assistant Secretary for Fossil Energy, Department of Energy; Dr. Ted Barna, Assistant Deputy Under Secretary of Defense for Nuclear, Biological, Chemical Technology. And then I guess we have another witness here that I did not catch, Tom Lonnie. Is that how you say it?

Mr. LONNIE. Yes.

The CHAIRMAN. Assistant Director for Lands and Minerals, Bureau of Land Management from the Department of the Interior.

I assume we are going to proceed, starting with you, Mr. Maddox. Would you please start? Remember the 5-minute rule. Please proceed.

**STATEMENT OF MARK MADDOX, PRINCIPAL DEPUTY ASSISTANT SECRETARY FOR FOSSIL ENERGY, DEPARTMENT OF ENERGY**

Mr. MADDOX. Mr. Chairman, members of the committee, thank you for the opportunity to testify on oil shale and its potential for increasing our Nation's energy security by mitigating our dependence on imported oil.

Our domestic total oil shale resource is more than 1.8 trillion barrels, with perhaps 100 billion to 200 billion barrels commercially viable, to play a significant role in meeting the Nation's future demand for liquid fuels.

With high oil and gas prices, industry has strong incentives to develop technologies that can bring shale oil and other non-conventional fuels into production on an economically and environmentally sound basis.

The Nation's oil shale resource is concentrated in pockets in Utah, Colorado, and Wyoming, and 80 percent of the nearly 2 trillion barrel resource is owned by the Federal Government. The resource is so large that even if only partially developed, it could deliver 2 million to 3 million barrels of oil per day for decades.

But in order to tap this enormous energy resource, industry must develop economically and environmentally sound technologies as we attempted to do at the oil interruptions and price shocks of the 1970's when the Federal Government encouraged the development of oil shale and other unconventional domestic resources. Those efforts were abandoned when both government and industry concluded that the world oil market could provide adequate supplies, reasonable prices, and sufficient excess capacity.

While the benefit of 2 million to 3 million additional barrels a day of secure domestic oil from shale is obvious, there are numerous challenges to development, including the attitude of the public, business investment considerations, and land access and usage and environmental concerns.

The shale oil development work of 30 years ago left a legacy of uncertainty for industry and the public, particularly the people living in the centers of development. The affected areas enjoyed a boom period during development, followed by a devastating bust, and has left them understandably wary. Nevertheless, they seem to be ready to support a new development effort, only with more planning and support for infrastructure and development.

The oil industry today is finding most of its attractive investment opportunities overseas, but as conventional oil plays become more difficult and conventional oil production peaks, industry is again looking to develop a higher cost resource such as shale oil. How long this process will take is an open question. The answer will depend on economics and the economics will be determined by projected oil price trends, tax rates, resource access, royalty regulations, permitting requirements, and the receptivity of State and local populations to development.

Looking down the list, it is clear the Federal Government and State governments have a large role to play in shale oil development. A key development concern will be the environmental impact of extracting oil from shale by using technologies to heat the rock either above or below ground. Despite the significant research and development concluded 20 to 30 years ago, the industry has not reached consensus on the best technology to use. Regardless of the process, there will be environmental impacts to land, water, and air as a result of shale oil operations.

Fortunately, we have a very successful model for the development of oil shale to broad production of over 1 million barrels per day of oil from Canada's Alberta oil sands, where production is expected to exceed 2 million barrels per day in 8 years.

Many parallels exist between shale oil and oil sands technologies, markets, and economics. We cannot be certain that oil shale economics will parallel those of Alberta tar sands, and there are important physical differences between oil sands and oil shale, and the extraction technology for one cannot directly be transferred to the other. But some comparisons suggest the domestic oil shale industry in some ways is similar to the Canadian oil sands industry of 30 years ago.

As part of its energy security goal, the Department is committed to improving energy security by developing technologies that foster a diverse supply of reliable, affordable, and environmentally sound energy and improve our mix of energy options. This prospect of adding 2 million to 3 million barrels of secure domestic oil to our Nation's energy supply for decades to come demands our attention. The Department will work to achieve this goal in support of the economic security of the United States, in line with our commitment to deliver results for the American taxpayer.

Mr. Chairman and members of the committee, this concludes my statement. I will be happy to answer questions. Thank you.

[The prepared statement of Mr. Maddox follows:]

PREPARED STATEMENT OF MARK MADDOX, PRINCIPAL DEPUTY ASSISTANT SECRETARY  
FOR FOSSIL ENERGY, DEPARTMENT OF ENERGY

Mr. Chairman, Members of the Committee, thank you for this opportunity to testify on oil shale and other non-conventional oils, and their potential role in elevating our Nation's energy security by mitigating our dependence on imported oil. U.S. en-

ergy security is important by virtue of the crucial role it plays in achieving economic security.

I would like to share with you today our thoughts on the oil shale resource in these areas—first, oil shale’s magnitude and potential; then, the history of past unsuccessful attempts to develop it; and, finally, barriers to development as they exist today. In addition, I will compare the prospects for oil shale with the commercial development experience of another non-conventional resource, Alberta’s vast oil sand resources.

Ensuring the present and future energy security of the United States is a primary goal of the Office of Fossil Energy, and we are committed to the President’s goal of elevating our energy security through increased economic domestic production. Domestic oil shale represents a resource of more than 1.8 trillion barrels and is a resource which if economic, could play a significant role in meeting the Nation’s strategic needs for more liquid fuels over the next several decades. We also have potential domestic sources of non-conventional liquid fuels such as the technologically mature but uneconomic Fischer-Tropsch coal liquefaction, recovery of stranded oil; undiscovered oil and other currently uneconomic resources. With high oil and gas prices, industry has strong incentives to develop technologies that will facilitate exploration of non-conventional domestic resources, and in fact there is evidence that they are doing so.

#### THE RESOURCE

The total U.S. oil shale resource is estimated to be 1.8 trillion barrels and is primarily concentrated in the Green River formation in northeastern Utah, northwestern Colorado, and southwestern Wyoming. Over 50% of the world’s oil shale resources are in this area, 80% of which are owned by the Federal government. It is estimated that over 400 billion barrels will be found in shale at concentrations greater than 30 gallons/ton. In 1980, the Office of Technology Assessment published *An Assessment of Oil Shale Technologies*, which estimated that between 189 and 315 billion barrels of oil would be recoverable from this high quality shale. Oil and Gas Journal, in its August 9th 2004 issue, suggested that 100 billion barrels of oil from domestic oil shale could be reclassified as proven reserves if the technology became commercially viable. Suffice it to say, if it were economic to even partially develop, the resource could sustain an industry of 2-3 million barrels per day for decades.

The factors that limit the development of oil shale have nothing to do with the potential quantity of the resource. Historically, oil shale production hasn’t been economic. The cost of production has been too high compared to the cost of producing from conventional resources. This problem has been compounded by the need to build an infrastructure to support oil shale and the cost of disposal of byproducts. Although the federal government attempted to make oil shale economic in the late 1970’s and early 1980’s, this effort was abandoned because shale oil production could not be sustained in the face of abundant and cheap conventional crude oil. This was true even though the government embarked on this effort at a time when oil prices were higher in real terms than they are today. The failure of the government’s efforts in the 1980’s was not due to the failure of the resource, the technology, or environmental problems; economically it was simply too expensive. Recently, however, industry has shown renewed interest and has begun committing resources.

#### WHAT IS THE COMMERCIAL HISTORY OF OIL SHALE IN THE UNITED STATES?

After the oil interruptions and price shocks of 1973-74, the Federal Government encouraged the development of unconventional domestic resources including oil shale. The Department of the Interior offered commercial leases for development in 1973. Bonus bids totaled \$450 million for four oil shale leases and industry began development. Economic incentives were later offered for oil shale development including a guaranteed price floor, and a production tax credit of \$3 per barrel. In total we estimate \$5 billion was invested in oil shale facilities beginning roughly in 1975. Major players at that time included Exxon, Shell, Mobil, Occidental, Atlantic Richfield, Chevron, and Unocal. In the early 1980’s these projects began to close and the last closed in 1992.

The consensus of the industry was that oil prices simply did not stay on a price path over the long term that would assure a reasonable return on investment for an unconventional crude oil. In addition, policy changes accompanying new administrations removed the subsidies for synthetic fuels. Witness the demise of the Synthetic Fuels Corporation, which was chartered during the Carter Administration but allowed to expire during the Reagan Administration. The oil price collapse of 1986 assured the end of the U.S. synthetic fuels industry.

The general impression left following the demise of the U.S. oil shale industry was very negative. During the boom period, the influx of workers into Western Colorado strained and ultimately overwhelmed the local infrastructure and housing, producing lasting socioeconomic effects. When the industry collapsed, the local towns were left with infrastructure in excess to their needs, shrunken property values and a tax base incapable of supporting the infrastructure.

It will be instructive to include a very brief description of the two basic oil shale extraction processes at this point.

#### HOW IS OIL PRODUCED FROM OIL SHALE?

Kerogen, a low grade form of immature oil, is extracted from oil shale in a process called "retorting", which requires heating of the rock to about 900 degrees Fahrenheit. Two generic methods of retorting have been developed:

- *In situ*: This method leaves the rock in place and injects a heat source that releases the oil from the kerogen. The shale oil then flows to a well and is pumped to the surface. The source of the heat is a technical issue still open to research and testing. The only active pilot project in the U.S., owned by Shell Oil, is using down hole electric resistance heaters, but optional technologies involve steam, microwaves, and fire.
- *Surface retorting*: This technology depends upon mined ore for a feedstock. The ore can be either surface mined or mined underground. The ore is brought to the surface, crushed and placed into a retort. The shale oil is removed and the spent shale sent for disposal. The shale oil is upgraded by the addition of hydrogen and then is conventionally refined to produce finished products. Several different retort designs have been constructed and tested in the United States as a part of earlier development efforts. However, there are currently no commercial surface retorts in the U.S. processing oil shale.

#### CHALLENGES TO COMMERCIALIZATION

*Perceived Risk*: Shale oil activities in the late 1970s and early 1980s have left a legacy of uncertainty. Members of industry and the citizenry alike are uncertain about the risks associated with commercial development.

*Current Oil Industry Economics*: U.S. domestic oil production is high cost compared to many parts of the world because our fields are mature and declining. Private investment dollars are directed to the most economic areas where costs of production are low, like West Africa, Brazil, the Middle East, Russia and Central Asia. As long as current geopolitical and market conditions persist, we expect more money to flow to energy extraction on a world wide basis; however, not a large share of it is expected to be invested in the United States in the immediate future. As conventional oil plays become more difficult to find, and as conventional domestic oil production peaks, industry will again begin to focus on the development of the resources that can be extracted profitably at higher prices, including oil shale.

Prospects for commercial oil shale production will depend on the private sector's perception of the relative profitability of oil shale versus competing resources. Factors that will determine economics are projected oil price trends, tax rates, cost of production, resource access, royalty regulations, permitting requirements, cost of by-product disposal, and the willingness of the state and local populations to host a new industry.

The size of the industry will be limited by existing distribution, pipeline capacity, water availability, power distribution and refining capacity in this region of the Rocky Mountains. If the oil shale industry develops to any appreciable size, investments will be required to expand the limited infrastructure.

*Land Access and Usage*: A major driver of shale oil extraction economics is the concentration of the resource. Movement of ore to the retort can be very expensive, because the ore is mostly rock with only a little oil (more than one ton of ore per barrel of oil). Therefore, the ore must be processed at or near the geologic formation where it is found. While the natural resource is very concentrated in Colorado, Utah and Wyoming, the ownership is not. The Federal Government owns 80 percent of the resource base, and the remaining tracts are broken up. At this time the Department of the Interior does not have a commercial leasing program, although it recently solicited comments on a leasing program for research and development.

*Environmental Impact*: The environmental impacts of shale oil development are significant. Like the resource, they will primarily be concentrated in small geographic locations. Because oil shale is mined, there are surface impacts. Oil shale production is water intensive, which is an important limited resource in the regions with oil shale deposits. Because the retorting processes are energy intensive, there are combustion emissions in areas where the air is currently very clean. The mining

or in-situ technologies may also disturb the local water tables. In the case of the in-situ technology, the spent shale in place may contain toxins that need to be kept away from ground water. In the case of surface retorting, the spent shale, processing water, and other byproducts must be disposed of in a safe manner. How to do that on a massive scale has not been defined. To produce a million barrels of oil would require disposal of more than a million tons of byproducts. Finally, because shale oil production is energy intensive, the industry could add significantly to green house gas emissions during production. Similarly, greenhouse gas emissions will be released when the fuel is consumed.

The positive aspect of the resource is that its density is so great that the environmental impacts can be restricted to a relatively small area within two or three states.

*Extraction Technology:* Despite the significant research and development conducted 20-30 years ago, there is no accepted benchmark for the best technology to use. Furthermore, because of modern developments in environmental appreciation and resource conservation, it will be important for the existing technologies to improve from an efficiency, and environmental impacts perspective. Companies will have to advance extraction technologies through research development, and demonstration.

#### COMPARISON WITH ALBERTA OIL SAND COMMERCIALIZATION

Commercial production from formerly uneconomic resources occurs as markets change and drive technology development. Oil from Alberta oil sand, once considered to be an unconventional resource, is being commercially produced today. Oil was first produced at a commercial scale from Alberta oil sand more than 35 years ago. Today, oil sand production is over one million barrels per day and is expected to exceed 2 million barrels per day within the next eight years. A strong partnership between government and industry stimulated more than \$65 billion in private investment to accelerate development and achieve industry scale operations during this decade.

Like oil sands, U.S. oil shale is rich, accessible, geographically concentrated, and well defined. However, the technologies required for exploitation of oil shale are very different from those required for oil sands. The richness of the respective resources are similar, with oil sands yielding approximately 25 gallons per ton of bitumen while some oil shale deposits yield an average of about 30 gallons per ton. A comparison of the qualities of the two oils shows them to produce a similar product after processing. The Athabasca sand produces 34 degree API oil and the oil shale produces 38 degree API oil. However, there are important physical differences between oil sands and oil shale and the extraction technology for one cannot directly be transferred to the other.

#### SUMMARY

In summary, we need to examine all of our resource bases if we are to do a credible job in protecting the United States energy security interests. As part of its energy security goal, the Department is committed to improving energy security by developing technologies that foster a diverse supply of reliable, affordable, and environmentally sound energy and improve our mix of energy options. The Department will work to achieve this goal in support of the economic security of the United States, in line with our commitment to deliver results for the American taxpayer. Mr. Chairman, and members of the Committee, this concludes my prepared statement. I will be happy to answer any questions you may have at this time.

The CHAIRMAN. Thank you very much.

Let us proceed now with Dr. Ted Barna, and then we will come to the Interior Department.

#### **STATEMENT OF DR. THEODORE K. BARNA, ASSISTANT DEPUTY UNDER SECRETARY OF DEFENSE, ADVANCED SYSTEMS AND CONCEPTS, DEPARTMENT OF DEFENSE**

Dr. BARNA. Mr. Chairman and members of the committee, I am Dr. Ted Barna. I am Assistant Deputy Under Secretary of Defense, Advanced Systems and Concepts. I thank you for the invitation today to appear and discuss opportunities to advance the tech-

nology that will facilitate environmentally friendly development of oil shale and oil sands resources for the Department of Defense.

I would like to preface my remarks by highlighting DOD involvement thus far. In 2003, I was asked to manage a program, originated by Senator Inhofe of Oklahoma, to research synthetic fuels produced via the Fischer Tropsch process. I initiated a joint program with the Army's National Automotive Center in Detroit to investigate the military use of these fuels and evaluate the potential of producing and using a new generation of clean fuels for the military.

The Army formed a collaborative program with the Air Force Research Lab in Ohio, the Naval Air Systems Command, the Department of Energy National Technology Lab, as well as the Southwest Research Institute, San Antonio, several universities and industry, to conduct preliminary evaluation of the technological potential of these fuels for use in aircraft, tactical vehicles and ships. This effort did not address the economics of using clean fuels for the military or whether or not it is ever likely that commercial scale production by the private sector will occur.

The research, though, did provide me with exciting results since fuel made via this process produces lower pollutant emissions from diesel engines, reduces particulate emissions from jet engines, has superior high temperature and low temperature characteristics, and provides improved storage characteristics on Navy ships. Even the use of clean fuel blends, designed to counter problems like lubricity and seal swell, provide significant—by that, I mean about 50 percent—reduction in tailpipe emissions.

So based on this earlier work, in 2004 I have expanded this initial effort into a wider variety of resources for the production of clean fuels, notably oil shale, oil sands, coal, biomass, renewables, and petroleum coke, by looking at the broader picture of alternative fuels. And I established a clean fuels initiative. This program looks at the total energy picture.

So that is where we stand in DOD, Mr. Chairman. I look forward to working with you and members of the committee as we pursue our mission of providing energy security. And I would be more than happy to answer any questions. Thank you.

The CHAIRMAN. Mr. Lonnie from the Interior Department.

**STATEMENT OF THOMAS LONNIE, ASSISTANT DIRECTOR FOR MINERALS, REALTY & RESOURCE PROTECTION, BUREAU OF LAND MANAGEMENT, DEPARTMENT OF THE INTERIOR**

Mr. LONNIE. Mr. Chairman and members of the committee, thank you for the opportunity to appear here today to discuss the Bureau of Land Management's efforts to facilitate and promote oil shale research and development on public lands.

America faces an energy challenge.

For a considerable time, many have believed that oil shale has the potential to be a major source of domestic energy production, especially since it is suited for refinement as jet fuel for the military and the airline industry. Recently the BLM, which has the authority to issue leases for oil shale under the Mineral Leasing Act and to receive rental payments and royalties, has received expressions of interest from industry for conducting research and develop-

ment projects, particularly on public lands in the Green River formation in the tri-State area of Colorado, Utah, and Wyoming. It is the BLM's hope that renewed interest in oil shale research and development efforts will lead to environmentally responsible ways of unlocking the vast oil shale resources contained in the United States, potentially helping to reduce the imbalance in domestic energy consumption and production that currently exists in this country.

The current BLM efforts. The President's National Energy Policy outlined a number of recommendations to diversify and increase energy supplies, encourage conservation, and ensure environmentally responsible production and distribution of energy. In response, the BLM developed a plan containing 54 tasks designed to implement the President's directives, including efforts to promote the development of oil shale resources on the public lands. To carry out this task in an environmentally responsible manner, in keeping with our multiple-use mandate, the BLM established its own Oil Shale Task Force.

The Oil Shale Task Force was established to, one, address access to unconventional resources, such as oil shale, on public lands; two, to address impediments to oil shale development on public lands; three, assess industry interest in research and development and commercial development opportunities; and finally, provide the Secretary with options to capitalize on opportunities. The task force has prepared a draft report containing recommendations on designing an oil shale leasing program that will make public lands available to industry to conduct research and development activities and determine if Federal oil shale resources can be developed economically and in an environmentally responsible manner.

In addition, on November 22, 2004, the BLM published a proposed oil shale lease form and request for information in the Federal Register to solicit comments and suggestions from interested parties about the design of the oil shale leasing program. The BLM is now reviewing the comments it received. The draft report recommendations and BLM's analysis of the responsive comments to the Federal Register notice form the basis of policy options the Department is now considering for making lands available for oil shale research and development projects and subsequent commercial operations, all in support of the President's National Energy Policy.

Thank you for the opportunity to testify today about the BLM's oil shale development efforts. I would be happy to answer any questions you may have.

[The prepared statement of Mr. Lonnie follows:]

PREPARED STATEMENT OF THOMAS LONNIE, ASSISTANT DIRECTOR FOR MINERALS, REALTY & RESOURCE PROTECTION, BUREAU OF LAND MANAGEMENT, DEPARTMENT OF THE INTERIOR

Mr. Chairman and Members of the Committee, thank you for the opportunity to appear here today to discuss the Bureau of Land Management's (BLM) efforts to facilitate and promote oil shale research and development on public lands.

America faces an energy challenge. As recently as April 5, 2005, Federal Reserve Chairman Alan Greenspan commented extensively on this challenge. He stated,

"Markets for oil and natural gas have been subject to a degree of strain over the past year not experienced for a generation. Increased demand and lagging additions to productive capacity have combined to absorb a significant amount

of the slack in energy markets that was essential in containing energy prices between 1985 and 2000.”

For a considerable time, many have believed that oil shale has the potential to be a major source of domestic energy production, especially since it is suited for refinement as jet fuel for the military and the airline industry. Recently, the BLM, which has the authority to issue leases for oil shale under the Mineral Leasing Act and to receive rental payments and royalties, has received expressions of interest from industry for conducting research and development projects on public lands in the Green River Formation in the tri-state area of Colorado, Utah and Wyoming. It is BLM's hope that renewed interest in oil shale research and development efforts will lead to environmentally responsible ways of unlocking the vast oil shale resources contained in the United States, and presents a potential means of helping to reduce the imbalance in domestic energy consumption and production that currently exists in this country.

#### BACKGROUND

Oil shale is a type of rock formation that contains large concentrations of combustible organic matter. When processed, oil shale can yield significant quantities of shale oil. Various methods of processing oil shale to remove the oil have been developed. A common element among those methods is the use of heat to separate out the oil from the rock.

The United States has significant oil shale resources, primarily within the Green River Formation in Wyoming, Utah and Colorado. These oil shale resources underlie a total area of 16,000 square miles and represent the largest known concentration of oil shale in the world. Federal lands comprise roughly 72% of the total oil shale acreage in the Green River Formation.

In the latter years of World War II, several tests were conducted to determine the economic viability of oil shale extraction technologies. However, in the years following World War II, petroleum producers looked to more easily accessible and economically viable supplies and interest in oil shale extraction declined. More recently, during the mid 1970s through the late 1980s, the Department of the Interior and the BLM made oil shale resources on public lands available through the Oil Shale Prototype Program, which was designed to allow companies to develop and refine the technology for extracting oil from oil shale. Additionally, in the 1980's, the U.S. Geological Survey (USGS) had an active oil shale mapping program, which mapped the major oil shale fields of the United States and conducted geological research on the Green River deposits. The USGS also conducted mineralogical and geochemical studies aimed toward characterizing oil shale for the commercialization of this resource.

Precipitated by the oil price spikes of the early 1970s, companies showed significant interest in exploring domestic oil shale development. Previous oil shale research showed some promise from a technological standpoint, but the extraction process was energy-intensive and costly. Through a series of experiments, industry attempted to extract shale oil from oil shale rock, but the easing and subsequent collapse in petroleum prices led the companies to conclude their efforts to extract oil from oil shale were not economically viable. The participants in the Oil Shale Prototype Program withdrew from their research efforts before the BLM could promulgate permanent regulations for oil shale leasing and operation. As a result, BLM currently has no regulations for oil shale leasing, and no oil shale leasing program.

Most USGS activities related to this commodity have also diminished significantly. However, since the latter half of the 1980s, the USGS has maintained a small effort in oil shale studies, both domestically and abroad, which included evaluation of world oil shale resources and a cooperative effort funded by the Department of Energy to create a National Oil Shale Database, in which shale oil analyses and other data were entered and compiled. With the recognition that oil shale is a potentially important domestic fossil energy resource, the USGS has continued in these efforts to the present day. Although no national oil shale assessment has been done, there have been USGS oil shale resource studies done on a local or regional scale. One example of this is "Thickness, oil-yield, and kriged resource estimates for the Eocene Green River Formation, Piceance Creek basin, Colorado" USGS Oil and Gas Investigations Chart OC-132. Another example is USGS Open-File Report 91-0285 "Oil-Shale Resources of the Mahogany Zone in eastern Uinta Basin, Uintah County, Utah." USGS is currently working with the State of Utah to evaluate all oil shale lands in eastern Uinta Basin, compiling, among other things, geologic maps, cross sections, geophysical and lithologic logs, and drill hole information.

Elsewhere in the world, continuing efforts have resulted in the successful development of oil shale resources. For example, in Gladstone, Queensland, Australia, there

is a large-scale demonstration project where, from June 2001 through March 2003, 703,000 barrels of oil, 62,860 barrels of light fuel oil, and 88,040 barrels of ultra-low sulphur naphtha were produced from oil shale. In January 2003 alone, the operation produced 79,000 barrels of oil. Significant oil shale reserves also exist in the Republic of Estonia, where active oil shale deposits amount to about 1,200 million tons and, at current levels of consumption, are forecast to last one hundred years.

#### CURRENT BLM EFFORTS

The President's National Energy Policy outlined a number of recommendations to diversify and increase energy supplies, encourage conservation, and ensure environmentally responsible production and distribution of energy. In response, the BLM developed a plan containing 54 tasks designed to implement the President's directives, including efforts to promote the development of oil shale resources on the public lands. To carry out this task in an environmentally responsible manner in keeping with our multiple-use mandate, the BLM established its own Oil Shale Task Force.

The Oil Shale Task Force was established to address: 1) access to unconventional resources (such as oil shale) on public lands; 2) impediments to oil shale development on public lands; 3) industry interest in research and development and commercial development opportunities on the public lands; and 4) Secretarial options to capitalize on the opportunities. The Task Force has prepared a report, which is currently under review within the Department, concerning the development of oil shale resources on Federal lands in order to determine whether technological advances have reached the point where it is possible to those resources economically and in an environmentally responsible manner.

In addition, on November 22, 2004, the BLM published a proposed oil shale lease form and request for information in the Federal Register to solicit comments and suggestions from interested parties about the design of the oil shale leasing program. The BLM is now reviewing the comments it received. The report recommendations and BLM's analysis of the responsive comments to the Federal Register notice form the basis of policy options the Department is now considering for making lands available for oil shale research and development projects and subsequent commercial operation, all in support of the President's National Energy Policy.

#### CONCLUSION

Thank you for the opportunity to testify today about the BLM's Oil Shale Development efforts. I would be happy to answer any questions you have.

The CHAIRMAN. Thank you very much.

Well, let me say to you, first, Mr. Maddox, and then I will proceed with the others, I do not know why I gather from reading your testimony that you are not very enthused about moving ahead with oil shale from the standpoint of the Federal Government's activities. Are you or are you not?

Mr. MADDUX. We are enthused about this resource and would very much like to see it come on line and be produced.

The CHAIRMAN. So your testimony is not intended to be any different than this Strategic Significance of American Oil Shale which you have issued under date of March 14? Your testimony is not in any way intended to be inconsistent with this?

Mr. MADDUX. I am not familiar with that document, so I could not comment on that document.

The CHAIRMAN. What is your name?

Mr. MADDUX. Mark Maddox.

The CHAIRMAN. Well, this says Mark Maddox.

Mr. MADDUX. I am vaguely familiar with it. No, I am not intending to be counter to that. However, I am trying to make certain that the committee has a full picture of the challenges to development. I think that is probably the point of my testimony.

The CHAIRMAN. Let me ask all three of you. Have any of you tried to evaluate and look at in any detail how the Canadian pro-

gram is working and what are the significant features that made it workable?

Mr. LONNIE. I have not, Senator.

The CHAIRMAN. How about you, Mr. Maddox?

Mr. MADDOX. I have looked at it generally but not in detail.

The CHAIRMAN. How about you, Mr. Barna?

Dr. BARNA. No, I have not.

The CHAIRMAN. Well, who do you think would be doing that if you are not?

Mr. MADDOX. I have asked my staff to look at it. I can speak to it in general terms. One of the hallmarks was the Province of Alberta took very close ownership of this resource and actually became an equity owner in the resource and its development. So that was probably the single biggest factor, that they actually were partners in literally every sense of the word.

The CHAIRMAN. Do any of you have any other observations on that? None?

Well, I would say, Mr. Maddox, my brief encounter with it would say that was one part, but the most significant thing was tax policy that affected the companies that were making these major investments, without which it would have been very risky for them to do that. I wonder if we might ask if your Department could look at the Canadian plan in some detail and report to us, as soon as possible, what you think about their ideas.

Mr. MADDOX. We would be happy to, Senator.

[The information follows:]

The Canadian government provides the following tax treatments for development of oil sands within the general Canadian corporate income tax code:

Exploration expenses are treated as fully deductible in the year they are incurred. For this purpose the pre-production development costs for mines are treated as exploration expenses.

Development expenses are deductible at the rate of 30 percent per year. Property costs are deductible at the rate of 30 percent per year.

A resource depletion allowance is provided equal to 25 percent of net income before interest, exploration, property and development costs.

The depreciation schedule for most machinery and equipment is 25 percent of the declining balance.

An accelerated capital cost allowance: Certain eligible capital expenditures for new mines or major expansions and capital costs exceeding 5 percent of gross project revenue may be deducted to the extent of income from a particular mine.

In sum, these tax incentives, plus the equity position taken by the Alberta Government in Suncor, and a liberal leasing policy for resource access have served to preserve and stimulate a commercial Canadian oil sands industry. While the Canadian experience with incentives provides us with insights on the potential to stimulate oil shale production, any specific tax proposal would require scrutiny by the Department of Treasury, the Department of Energy, the Office of Management and Budget and possibly other agencies of government to determine its effectiveness as an incentive, its impact on competition and its impact on government revenues, all within the context of our existing tax code.

The CHAIRMAN. As chairman of this committee and as a member of this committee, if we were to ask about tax policies as it refers to the development of either tar sands or shale in the United States, would that question be asked of you, OMB, or the Treasury Department, or where would we get the information?

Mr. MADDOX. Probably a combination of the three, but I would assume eventually OMB would play into the mix, as well as Treasury.

The CHAIRMAN. Let me suggest right off that I am quite convinced that unless there is a major tax change with reference to the investment, that we are not going to get a significant involvement unless we choose to invest huge amounts of money in some kind of a demonstration project wherein the Federal Government puts the money in. I think Canada explored that and decided not to do that. It decided to do it with a series of expeditious write-offs and the like with reference to the major investments that were made and an alteration in the royalty policy so as to capture more at the end rather than at the beginning and give incentives, depending upon what you invested and what you produced.

In any event, let me move to the environment, again, with you, Mr. Maddox. You outline a series of environmental issues that are significant to overcome. You included a comparison with Alberta oil shale. I think you would agree that the principal similarities are that at one time both resources were considered uneconomic as unconventional resources. Is that correct?

Mr. MADDOX. That is correct.

The CHAIRMAN. The oil sands succeeded due largely to a strong effort on the part of that province to move ahead and getting some significant tax assistance. Is that correct? Forget the tax part. But they made a real serious—

Mr. MADDOX. Very much so. They embraced their resource and made a commitment to developing it, yes.

The CHAIRMAN. Is it possible that the Government of the United States can move, together with industry, to develop a similar emphasis with reference to shale? And is that currently the status of things?

Mr. MADDOX. It is very possible. The administration is reviewing its options on how to support this industry. I know there is a great deal of interest at very senior levels in how it is we bring this oil shale to market.

The CHAIRMAN. Now, what does that mean, at very senior levels? I mean, we thought we had senior levels here.

Mr. MADDOX. Well, as you know, there is a large policy process at the White House and at DOE, and I think everyone is engaged in it in trying to figure out how best to support this industry.

The CHAIRMAN. I will yield now to Senator Bingaman.

Senator BINGAMAN. Thank you very much, Mr. Chairman.

As I understand it, we are all, I guess, in agreement that the economics of producing oil from this resource is going to ultimately determine whether or not it is done. But in determining whether the economics work, obviously the technology that is used is absolutely essential.

I am concerned that as I read the President's budget request to us, there is absolutely nothing requested for the Department of Energy to pursue the technology development in this area. Maybe I am missing something, but the only thing I found in your budget request is under petroleum oil technology, and I assume that is all oil and gas-related activity. You have asked for an over 70 percent cut from current year's levels, and there is nothing I can find that relates to oil shale or oil sands or anything like that. Am I missing something, Mr. Maddox, or is it the judgment of the Department of Energy that this is not worth investing taxpayer dollars in?

Mr. MADDOX. I think the sense of the budget was that at current price levels, there is adequate private sector capital to go forward on commercially viable projects, and that was the basis for developing the budget.

Senator BINGAMAN. So this is R&D that, if it makes sense to do it, it ought to be done by the private sector is basically your position.

Mr. MADDOX. I think that is the general belief, that industry is better able to assess its potential opportunities and invest accordingly.

Senator BINGAMAN. Well, let me just give you my perspective, which is that we have some very capable Department of Energy laboratories around this country. Some of them are focused directly on energy issues and others are certainly active in those areas. My own view is that the private sector suffers somewhat the same problem that those of us in politics suffer from, and that is we have a short planning horizon. We are not able to look long-term as well as we should, and that is one reason why Government support for research and development, particularly long-term research and development, makes so much sense.

I am just disappointed that we do not have a commitment to have some of our capable scientists and engineers in the public sector in these DOE national laboratories working on this issue. It would seem to me to make a lot of sense if there is any potential there. If there is not any potential, obviously they should not be fooling with it.

What is your reaction to that, Mr. Maddox?

Mr. MADDOX. I think you have a great deal of legitimacy in your comments. As I think Secretary Bodman testified in various committees, there have been a lot of budget constraints this year, and unfortunately, oil and gas research is not the priority based on some of the private sector activities and the relative wealth they are feeling right now.

Senator BINGAMAN. Well, I know when Secretary Bodman was here testifying on the budget, he made the point that the high prices of gas were adequate justification for the cutbacks in Federal support for research and development in the oil and gas sector. I would think that this is a sufficiently challenging area, though, the technology in this area, that it is not realistic to just think that every oil and gas company would be willing to take on the job of developing the new technologies that are going to be needed to pursue this because this is a resource that is not currently under lease, as I understand it, and it will never be under lease unless the technology is developed that will make it economic to develop it in the eyes of industry. Am I right in that thinking?

Mr. MADDOX. I will defer to Mr. Lonnie on the leasing questions. But I would argue that clearly you look at our next set of testifiers, at least one private sector company who is involved in this research now. I think that a lot of issues need to be explored, including what the appropriate leasing structure is, and I think BLM is doing a good job right now putting out feelers on what it is industry needs to move forward on this. But it goes hand in hand. Research dollars will flow in the corporate sector to places where they think

there is a likelihood that they can actually apply this research. So it has got to be a complete package.

Senator BINGAMAN. Mr. Lonnie, let me ask you. As I understand it, the Department of the Interior did have two previous instances where they tried to lease. One was during the 1960's. The other was a Federal prototype oil shale leasing program established in the 1970's. Could you tell us what went wrong in those circumstances or what the experience was in those cases? Do you think there is a demand out there? Are there companies that are contacting you saying we want to lease this land for development of this resource?

Mr. LONNIE. Senator, many companies have contacted us indicating they have an interest in access to the Federal oil shale resource, particularly in the Green River formation in the tri-State area that I mentioned in my oral testimony.

In terms of what occurred earlier in the oil shale program, I think what has been identified is that the volatile prices that occurred during the 1970's and early 1980's required that companies pull out of that program at the time.

In terms of what we received in more or less broad terms from the comments we received on the R&D proposal that we put out in the Federal Register back in November, we received 32 different commenters submitting comments, and the vast majority, well over 90 percent, were very positive about R&D availability of the Federal resource for research and development. That included in situ, as well as mining and retorting, which basically was what was occurring in the 1970's and early 1980's.

Broad comments associated with incentives. Most commenters indicated that royalties should not be applied during at least the research and development phase.

Senator BINGAMAN. Mr. Chairman, maybe my eyesight has given out on me, but I cannot see the lights down there anymore. Is my time up?

Senator THOMAS. Yes.

[Laughter.]

Senator BINGAMAN. Senator Thomas evidently can see the lights. So I will go ahead and quit. Thank you.

The CHAIRMAN. The reason they are not on is you passed up your time and the light went out.

[Laughter.]

The CHAIRMAN. No. They never were on. I am sorry, Senator.

Now, we are going to proceed. Let us see. Senator Thomas, you are next.

Senator THOMAS. I really did not mean to get into that one, Senator.

Mr. Barna, you mentioned wanting a clean fuel. Were you exploring a clean fuel where there was not any production?

Dr. BARNA. We had limited production going on in the United States, and we used that fuel to—

Senator THOMAS. When? When was that?

Dr. BARNA. Starting in 2003, sir.

Senator THOMAS. Where is the production?

Dr. BARNA. It is in Syntroleum Corporation in Tulsa, Oklahoma. It is a plant that was developed by DOE to make clean fuel. That

particular plant makes it from natural gas, although it can be made from—

Senator THOMAS. But were they using oil from shale?

Dr. BARNA. No, they were not at that time. Our initial involvement was just looking at clean fuels, and then we have now expanded to look at all fuels.

Senator THOMAS. Oh, I guess I did not quite understand what your role was here.

Why have these resources not been brought forward before in the Department in terms of looking for new sources? Mark, yes.

Mr. MADDOX. I think the issue has been the commercial viability of the project. One of the issues from a commercial standpoint is not just profitability, but the return on investment rate, and you need a high price in the \$40 to \$50 range to really make this commercially viable. It is not just enough to make profit. I mean, if you make 10 cents, it is not enough for a company to go back and justify to their shareholders. So I think the belief that prices would not support a profitable venture or a commercially viable venture has been a pretty large barrier to people looking at this resource.

Senator THOMAS. Are we pretty well persuaded that this \$50-plus price is there forever?

Mr. MADDOX. I do not know if the industry is ready to concede that. I know most companies are still looking from a planning number in the 20's somewhere, so I do not know if that price confidence is there at this time.

Senator THOMAS. Mr. Lonnie, the policy of the BLM has been to restrict the size of leases. As I understand, that has been something that the shale people are concerned about. Have you done any thinking about that?

Mr. LONNIE. Under the R&D proposal that was in the Federal Register, we solicited comment on lease size, at least for the research and development leases. The comments that we got ranged from 40 acres would be enough for an R&D lease all the way to we need at least 1,200 acres for R&D. The Mineral Leasing Act, the statute, only allows up to a 5,120-acre lease. So anything beyond that would require legislation.

Senator THOMAS. Some of the private folks believe that it should be beyond that. Is that correct?

Mr. LONNIE. For commercial operations, that is what we have been told.

Senator THOMAS. What do you think, Mr. Maddox, is necessary to provide the necessary incentive for the private sector?

Mr. MADDOX. Kind of referencing back to my earlier discussion, I think probably the industry needs to know they are going to have access to the resources in a timely manner. R&D does not make sense if you cannot apply it, and there has got to be confidence that you can apply your R&D and your technology once you develop it. I think you need access to land in order to test your technology, which is the path BLM is pursuing right now.

Senator THOMAS. Thank you, Mr. Chairman.

The CHAIRMAN. Let us go to Senator Salazar. Thank you, Senator, for coming.

Senator SALAZAR. Thank you, Senator Domenici.

Let me just say from my point of view I think this committee is doing the right thing in terms of having oil shale on the radar screen of our country as a potential avenue to help us deal with our over-dependence on foreign oil and the rest of the energy crisis that we are dealing with.

I will tell you, frankly, I am somewhat disappointed, Mr. Maddox, that the Department of Energy is not coming before this committee saying this is our program and our effort with respect to oil shale development, whatever that might be. It seems to me you are still very much in the development phase, and I think what you are going to see from this committee is action and moving forward with an energy bill. I think oil shale will be a part of that in some way.

Let me ask a question of Mr. Lonnie, because so many of these resources are located on our public lands, two questions. One is the comments that you received concerning the BLM oil shale leasing program that you asked for in the November Federal Register, if you could summarize what those comments have been back to the BLM and the Department of the Interior, I would appreciate that, No. 1.

No. 2, Senator Domenici has requested a \$2 million appropriation for the oil shale leasing program. If that gets approved by the Congress, what will that do then with respect to the BLM moving forward? What capacity will that allow you to develop? How will you use the \$2 million that Senator Domenici has suggested be given to the BLM for this purpose?

Mr. LONNIE. Thank you. Let me summarize the comments. As I have mentioned, actually 32 different individuals or entities commented on the proposed regulations. What that included was a lease form and then how should we go forward with research and development leases and opportunities for access.

The main areas of comment were lease size, lease duration, royalty amounts, including bonus bid amounts, research and development transition to commercial operations. Let me just give you the general scale of the comments.

As I mentioned earlier, lease size ranged from 40 acres to 1,250. This is just research and development component of it.

In terms of duration, it was anywhere from 30 months to 20 years for R&D leases. There were concerns expressed associated with duration from the standpoint of speculation and requiring some diligence associated with the R&D. Some of those comments dealing with lessees should be required to submit a plan of operations that the BLM would approve and review and then monitor to assure that a particular lessee was continuing research and development at an approved rate.

Royalty amounts. Most commenters said that royalties should not be charged for at least the first 5 years of a research and development lease, that to charge a royalty would be a disincentive.

Rental was identified in the same way, but similar to the statute that limits the size of an oil shale lease from the standpoint of commercial development, the statute also requires a 50 cent rental payment per acre. So the BLM would not have discretion there.

In terms of R&D to commercial transition—

Senator SALAZAR. If you could get us a summary of those comments, that would be, I am sure, appreciated certainly by me and

I think by members of the committee, if we could just get a summary.

Speak briefly to my second question, that is the \$2 million appropriation request from Senator Domenici. How would the BLM intend to use those dollars if they are, in fact, appropriated by Congress?

Mr. LONNIE. Well, depending on the final decision of the Secretary in terms of reviewing the options that she has to go forward with, R&D leasing, based on the comments we received in the Federal Register notice, also based on the draft report that was completed by the Oil Shale Task Force, I think that how additional funding for oil shale could be used would range from a speedier approach to making oil shale available, or we have identified that some additional alignment or analysis in terms of the National Environmental Policy Act will have to be completed. So those would be two potential areas, I would assume.

Senator SALAZAR. Dr. Barna, if I can ask you this question. In terms of the difference between the successful effort in Canada concerning the development of the oil sands and the recovery effort there of oil shale, can you describe to us, in a very general way, what the differences are with respect to the two kinds of resources that we are looking at here?

Dr. BARNA. Well, from DOD's perspective, we are looking at shale oil primarily as a jet fuel. We have a lot experience with that from back in the 1970's when it started and then fell apart, and we are using that.

Also, you are going to hear from Shell Oil Company here later on. They are also shipping us some of their fuel that they got from the Shell project in Mahogany sands. So we can do further testing for DOD so that if and when these become available, we are ready to use them as a source of fuel for us.

Senator SALAZAR. Do you have any preliminary sense of how those fuels are working for you that you have gotten from the Mahogany project?

Dr. BARNA. We have not actually gotten them from the Mahogany project. The ones that we got earlier, I understand, were excellent jet fuels.

Senator SALAZAR. Thank you, Mr. Chairman.

The CHAIRMAN. Thank you very much, Senator.

Senator Murkowski, then Senators Craig, Burns, and Burr.

Senator MURKOWSKI. Thank you, Mr. Chairman.

Mr. Lonnie, this is a question directed to you. In reviewing your testimony, you were talking about trying to determine what is it that we have, and I have always been fascinated that we do a lousy job with our natural resources in terms of inventorying them. As I understand, you have done regional assessments of the areas that have potential for oil shale, but you have not done a national assessment. Is that correct?

Mr. LONNIE. Was that question directed at me?

Senator MURKOWSKI. Yes.

Mr. LONNIE. No, we have not done a national assessment in the BLM.

Senator MURKOWSKI. So how do we know what it is that we have?

Mr. LONNIE. Well, I think there are estimates the Department of Energy has put together in terms of total resources.

Senator MURKOWSKI. Okay. Maybe my question is directed to the wrong person then. Mr. Maddox, can you help me out?

Mr. MADDOX. Total resources?

Senator MURKOWSKI. Do we have a national assessment of the oil shale and the potential here in this country?

Mr. MADDOX. Yes. We are estimating about 1.8 trillion based on an early 1980's assessment and approximately 300 billion available that has the right depth and formations to be relatively easily and economically available, which is significant by any standard.

Senator MURKOWSKI. I guess I was getting this from your testimony, Mr. Lonnie, about the national oil shale data base and the national oil shale assessment. So that was why I directed it to you. So I do not know whether it was an issue on BLM lands or not.

Mr. Maddox, you are telling me that we, in fact, do have analysis that comes to us from the early 1980's on a national level.

Mr. MADDOX. That is correct.

Senator MURKOWSKI. I guess I will go back to the chairman's initial questions about what we know and what Alberta has demonstrated in terms of the incredible potential coming out of that province and how they have figured out a way to make this process economic and to truly provide a benefit. If we have had this level of assessment for the past 25 years, I understand the realities very, very well of the market, but we kind of do this boom and bust. We get going with a little bit of technology, somebody gets a good idea, and then it goes flat.

If we recognize the potential here in this country, we can look to other countries where they are making a difference, whether it is in Canada or someplace else, I guess we have a project going in Australia, in Estonia, what can we do in this country to eliminate or even out this boom and bust and actually get this technology moving forward?

Mr. MADDOX. Clearly, there needs to be a full commitment by all the stakeholders, the Federal Government, State governments, local communities. We do have a problem that we do tend to live on today's level. From the Government's standpoint, we all have budget pressures. We are feeling them this year. But I think the commitment needs to be made to developing these nontraditional resources and bring them to market. Some grew up and came of age in the oil situation of the 1970's. We have got to, I think, embrace as a Nation that energy is an ongoing issue, regardless of today's price, and make a commitment to policies that understand that, that even if we dropped to \$20 tomorrow, it could be again \$50 the day after. We have a very tenuous supply situation around the world and a highly competitive one, and I think we need to sit down and say, okay, what do we need to do to make certain that we do not zig and zag.

Senator MURKOWSKI. I guess maybe that is my frustration. We have recommendations coming out of DOE that call for us to develop a Federal oil shale program plan, but there is no real hard specifics in terms of what it is that we do to advance that policy. Do we need tax incentives? Do we need a Federal financial policy? What is it that we need in order to provide some leveling?

Mr. MADDOX. I would argue what we really need is a regulatory policy that allows people to explore for oil and extract oil. We have seen a large number of large producers leave the country, and if you talk to them—I am sure you have heard it too—they do not have any confidence that they are going to be able to bring their resource to market ultimately because of various regulatory issues, public concern issues. And I think that you have got to essentially tell people that we want to produce oil in this country.

The United States is the third largest oil producer in the world, 5.5 million barrels a year. 80 percent of that is from independents. Some of these resources—you want to see money involved in oil shale, for example. That is not going to be developed by an independent. It is going to be developed by a major producer just because of the sheer amount of money involved, I mean, billions and billions of dollars. But right now, I think most oil companies' senior people would tell you, at least privately, that they have concerns about whether the United States will support development of domestic resources.

Senator MURKOWSKI. Let me ask just one very quick question, if I may, Mr. Chairman. This is in regard to the balance between oil and natural gas. The process, as I understand, to release these hydrocarbons, we have got to use a considerable amount of natural gas in order to allow this process to move forward. As we all know, the price of natural gas is sky high. The demand in this country is very high and growing higher every day. At some point in time, does this process get stopped because we do not have the natural gas that we need in order to allow this process to go forward if the price of natural gas is just too high?

Mr. MADDOX. A byproduct of this process, at least in the in-situ process, once it gets up and going, is natural gas, and it will self-generate natural gas adequate to create the energy and the heat necessary. So there should not be any net loss of natural gas in this process to the market. So there should not be any kind of price pressures as a result of the natural gas being used.

Senator MURKOWSKI. Thank you. Thank you, Mr. Chairman.

The CHAIRMAN. Thank you very much, Senator.

I am going to turn the meeting over for the next 15 minutes to Senator Craig.

But I wanted to ask you, Mr. Maddox, did I hear that you have a plan or do not have a plan? Which was right?

Mr. MADDOX. We are developing a plan now.

The CHAIRMAN. Could you tell us what that means? Will we have one pretty soon?

Mr. MADDOX. Hopefully in the next several months. We are trying to identify both regulatory barriers and market barriers to developing this resource.

I want to leave no misimpression with the chairman. We actually do believe that this resource should be developed. We are trying to avoid the mistakes of the past and make certain we do not run down any blind alleys. I apologize if I have left some sort of misimpression.

The CHAIRMAN. Well, I want to just make this point. Then I will quit on this subject. But the biggest problem in the past was the price of oil was too low. Of all the arguments you want to make,

that is it. We started at time and those communities he spoke of fell apart because the price was so low, and every time it got up, the companies noticed, it came down.

So now the question is, is it going to come down from its \$50-plus to a settlement level that is so low that it does not justify this production? And I do not know what that is, but we have got to ask the companies and you all have to find out, if you are going to put a plan together, what is the general expectation on the supply demand piece. Is supply demand still relevant? Is there still a great supply, or is it all a demand question?

I would say to the Defense Department I do not speak for you all, but I would tell you if I were in charge of the defense of the United States, I would have them involved in this. Speaking of a demonstration project, the Defense Department ought to be building one consistent with environmental conditions right now. At least they could say here is an alternative. We are sitting here. You probably do not even know today how much we are spending out of the defense budget for oil and related projects, but it is an enormous amount of money. Right, Senator Craig? We probably cannot even figure out in the defense budget what it is. We could probably guess.

Senator CRAIG. Yes, we do not know.

The CHAIRMAN. We do not know. If we put it in at 30, it ends up at the end of the year at 50. They have got to spend it. Right? They have got to take out of something.

But anyway that is my comment, and now we will turn it over to you, Senator.

Senator CRAIG [presiding]. Well, Mr. Chairman, consistent with that comment, I had a price shock on Sunday evening. My family had rented a 24-foot Penske diesel truck to haul a family member across country. So at the end of the day, the keys were handed to me and dad was going to take it and refuel it and take it back to Penske. I hunted around town for the cheapest diesel. I grew up at a time when diesel was by far less expensive than gas by almost a factor of half. Well, in Boise, Idaho, this past Sunday evening I found \$2.45 diesel, and I had to fill a 50-gallon tank.

I am not used to that. But it was a reality check about input cross in the economy in this country that we are still sleeping with today that is amazing to me. I suspect if more consumers and more, shall I say, anti-folks as it relates to resource development had the similar price shock that I had this past Sunday, maybe—maybe—they would change their thinking.

Let me ask this question of you, Mr. Maddox and Mr. Lonnie. We had the chairman of the Federal Reserve before us recently talking about natural gas and a variety of other issues as it relates to energy and the impact on our economy. I was not able to ask all the questions I wanted, so I have just received response to some questions as it related to growth of resources in the market.

Here is the chairman's observation. I thought it was pretty valid, and I suspect it is underlying and it is a bias within our agencies of the Federal Government today, especially those who sometimes view themselves as the protector of the resource instead of the manager, guardian, and reasonable facilitator of the resource.

He said this. In a sense, there are two value systems, the economic value system and the environmental value system, and there is no mechanistic tradeoff. As an economist, I cannot provide a clear mathematical formulation to allow you to compute the tradeoff. This is a judgment call the Congress will have to make.

It is also a judgment call that the administration will have to make and should accelerate their facilitating of all that we need to know to make the judgment call here. We are about at a time to make that judgment call, I hope, again and that we can get it completed.

But my guess is that one of the reasons our oil shales have not come to development yet is that we have spent more time guarding them than we have facilitating their value as a resource. Would you disagree with that?

Mr. MADDOX. I would not disagree with it. I think it is also a little bit of benign neglect more than anything else or as much as guarding them.

Senator CRAIG. Mr. Lonnie.

Mr. LONNIE. I think from the BLM standpoint, we think—and the Director speaks to this quite a bit—quality of life type issue in terms of access to public lands and impacts on local communities. So I think from, at least, the perspective that I have we are anxious to make the resource available and the economics will help determine what can actually occur in terms of its ultimate production.

Senator CRAIG. But the Secretary and the Director have not come up with any form of mechanistic tradeoff, have they?

Mr. LONNIE. I think through our land use planning process, we attempt to do that in terms of soliciting public comment and involving local communities.

Senator CRAIG. Mr. Barna, what other fuels is DOD looking at, any alternative fuel interests that you are looking at?

Dr. BARNA. Right now we are looking at synthetic fuels produced by Fischer Tropsch primarily from coal. We are looking at getting the fuels that will be produced by shale and also just redefining what our specifications for fuels are so that we can cut down on the number of fuels that we have to use during deployments. So we are looking very hard at the specifications so that perhaps we can get one fuel or two fuels, where right now in Iraq we have, I think, nine fuels.

Senator CRAIG. Has DOD at all spoken about biomass, cellulose biomass or any of the biomass—5

Dr. BARNA. We are looking at biomass. We are looking at all fuels. We do have biodiesel right now and we do use it. It does have some limitations based on temperature that we could perhaps get around by blending it with Fischer Tropsch type fuels. That is one of the things we are investigating, but we are in fact using biodiesel.

Senator CRAIG. Thank you.

Senator Burns, you are up.

Senator BURNS. Yes, sir. I just got a couple of questions with regard to Mr. Barna and the work that you have done. I have been to that plant, by the way, and also reviewed the situation with coal gasification to go into diesel. It is my understanding that they can

take all the environmentally bad stuff out of that. With the people you mentioned, the Fischer Tropsch people—clean fuels—is that important to you?

Dr. BARNA. Absolutely.

Senator BURNS. Or just fuel general?

Dr. BARNA. Well, just fuel generally. While we are doing just fuel generally, clean fuel is certainly important to us from an environmental standpoint. The problem is it is such a clean fuel that we have to investigate its impact on the fleet. It is especially true of our legacy fleet, the older things as opposed to the new ones.

Senator BURNS. Do you plan to continue to support that idea down there in your research dollars?

Dr. BARNA. Absolutely.

Senator BURNS. Thank you. I appreciate that.

I was just looking here and you were talking about research, Mr. Maddox, and you have cut your research dollars on fuels and especially in this area and on oil and gas, saying that the companies are making enough money and they should be investing in research and development in their own right. Are they doing so? Have they increased their resources into their R&D to a level that satisfies you?

Mr. MADDOX. I do not think I would ever be satisfied with enough research especially at a \$50 level or \$55 price level. However, we do have significant budget issues in the Federal Government, and we have all been asked to tighten our bootstraps.

Senator BURNS. Do you monitor those companies on the amount of dollars that they spend in research?

Mr. MADDOX. We have discussions. Can I give you a number? No, I cannot. In discussions with them, my impression is that they are looking very hard at research and are funding every possible avenue they can, but I cannot give you a hard number on that.

Senator BURNS. Well, I think maybe if they are not, I would suggest you work with them a little more to make sure that they do, and if they do not, I think it is irresponsible from our standpoint that we are not picking up that slack. Now, I do not want to throw that out there and let them off of the hook, but nonetheless, I think the time has come to look at what Syntroleum and those people are looking at, gasification and fuel cells, anything. But we know that there is nothing in the near future that would replace diesel as far as a transportation fuel is concerned. Is that correct?

Mr. MADDOX. Correct.

Senator BURNS. Then I would suggest that we accelerate some of these programs because the impact of high transportation costs is being borne by, of all people, my farmers. I know you do not think much about my little farmers out there in Montana, but I will tell you what, high natural gas, fertilizer costs, because you got to remember that we are in an industry that we sell wholesale by retail and we pay the freight both ways. I do not know. If you keep commodity prices at the present level, we cannot make it. So your Department and the Bureau of Land Management becomes very important to us in production agriculture.

So I would suggest that you find out what they are spending, how much they are spending, and where they are spending it and work with them to make sure that those resources are used in that

area. And if not, then we should be looking at actions on our part to make sure that it is happening. We are at wits end. We cannot operate under circumstances like this. So you may not have a crisis in some areas, but boy, you have got one on the farm, I will tell you right now. That is very, very important.

I am going to look at this budget and the appropriations, as far as we are concerned, to the Department of Energy. That used to be under my chairmanship. But, nonetheless, I would hope that I would have some suggestions to make to that.

But I would get a little more enthusiastic about what you guys are doing down there and make damned sure they get done because we are in a crisis. Any way you look at it and any way you want to turn it, we are in a crisis. I just do not see anybody getting very excited about it down there.

End of comment. End of questions. Thank you very much, Mr. Chairman.

The CHAIRMAN [presiding]. They got the message.

Senator BURNS. They better get it or we will have a new Department.

The CHAIRMAN. Senator, go ahead.

Senator BURR. Mr. Chairman, thank you. To the witnesses, I will not ask questions, but I want to take this opportunity to make an observation, having come late.

I have heard all of you answer questions and I have heard looking at, working on, considering changes. Let me fast forward for a second to some of Mr. Mut's testimony, who will come up in the next panel. I just want to use half of his recommendations to this committee.

"Shell believes that the United States recognize oil shale as a strategically important domestic energy source. We believe that Congress and the administration should officially support public policy initiatives that encourage and support accelerated commercial oil shale development and use as a feedstock for transportation fuels and other products.

"Two, Shell believes that the Secretary of the Interior should develop a commercial oil shale leasing program on an expedited basis. We support the BLM's proposed R&D leasing program as a small but important first step in the right direction. BLM should be urged to finalize and implement that program on an expedited basis."

I want to just highlight the differences. Looking at, working on, considering change. Shell: accelerate, expedite, finalize, remove. A huge difference here. There is a canyon between what they are saying and what we are doing.

I commend all of you.

If there has ever been a crisis in my young life, we are in it. I am not sure—I will turn to some of the more senior members in their lifetime—whether we have had a more defined crisis as it related to our energy needs in this country. If there is, I am not aware of it.

I am not willing to accept \$50 a barrel plus is the norm and not the exception. But we cannot wait to figure out which one is right before we focus our efforts on how we come up with alternatives. I understand the stop and start and exit from the marketplace in

prior years, but we have to restructure in a way that we cannot allow that to happen. We cannot expect an industry to be created in shale if there is not somebody that is leading it.

I think the one thing that is highlighted in this testimony that I read was it has to be the U.S. Government. That is us. That is us up here and it is you down there. I am not sure that looking at, working on it, and considering change displays leadership.

And clearly if we have got agencies that are not in agreement with us that there is a crisis, then Mr. Chairman, we need to work on that. But I am hopeful, in a bipartisan way, we will do our job at producing an energy bill. We cannot solve finalizing regulations. We can but you do not like it when we do it. There are a lot of things that are pointed out in there that are administrative matters. It does not take us for these things to happen. It takes you expediting, and I think that this has to be a partnership if we want to make this possibility at least reach a point where we can determine its viability and whether, in fact, for somebody like Mr. Barna, whether it is an opportunity for military security and for the security of this country.

I thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Senator. Thank you very much. I assume you do not have any comments on what the Senator said.

Do you all agree there is a crisis in terms of the United States being so dependent upon foreign oil? Mr. Maddox?

Mr. MADDOX. Yes, sir.

The CHAIRMAN. Mr. Lonnie?

Mr. LONNIE. I think we certainly need to diversify our energy supply, and I think oil shale could be a big part of that.

The CHAIRMAN. Dr. Barna?

Dr. BARNA. Absolutely.

The CHAIRMAN. All right. Let us go. Thank you very much. Whatever you have agreed to get us, get us as soon as possible.

The next panel: Steve Mut from Shell; Jim Evans, Associated Governments of Northwestern Colorado, a friend of Senator Salazar; Mr. Russell George, Colorado Department of Natural Resources from Denver; Steve Smith from Denver. All of these Coloradans are here to visit with you, Senator.

Senator SALAZAR. Thank you, Senator.

The CHAIRMAN. Mr. Steve Mut from Shell, we are glad you are here. You have heard a little bit of the rumblings up here. While you are not the whole solution, clearly you have got to shed a little light on things for us, if you can, please. Your testimony will be made a part of the record and you can proceed.

**STATEMENT OF STEPHEN MUT, CEO, SHELL UNCONVENTIONAL RESOURCES ENERGY, SHELL EXPLORATION AND PRODUCTION COMPANY**

Mr. MUT. Thank you. Good morning, Mr. Chairman and members of the committee. I am Stephen Mut, CEO of the Shell Unconventional Resources group of Shell Exploration and Production. It is a real pleasure to be here to discuss progress we are making on a new technology called in-situ conversion process. I want to state unequivocally it is not the 1970's technology. It is a new path.

We have three specific goals for this: to exploit shale oil in an environmentally friendly fashion, to make it economically viable, between \$25 and \$30 of crude price, and to be of scale. That means having a significant part of the U.S. energy production matrix.

In-situ conversion means just what it says. It is in the ground, and conversion, converting from one form to another. We insert many electric heaters into holes drilled down into the rich oil shale layer and heat to 650 degrees plus. During that time, immature oils are matured. In 3 or 4 years' time, we do the work, with a little assistance from electricity, that nature takes tens of millions of years to do. In the process smaller, light compounds are sheered away from the dense mass that was the original material. The majority of the hydrogen present in the resource is concentrated in those lighter molecules. At that temperature, these lighter molecules are in the gaseous phase and move more readily in the subsurface to a well bore than they would have if they were in liquid phase.

We form an ice wall around this heated zone to do two things: to keep water out, which destroys the thermal efficiency of the process, and to keep the products that we have produced contained, thus protecting the groundwater. We project that about 70 percent of the carbon that is in the subsurface is recovered through this process. Of that which comes to the surface, at room temperature, you will have one-third that is gas and gas liquids like propane and butane, and two-thirds that will be transportation fuels.

Through modest upgrading, relative to refining, this liquid can be treated to form gasoline, jet fuel, and diesel in about a third and a third and a third ratio by the injection of hydrogen. This injection of hydrogen also removes sulfur and nitrogen that are the key contaminants. Nitrogen can be used, in fact, to create urea or fertilizer.

The carbon left in the ground is very dense. Is it not movable and contains the majority of the nitrogen and sulfur that was originally there, as well as all the metals that were in place originally.

The resource is the most concentrated resource that we know in the world, and therefore, in exploiting it, we are going to have a relatively small footprint relative to the production. In addition, because of reduced processing, there are lower air emissions. Because we produce only clean products, we are going to have much less carbon dioxide impact. Because there is no mining, there are no tailings piles, significantly less water use than previous technologies. And that, combined with a robust system developed to protect groundwater, gives us an environmental package that is a sense of pride to the 150 people working on this on the Western Slope and in our offices in Denver and Houston.

The DOE reports that in the Green River basin alone there are a trillion barrels of reserves that could be recovered using various technologies. That size and this technology are consistent with some descriptors of the future. That would be large scale developments, high capital intensity, and high volumes that are obviously produced far distant from markets. In our initial views, we believe that the first markets for this material will be in southern and central California where these clean products can act to reduce supply

constraints and give the people of the west coast an alternative supply of light products.

Shell has made a great deal of progress over the last few years. We have tested and proved all parts of our technology on an individual basis. We have, in fact, built one of those freeze walls or ice walls taller than the Empire State Building and have produced out of this recent experiment referred to earlier at the Mahogany project 1,200 barrels of very light crude oil type material.

There is still much to be done, however. We need to test this process in an integrated fashion to make sure that all the pieces of the technology work together so that we can make a commercial decision by the end of the decade to develop oil shale. While we are doing this, we have to keep the people informed as we go.

Shell believes that there is a role for government too and some of that is already going on. We are working with the Oak Ridge Labs, the Sandia Labs, and Morgantown Labs in developing the mix of technologies we believe are required. As stated earlier, we believe that oil shale should be recognized as a vital part of the future energy mix of this country.

The DOI should provide access via commercial leasing programs and land exchanges, in addition to the fine work that has already gone on in developing an R&D leasing program.

We believe that some change or removal of the acreage limitations associated with the 1920 Act regarding oil shale should be made.

We hope that a simple royalty mechanism can be developed, one which encourages development but provides significant revenue as well to the State and Federal Governments.

We believe we need a regulatory regime that protects the environment but is devoid of duplicate processes and extracted delays due to sequential processes.

And finally, we believe that clarity is required on the fiscal side such that oil shale is treated for tax purposes like any of the other nonconventional fuels.

We at Shell are very excited about ICP, the process, and the part it might play in the U.S. energy mix.

That concludes my remarks. It is a summary of the written statement I sent. And I would be happy to answer any questions that you may have.

[The prepared statement of Mr. Mut follows:]

PREPARED STATEMENT OF STEPHEN MUT, CEO,  
SHELL UNCONVENTIONAL RESOURCES ENERGY

Good morning, Mr. Chairman and Members of the Committee.

My name is Stephen Mut. I am CEO of the Shell Unconventional Resources unit of Shell Exploration and Production Company. I am delighted to appear before you today to describe Shell's initiative to develop and advance, hopefully to commercial success, a unique and innovative technology which we are increasingly optimistic can open up the vast oil shale resources in the Western United States. This technology, once thoroughly proven technically, will allow Shell to produce clean transportation fuels such as gasoline, jet fuel and diesel as well as clean burning natural gas from oil shale in an economically viable and very environmentally sensitive fashion. Because the oil shale resource in the United States is extensive, this technology holds promise for significantly increasing U.S. domestic energy production.

For decades, energy companies have been trying, without success, to unlock the large domestic oil shale resources of northwestern Colorado, eastern Utah and southwestern Wyoming. Oil shale can be found in large parts of the Green River

Basin and is over 1,000 feet thick in many areas. According to DOE estimates, the Basin contains approximately 1 trillion recoverable barrels of hydrocarbons locked up in the shale. It is easy to see why there have been so many attempts to unlock this potentially enormous resource in the past.

Some 23 years ago, Shell commenced laboratory and field research on a promising in ground conversion and recovery process. This technology is called the In-situ Conversion Process, or ICP. In 1996, Shell successfully carried out its first small field-test on its privately owned Mahogany property in Rio Blanco County, Colorado some 200 miles west Denver. Since then, Shell has carried out four additional related field tests at nearby sites. The most recent test was carried out over the past several months and has produced in excess of 1,200 barrels of light oil plus associated gas from a very small test plot using the ICP technology. We are pleased with these results not only because oil and gas was produced, but also because it was produced in quantity, quality and on schedule as predicted by our computer modeling. With this successful test, Shell is now ready to begin work on the final tests that will be required to prove the technology to the point where there is sufficient certainty so as to make a decision to proceed to commercial development.

Most of the petroleum products we consume today are derived from conventional oil fields that produce oil and gas that have been naturally matured in the sub-surface by being subjected to heat and pressure over very long periods of time. In general terms, the In-situ Conversion Process (ICP) accelerates this natural process of oil and gas maturation by literally tens of millions of years. This is accomplished by slow sub-surface heating of petroleum source rock containing kerogen, the precursor to oil and gas. This acceleration of natural processes is achieved by drilling holes into the resource, inserting electric resistance heaters into those heater holes and heating the subsurface to around 650F over a 3 to 4 year period. During this time, very dense oil and gas is expelled from the kerogen and undergoes a series of changes. These changes include the shearing of lighter components from the dense carbon compounds, concentration of available hydrogen into these lighter compounds, and changing of phase of those lighter more hydrogen rich compounds from liquid to gas. In gaseous phase, these lighter fractions are now far more mobile and can move in the subsurface through existing or induced fractures to conventional producing wells from which they are brought to the surface. The process results in the production of about 65 to 70% of the original "carbon" in place in the subsurface. The carbon that does remain in the sub-surface resembles a char, is extremely hydrogen deficient and if brought to the surface would require extensive energy intensive upgrading and saturation with hydrogen. Chart 1 illustrates the ICP process.\*

The ICP process is clearly energy intensive as its driving force is the injection of heat into the subsurface. However, for each unit of energy used to generate power to provide heat for the ICP process, about 3.5 units of energy are produced and treated for sales to the consumer market. This energy efficiency compares favorably with many conventional heavy oil fields that for decades have used steam injection to help coax more oil out of the reservoir.

The produced hydrocarbon mix is very different from traditional crude oils. It is much lighter and contains almost no heavy ends. Its quality can be controlled by changing the heating time, temperature and pressure in the sub-surface. The production mix generally seen from Colorado oil shale is about two thirds liquids and one-third natural gas and gas liquids such as propane and butane. On the liquid product side, the typical split encountered is about 30% each of a gasoline precursor called naphtha, jet fuel and diesel with the remaining 10% of the barrel being slightly heavier. These fractions can be easily transformed into finished products with significantly reduced processing when compared with traditional crude oils.

Because the ICP process occurs below ground, special care must be taken to keep groundwater away from the process, as its influx would seriously reduce thermal efficiency. Special care must also be taken to keep the products of the process from escaping into groundwater flows. Shell has adapted a mining and construction technology to isolate the active ICP area and thus accomplish these objectives and to safe guard the environment. For years, freezing of groundwater to form a subsurface ice barrier has been used to isolate areas being tunneled and to reduce natural water flows into mines. Where groundwater intrusion is a problem in the ICP process, the subsurface adjacent to the rich oil shale layers is frozen forming a container of sorts thus preventing the influx of water while at the same time containing the products formed. Shell has successfully tested the freezing technology and determined that the development of a freeze wall prevents the loss of contaminants from the heated zone. During this same test, Shell was able to demonstrate that traditional subsurface reclamation technologies such as steam stripping, pumping and

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\*All charts have been retained in committee files.

treating and carbon bed stripping were able to remove contaminants developed in the ICP process from the subsurface to levels sufficient to meet stringent permit requirements. Though freezing the subsurface while simultaneously heating it is clearly a counter-intuitive application of technology, it is a good example of the creativity and unconstrained thinking that necessarily has been a major contributor to solving potentially vexing problems in this complex Research and Development project. A schematic of the basic freezing technology is shown in Chart II.

Because the ICP process involves no mining, no large or contaminated tailing piles are created. Water usage is expected to be considerably less than is required for traditional retort methods. Because the technology has the potential to recover in excess of 1 million barrels of oil per acre in the richest parts of the Basin, or about ten times that possible from conventional mining and retorting, temporary land disturbance associated with ICP during production will be significantly less. This smaller and cleaner footprint, the reduced water needs, the reduced processing needs, a robust system for protecting groundwater from contamination and the production of clean, less Green House Gas intensive products creates an environmentally attractive package about which we at Shell are very proud.

It is through well-established technologies and constant monitoring that Shell expects to ensure proper and transparent stewardship of the environment. Shell is already working closely with local communities, NGOs, elected officials, and regulatory agencies to ensure that our research addresses community needs and sensitivities while ensuring strong environmental protection.

Shell is currently focused on reducing the remaining risks and uncertainties that could affect the commercial viability of this technology. For this reason, Shell has a research staff in Colorado of approximately 55 personnel in addition to approximately 100 Houston and Denver based employees assigned to the oil shale project. The focus of these efforts is to insure the technical, commercial and environmental viability of the technology via a relatively large integrated demonstration project. This project would represent the final step required before a financial investment decision would be taken by Shell for a commercial scale unit.

While Shell has spent many tens of millions of dollars on research and development for this technology and has learned a tremendous amount while reducing risk and uncertainty, much work and expenditure still remain before the ICP process can be commercialized. Shell is anxious to proceed with ICP research so as to help unlock the significant potential that oil shale holds to increase indigenous energy supply in the United States. Achievement of this objective on a timely basis will require the active support of Congress and the Administration.

Because the commercial development of oil shale would yield many benefits to the U.S. economy, Shell supports responsible policy initiatives that will facilitate early commercial production of shale oil and associated gas via methods that minimize industry's footprint and protect the environment. Shell is committed to working with Congress, with the Department of Energy, the Department of Defense, the Department of Transportation, the Department of Homeland Security and the Department of Interior, which has stewardship responsibility over approximately 80% of the oil shale bearing lands in the Green River Basin of the Rocky Mountain West, in order to accomplish this objective.

Key to the early development of oil shale technology is early access to appropriate Federal oil shale deposits to allow for pilot field tests to be carried out. The leasing of tracts of federal land to encourage research and development is an essential next step. As a private company, Shell supports appropriate lease terms and incentives for the development of new oil shale development technologies.

As the Department of Energy has pointed out in a recently released two volume report entitled "Strategic Significance of America's Oil Shale Resource", that while oil shale is located in many countries throughout the world, the Green River Basin of northwestern Colorado, eastern Utah, and southwestern Wyoming contains the largest, most concentrated quantities of potentially recoverable shale oil in the world. The Report indicates that the Basin may have as much as 1.6 trillion barrels of oil in place, of which an estimated 1 trillion barrels ultimately may be recoverable using various recovery technologies. This latter number is roughly equivalent to all the combined proven conventional oil reserves in the world today, (see DOE Charts 3, 4 & 5).

Given the size of the resource, Shell is committed to pursuing commercially and environmentally viable technologies that can unlock the enormous potential for oil shale that exists in the Rockies. Shell's advancing ICP research is getting us close to being able to help unlock these resources. We believe that successful utilization of the ICP technology could yield substantial economic impacts to Colorado, the rest of the Rocky Mountain West and to the United States as a whole.

Clearly, Shell believes there is a role for the appropriate development of oil shale deposits as part of America's overall energy and conservation mix to meet increasing energy demand. We are committed to the principles of Sustainable Development, to ensuring that our activities minimize the impact on the environment and to enhancing opportunities for local communities while facilitating our business objectives.

Ironically, despite the fact that the United States clearly has the largest and most concentrated oil shale resources in the world, several other countries have ongoing oil shale Research and Development projects. Australia, China, Estonia and Brazil are all progressing projects that are governmentally assisted or driven in one fashion or another.

It is Shell's belief that the time has come for the United States to join these other nations so as to encourage, facilitate, and accelerate the development of this potentially vast domestic energy resource.

A range of options should be seriously considered in order to accelerate responsible U.S. oil shale development that would enhance national security and protect our Nation's economy. We would offer the following six recommendations for this Committee's consideration. While we are not including specific legislative language, we are willing to work with the Senate Energy and Natural Resources Committee, as well as all other relevant Senate and House Committees of jurisdiction on specific language to create the proper mix of incentives and opportunities for accelerated, but responsible, oil shale development.

Recommendations for the Senate Energy and Natural Resources Committee:

1. Shell believes that the U.S. government should recognize oil shale as a strategically important domestic energy source. We believe that Congress and the Administration should officially support public policy initiatives that encourage and support accelerated commercial oil shale development and use as a feedstock for transportation fuels and other products.

2. Shell believes that the Secretary of the Interior should develop a commercial oil shale leasing program on an expedited basis. We support the BLM's proposed R&D leasing program as a small but important first step in the right direction. BLM should be urged to finalize and implement that program on an expedited basis.

3. Congress should act to lift the current federal acreage limitation under Title 30, Section 241(a) of the Mineral Lands Leasing Act that restricts a lessee to acquisition of but one lease of 5,120 acres nationally. In order to facilitate commercial development for oil shale production, Shell believes that this acreage limitation should be removed. Otherwise, companies who wish to build facilities and produce shale oil from federal lands will forever be limited to one project. Such a limitation, which dates back to 1920, until changed will create an impediment to even first-generation projects where the costs and risks will be greatest.

4. Congress and the Administration should work to develop royalty rates that encourage investment in oil shale development giving particular recognition to the extraordinary costs involved in literally bringing a new energy industry into existence. In particular, Shell believes that government should develop a royalty regime for first generation commercial oil shale production that: 1) is simple to administer and to enforce and eliminates the need for interpretation or the likelihood of litigation; 2) would deliver significant revenue to the U.S. Government, and thus 50% of that amount to the impacted states; and 3) would not involve royalty rates that are steep enough to create another obstacle to the acceleration of large scale commercial oil shale projects.

5. Shell believes that Congress and the Administration should work to ensure that an appropriate system is put in place to provide certainty and timeliness in the permitting process for oil shale development without waiving substantive environmental performance standards. A concern is that sequential overlay of multiple federal and state permitting processes has the potential to add many years to what will already be a complex and protracted permitting process.

6. Congress and the Administration should identify appropriate tax incentives that encourage investment in oil shale technology and development, that recognize the research and development hurdles involved in oil shale technology and development, and that appropriately treat oil shale production as the development of a "non-conventional resource" in a manner similar to other non-conventional energy resources. Specifically, where ambiguities may now exist relative to determining whether or not in-situ oil shale recovery technologies will qualify for tax benefits in the same manner as do existing mining tax regimes, those ambiguities should be cleared up as soon as practicable.

In summary, the United States has a huge energy resource in the form of oil shale. The time has come for Congress and this Administration to consider appropriately targeted legislative and regulatory measures to allow oil shale to be devel-

oped at an early date, provided that such development can occur in an economically feasible and environmentally acceptable manner. We are increasingly encouraged and optimistic that our ICP technology may very well represent the first available technology to do so.

This completes my written testimony. I will be happy to respond orally or in writing to any questions any Committee member may have.

The CHAIRMAN. Thank you very much. We have some questions, but let us proceed with the witnesses.

Mr. George, please.

**STATEMENT OF RUSSELL GEORGE, EXECUTIVE DIRECTOR,  
COLORADO DEPARTMENT OF NATURAL RESOURCES, DEN-  
VER, CO**

Mr. GEORGE. Thank you, Mr. Chairman. I appreciate your invitation to participate in this hearing. I am Russell George, executive director of the Colorado Department of Natural Resources. As the lead State agency responsible for natural resource management, I appreciate the opportunity to be here and provide our perspective on the potential for renewed oil shale development in northwest Colorado.

The State of Colorado is excited to be partners in this effort to move our great Nation closer to energy independence. With perhaps as much as 2 trillion barrels of oil locked in the shale of the Western States, this vision of energy independence may well be achievable in our lifetimes.

As a lifelong resident of shale country, I would like to share some thoughts with you on the three decades of lessons that we have learned regarding impacts and possible tools to manage the resource successfully in the future.

The State of Colorado has consistently supported the development of oil shale resources in northwest Colorado since the early 1970's. Our focus has been on making sure that the projects are fiscally and environmentally sound and that the communities do not incur extraordinary economic burdens.

Over the last 30 years, several concepts have worked. These included oil shale lease bids, the Synthetic Fuels Corporation, the Colorado Joint Review process, the Cumulative Impacts Task Force, and the DOE Technology Partnership. These efforts provided funds to mitigate impacts, provided incentives for private investments, supports and grants to fund private sector technology development, a coordinated permit review process that allowed adequate public input into the environmental impact analysis process and the permit process at the State and local level, and accessible economic analysis tools to model local economies to determine what projects would be causing what impacts in what communities in what years. These processes and procedures were critical, given the enormity of the issues facing western Colorado, primary concerns that focused on how to dispose of the spent shale, the cost of production, the impacts to local communities, and the water requirements that would be needed to carry out large scale operations.

While we do not know the specifics of the technologies that may be pursued over the next decade, we do know water availability, materials handling, power requirements, and transportation networks must be assessed in detail and the impacts mitigated appropriately.

The CHAIRMAN. Mr. George, could I just interrupt for a minute?  
Mr. GEORGE. Certainly.

The CHAIRMAN. I am going to excuse myself for just a few moments. I am going to let Senator Salazar preside until I return. Thank you for doing this for me. I appreciate it.

Senator SALAZAR [presiding]. Thank you, Mr. Chair. It is a great honor for me to actually do this since Russ George is not only executive director of the Department of Natural Resources, which is a position that I previously held, but also a very esteemed statesman in Colorado, former Speaker of the House of Representatives, and a person whose wisdom ultimately will be what I believe will guide the whole future oil shale and a whole host of other things in Colorado. So please proceed.

Mr. GEORGE. Well, thank you, Senator Salazar. Mr. Chairman, the honor is all mine.

Again, talking about where we think we are today, times have changed, but the circumstances are proportionately the same. As in the 1970's, we have record coal production that is straining existing transportation networks. We have record natural gas production levels and increased permitting for coalbed methane development. This development overlaps an area with increasing tourism and recreation opportunities and an expanding urban population. There are many competing issues at play here.

To that end, technology and environmental oversight must be rigorous. Technology must employ the best available practices to minimize impacts. State and local needs must be anticipated and funded. Development of public land must be prioritized by resource and by region, and the cumulative impacts of mineral and energy development on both public lands and private lands must be mitigated.

So where should we go from here? We have some suggestions to propose.

Given the complexity of multiple uses and demands already present in oil shale country, for example, natural gas, recreation, wildlife, coal, the Federal Government must determine those areas where oil shale development could be accommodated in a manner that is least disruptive to communities and existing activities. The Federal Government should provide this cumulative impact analysis and identification of areas suitable for oil shale development through a public process.

Any Federal leasing program to be implemented in this new effort should ensure that the bonus bid concept continues and the proceeds are distributed to the State in which the lease is located.

Any financial incentive program must have a duration comparable with the timeframes for private investment that include a realistic timeframe for technology development and implementation or the private dollars will not come.

Given the economic transformation of northwest Colorado in the past 20 years, coupled with the increasing level of coalbed methane development, a coordinated and integrated permitting process is essential. The Colorado Joint Review Process is an option that the Federal Government should consider fully funding or partially funding, along with industry, to assure a rigorous review with adequate public input and consultation.

It is essential that Congress consider the full life cycle of oil shale development as it contemplates a renewed national oil shale effort. We must understand the complete picture.

The State of Colorado looks forward to ongoing discussions and being a partner in this process.

[The prepared statement of Mr. George follows:]

PREPARED STATEMENT OF RUSSELL GEORGE, EXECUTIVE DIRECTOR, COLORADO  
DEPARTMENT OF NATURAL RESOURCES

Mr. Chairman, thank you. I appreciate your invitation to participate in this hearing. I am Russell George, Executive Director of the Colorado Department of Natural Resources. As the lead state agency responsible for natural resource management, I appreciate the opportunity to provide our perspective on renewed oil shale development in Northwest Colorado.

We are excited to be partners in this effort to move our great nation closer to energy independence. With perhaps as much as two trillion barrels of oil locked in the shales of western states, this vision is achievable in our lifetimes.

As a lifelong resident of "Shale Country", I would like to share some thoughts with you on three decades of lessons learned regarding the impacts and possible tools to manage the development of the resource successfully.

BACKGROUND PRINCIPLE

The State of Colorado has consistently supported the development of oil shale resources in Northwest Colorado since the Arab Oil Embargo of the early 1970's. Our focus has been on making sure that the projects are fiscally and environmentally sound, and that the communities do not incur extraordinary economic burdens. As history has shown, if development pays its way, the community impacts are less if the projects do not materialize.

HISTORY

Let me summarize the key elements of the oil shale development cycles of the last three decades.

*Oil Shale Lease Bids.* The federal government leased two tracts in each state—Colorado, Utah, and Wyoming—in the early 1970's. Bonus payments accompanied each of these leases—that determined the winning bid for the lease. Half of those bonus payments were distributed back to the state. The General Assembly established the State Oil Shale Trust Fund and Program which developed planning and coordination mechanisms for federal, state, and local governments and provided funding for designated local government services and projects (\$100+ million). The goal was to mitigate the "boom town" syndrome.

*The Energy Mobilization Board.* As the energy crisis worsened in the late 1970's, the Executive Branch of the Federal Government pondered a national board that could declare the development of a resource in the national interest—thus preempting local land use regulations and much of the state permitting process. The Western Governors, in particular, led the effort to oppose this preemptive measure by the federal government. The Board never materialized.

*Synthetic Fuels Corporation.* Congress funded the Synthetic Fuels Corporation to initiate oil shale projects in a manner that would allow several technologies to develop simultaneously. Congress allocated \$15 billion in price guaranties and price incentives that were competitively awarded on a multiple year cycle. In a large part, this approach made the federal government a partner in accelerated technology development.

*Joint Review Process.* In response to the national focus on the oil, gas, oil shale, coal and uranium resources in Northwest Colorado, Colorado developed the concept of a Joint Review Process. That process consisted of a centralized facilitation of the permit process at the local, state, and federal level. The Joint Review Process Program determined the timelines of the various required permits, coordinated the scoping process for the environmental impact statements, and facilitated public hearings and public comments. The overall coordination of the effort could allow for the application of several permits for an individual project to occur simultaneously. All the major oil shale projects, associated power plant projects, and coal mines used the Joint Review Process.

*Cumulative Impacts Task Force.* In addition to the permitting and environmental analyses related to the simultaneous development of multiple resources, the State of Colorado was also concerned about the fiscal impact to individual communities

and counties in high development areas. To that end, the state developed the concept of the Cumulative Impacts Task Force that modeled the budgets, revenues and expenditures of 104 jurisdictions in Northwest Colorado. The key task was to determine what projects would cause what economic impacts to what jurisdictions in what years based on different population and development scenarios.

The effort proved to be extremely valuable when Exxon closed its Parachute Creek facility. At that time, because of the front-end analysis work, the distribution of energy impact funds, and the use of the Oil Shale Trust Fund, long-term economic impacts were manageable. At the time of the Exxon pullout, only one school district had a multiple hundred thousand dollar residual impact.

*DOE Technology Partnership.* In the late 1980's, Occidental Oil under the leadership of Armand Hammer, proposed the cooperative development of an improved oil shale technology at the C-b Oil Shale Tract in Northwest Colorado. This was to be a 50-50 partnership of Occidental and the Department of Energy. Through the work of the state, the Department of Natural Resources, and the Associated Governments of Northwest Colorado, a seven-year commitment of funds was secured from the Department of Energy for this demonstration project. The other oil shale states contributed to the technology analysis for the project. The primary market was not for processing shale oil into motor fuels, but as chemical feedstocks for other uses. The project terminated upon the death of Armand Hammer when corporate directions were changed.

#### TECHNOLOGY AND THE ENVIRONMENT

In the 1970's and 1980's, the Project Independence Technology Assessments and the Synthetic Fuels Corporation financial plan focused on both in-situ (in the ground), surface, and modified in-situ technologies. The goal for synthetic fuels was an industry that would convert coal, tar sands, and oil shale to liquid fuels at a level of two million barrels per day by 1992—the majority of which would have come from western oil shale.

The dimensions of the proposed technologies were immense. A surface oil shale mine associated with a minimum-sized (50,000 BPD) commercial plant would be comparable in size to the largest iron and copper mines in the world. This scale was necessary since it required 2.5 tons of rock to produce one barrel of oil.

Underground (in-situ) processes would have recovered less resource. Such mines would need to produce as much as 100,000 tons of rock each day to support a 50,000 BPD facility. The ore would be processed (retorted) above ground. Disposal of the spent shale in some cases would have filled valleys.

The most advanced technology was modified in-situ. That technology mined a portion of the deposit by conventional methods for surface processing. The remaining shale was then fractured by underground detonations, the rubble ignited, and the oil transmitted to the surface. This process would recover less, but with less surface impact.

As you can see, the surface area requirements for mining, retorting, or spent shale disposal were significant. Costs were enormous even in 1980 dollars—an average of \$2 billion for each 50,000 BPD plant. Based on the applicable 1977 Clean Air Act standards, production in NW Colorado would have been limited to 400,000 BPD. Water requirements for a 50,000 BPD facility would require 8500 acre-feet per year of water.

In the end, the oil shale industry collapsed of its own weight—given the volumes of material to be removed and processed, the enormously fluctuating world oil price, and the lack of a consistent national vision for the development of this resource that could focus private capital investment.

While we do not know the specifics of the technologies that may be pursued over the next decade, we do know water availability, materials handling, power requirements, and transportation networks must be assessed in detail and the impacts mitigated appropriately.

#### WHAT WORKED—WHAT DIDN'T WORK

If the Federal Government is to contemplate a renewed oil shale effort, it must do so based on the lessons learned over the past thirty years. While the technologies are changing, so are the characteristics of "energy country" in Northwest Colorado.

As in the 1970's, we have record coal production that is straining existing transportation networks. We have record natural gas production levels and increasing permitting for natural gas development. The diverse development of this resource has dotted the landscape, increased truck traffic on county roads, and access to the resource has impacted many private landowners where the surface and mineral es-

tates are severed. Additionally, there is a growing public sensitivity to in-situ activities, such as fracking with “proprietary fluids”.

This development overlaps an area with increasing tourism and recreation opportunities and an expanding urban population. Oil shale leasing on top of this existing network of energy development and changing land uses may put more pressure on an already fragile ecosystem and public temperament.

We do not control world oil markets, nor do we control the actions of OPEC. Therefore, the development of oil shale cannot be purely price driven. It must be a commodity of national interest developed on public lands in the national interest. That implies a prioritized use of public lands for the development of specific resources. Federal financial support must be sustainable over several decades to encourage private sector investment. An environmental review process must be thorough. A financial safety net for local governments that allows for growth to pay its way, and allows front-end financing of some infrastructure needs and analytical tools, is essential.

All this said, the implication is that bonus lease payments from federal leases for local government facilities and services are good. Long-term federal financial support that fosters private investments is good. A coordinated permit process with adequate public input is good. And analytical tools that allow state agencies and local governments to anticipate the timing and amount of revenues for impact mitigation are essential.

What will not work are processes that preempt or supersede local and state land use and environmental permit processes. What will not work is the development of technologies without adequate oversight to insure both public acceptance and environmental compatibility. What will not work is a national effort that does not address financial and infrastructure needs at the local level.

#### COLORADO RECOMMENDATIONS

Colorado is excited to be a partner in the development of a resource that is both abundant and in the national interest. But it does intend that technology and environmental oversight be rigorous, that development use the best available practices to minimize impacts, that state and local needs are anticipated and funded, that development on public land be prioritized by resource and by region, and that the cumulative impact of mineral and energy development on both public lands and private lands be mitigated.

*Oil Shale Lands Suitable for Development.* Given the density of natural gas and coal development in some areas of NW Colorado, the need for recreational/wildlife habitat/undeveloped areas, and the network of privately held oil shale lands that did not exist in the last boom, the federal government must determine those areas where oil shale development could be accommodated in a manner that is least disruptive to communities and existing activities. Not all types of resource development can occur everywhere. The carrying capacity of the land, communities and infrastructure must be evaluated. That will determine the suitable areas for coal, natural gas, and oil shale development.

One type of mineral and energy development today, may preclude or limit another type of resource development tomorrow. We cannot forget that a consequence of the oil shale pull-out of the 1980's, and the sustained soft energy market in the 1980's, has been the transformation of the NW Colorado economy from an energy base to a tourism, retirement, second home and recreation base—and public attitudes have changed as well. That cannot be underestimated if accelerated development is to resume.

The lead federal agency in this new effort should provide this cumulative impact analysis and identification of areas suitable for oil shale development as an element of any development and leasing plan.

*Oil Shale Lease Bids.* Along with an oil shale lease process that generates front-end revenue and production royalties for the federal government, the 1970's concept of the bonus bid should be applied to any oil shale leases in the future. For the tracts leased in Colorado, a sum of over \$100 million was collected and distributed to the impacted counties. This economic cushion is essential to community stability, and the ability to withstand the economic shock of a project termination.

The federal leasing program to be implemented in this new effort should insure that the bonus bid concept continues, and the proceeds are distributed to the state in which the lease is located.

*Federal Financial Support.* Several options have been pursued through the years to fund technology development. Tax credits have been one avenue that proved very successful for coalbed methane development. Incentives like those of the Synthetic Fuels Corporation have been another. The DOE Demonstration Project route like

that at Logan Wash is another. And the DOE cost-share like the Occidental C-b Oil Shale Project is another.

Oil shale technology development is still fraught with uncertainty. Once a technology appears promising, it must be field tested. And then limited commercial scale production may occur. Collectively, this could span a decade or more. But the lesson learned from the 1970' and 1980's is that any financial incentive program must have a duration comparable with the timeframes for private investment that include a realistic timeframe for technology development and implementation, or the private dollars will not come.

The Department of Energy should poll the industry prior to the passage of any legislation to determine the adequate minimum timeframe to encourage private investment.

*Coordinated Permitting Process.* Given the economic transformation of NW Colorado in the past 20 years, coupled with the increasing level of natural gas development, a coordinated and integrated permitting process is essential. The environmental and land use permitting process can be complex and time-consuming when all the local, state and federal requirements are considered. Coordinating the process is essential, and cannot be underestimated. For the requirements in place 20 years ago, the average timeframe to permit an oil shale project was about 42 months. Some processes have become more complex since then—and certainly public interest is more organized and focused.

As a reminder, the Colorado Joint Review process grew out of the concerns raised over the concept of the Energy Mobilization Board. That Board would have had the power to preempt local and state regulatory requirements in the national interest. The reaction in the West was to coordinate and streamline, not dismantle, the existing process. And it worked. Attempts in recent years to truncate the process have been met with public criticism and lawsuits. Such efforts have proven to be counterproductive to the goal of developing these important resources.

The Colorado Joint Review Process is an option that the federal government should consider fully funding, or partially funding along with industry, to assure a rigorous review with adequate public input and consultation.

*Economic Impact Analysis.* Once the development area is determined, a procedure must be established to evaluate economic impacts at the local level. The federal government should fund, either through the bonus bid process or authorizing legislation, a concept similar to the tools used by the Cumulative Impacts Task Force. This analysis would not only guide the timing of needed permanent and temporary community services and infrastructure, but also allow local governments to establish fiscal tools that would insure that growth could pay its own way.

The true cost of the development of strategic resources such as oil shale must be evaluated not only in the context of their technology and development costs, but also the costs and benefits to the community. Securing a safety net is the primary lesson of the last bust.

#### CONCLUSION

It is essential that Congress consider the life cycle of oil shale development as it contemplates a renewed national oil shale effort. Only this view will portray the complete picture, so that the appropriate technology, environmental and economic structures can be defined and funded for a successful long-term effort. I look forward to working with you in the months ahead.

Senator SALAZAR. Thank you, Mr. Speaker. I appreciate your comments here this morning.

Mr. Evans.

#### STATEMENT OF JIM EVANS, EXECUTIVE DIRECTOR, ASSOCIATED GOVERNMENTS OF NORTHWEST COLORADO, RIFLE, CO

Mr. EVANS. Thank you, Mr. Chairman. My name is Jim Evans. I am the director of the Associated Governments of Northwest Colorado, a local government association of cities and counties that was formed 30 years ago as the regional oil shale planning commission, and it was formed specifically to deal with the impacts of oil shale development in our five-county region.

I am here in support of the DOE strategy that was referenced earlier by the chairman for a research and development approach rather than a commercial scale venture that was premature in the last cycle. So my testimony, that submitted, references some of the things we learned from the last cycle and some of the things we would like to be addressed as we go forward now. I would just like to hit those highlights and actually start with the statement that I am here from the local government and I am here to help you. You know, that is what we hear from the Federal agencies when they come out to help us. This time I would like to repay that because I have some specific recommendations.

Senator SALAZAR. Usually when it is the local government, it is very helpful, Mr. Evans.

Mr. EVANS. Well, we appreciate all the comments of the members of the committee about that concern and the Department of Energy and Department of Defense have all indicated that as well.

The Club 20 resolution that has been submitted that Senator Alard referenced earlier basically sets forth what our local position is. We do not want to wait for another crisis mode like the Arab oil embargo of 1974 and go for premature commercial scale development. We very much appreciate Shell Oil Company's efforts going forward with a steady research and development effort, and we think that that should be encouraged by the Department of the Interior and the Department of Defense, as well as DOE.

Specifically, with some of the recommendations that are contained in our testimony, we would like environmental impacts as part of this effort, and I think Mr. Smith will go into that in more detail.

We would like the socioeconomic impacts that Russ George has just indicated considered as part of that effort, and my written testimony goes into more details.

At the State level, we would encourage those things the Colorado Joint Review program already referenced, the Department of Natural Resources. Also their wildlife and reclamation programs should be utilized. And the Colorado Department of Public Health air quality—I also sit on the State Air Quality Control Commission—I think the State is in a position to the air quality and we are encouraged by Shell's experience so far.

Then I would like to get to money. I have a suggestion for the Federal Government. You have an opportunity before you. Congress approved the transfer of the Naval Oil Shale Reserve lands in our State from the Department of Energy to the Department of the Interior. I have attached a letter from the Secretary of the Interior on the status of the funds that now have been accumulated from the natural gas leasing that that triggered. That is the current natural gas leasing, Mr. Chairman. I am not talking about the proposed additional leasing. There is a \$38 million fund accumulated now from the Federal and State share that is being transferred over to the Department of Energy in a special account, and it is referenced in that letter. I think those funds should be made available for the oil shale program in some mechanism.

Then estimates of future leasing on the Naval Oil shale Reserve. There is a lot of discussion on whether there should be additional drilling on top of the area or from the side. Technology will eventu-

ally get at that resource, but it is an \$8 billion natural gas resource in estimates, of which one-eighth, or \$1 billion, in royalties will occur that both Shell and the Governor's representative here have referenced. That would be split 50-50 with the State and the Federal Government. So there is a \$500 million potential for the Federal Government and a \$500 million State share over a 20-year period estimated for that resource.

I believe—and our association and local governments believe—that a statement in legislation you are considering should reference that some of these mineral leasing funds should go toward oil shale impact, as well as other energy impacts. There is already priority language in the Mineral Leasing Act, but I think it should be strengthened. There would be a good source of funds for the research and development efforts that you are considering.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Evans follows:]

PREPARED STATEMENT JIM EVANS, EXECUTIVE DIRECTOR OF THE ASSOCIATED GOVERNMENTS OF NORTHWEST COLORADO, RIFLE, CO

A LOCAL GOVERNMENT PERSPECTIVE ON FEDERAL OIL SHALE RESEARCH AND DEVELOPMENT EFFORTS

Mr. Chairman and Members of the Committee:

My name is Jim Evans, Executive Director of the Associated Governments of Northwest Colorado (AGNC), representing cities and counties in the 5-county region of Garfield, Mesa, Moffat, Rio Blanco and Routt Counties in Northwest Colorado. On behalf of our local governments I want to express our appreciation to your committee for asking our local government views on the development of oil shale technology.

Our local government association was formed at the start of the last oil shale development cycle as the "Regional Oil Shale Planning Commission" with the specific charge to address the socioeconomic and environmental impacts of a potential commercial scale oil shale industry. Now, renamed as the Associated Governments of Northwest Colorado, we are still concerned with this issue. This time around it appears that our region will need to address the potential growth and infrastructure impacts of oil shale development on top of the socioeconomic impacts already occurring in our region from record levels of natural gas, oil and coal production. With estimates of from 600 billion barrels to 1.8 trillion barrels of recoverable oil from shale in our region, we recognize the national interest in developing the technology for this resource. In particular, the needs identified for the Department of Defense for a secure domestic source of fuel make us realize that the importance of the resource cannot be ignored. We also understand the potential economic benefit development of this resource can play on our national balance-of-trade and G.N.P.

Since more than 80% of the oil shale resource is located on federally-owned public land and recognizing that the future development is driven by national interests, local governments in our region believe the federal government must play a lead role in addressing these socioeconomic and environmental impacts and costs. We do not want to see local governments (and local taxpayers) stuck with the costs of new infrastructure and the mitigation of environmental impacts. So we are pleased to see that your Committee and the Department of Energy as we begin this next cycle in Oil Shale development are addressing these issues up front. This is a refreshing difference than the start of the last cycle. Back then, with an oil embargo facing the country, Congress first responded with a proposal for an Energy Mobilization Board with the power to declare Northwest Colorado as a "National Sacrifice Zone". Fortunately, that proposal did not make it all the way through Congress and as my following testimony indicates, we learned a lot during a fairly painful 18-year boom/bust cycle prematurely attempting to develop commercial scale projects.

This time we appreciate the "Research and Development" type approach being put forward by the Department of Energy, and by the recognition of your Committee up front that you are looking for development of an environmentally friendly technology, and an approach not dependent upon the price of oil.

Because we support your stated approach it gives me the opportunity to say, "*I am from the Local Government, and I am here to help you.*"

I would like to start my help by submitting for the record the following resolution from Club 20, the community based Colorado organization representing cities, counties, businesses and citizens throughout Western Colorado. This resolution was unanimously adopted by the Club 20 Board of Directors endorsing a Research & Development program as being considered by your Committee.

CLUB 20 SUPPORT FOR AN ECONOMICALLY VIABLE  
AND ENVIRONMENTALLY SOUND OIL SHALE R&D PROGRAM

*Whereas* Oil shale may still be the largest untapped resource available for transportation fuels;

*Whereas* the richest deposits of oil shale in the world are located in North-western Colorado and Eastern Utah;

*Whereas* a DOE report indicates that oil shale development may still be important for our country's National Security (as an alternative to imported oil) and for our Economic Security (to improve our balance of trade); and

*Whereas* without a well conceived federal R&D program this region may again someday be faced with another crisis oriented commercial scale oil shale program.

*Now therefore be it resolved* that Club 20 supports research and development efforts leading to an economically viable and environmentally sound oil shale program.

*Further*, Club 20 supports DOI/DOE/DOD efforts to develop a national oil shale policy and long-term R&D plans.

Approved, Feb. 15, 2005,

CLUB 20 ENERGY COMMITTEE,  
*Club 20 Natural Resources Committee.*

Approved, April 1, 2005,

*Club 20 Board of Directors.*

*Background: Last Oil Shale Development Cycle 1974-1992*

- The last oil shale cycle started with the Arab Oil Embargo in 1974. This was a Sudden Oil Shortage, resulting in long lines at gas pumps, temporary high gas prices, and a staggering impact on the U.S. Auto Industry and U.S. economy, aggravated by gasoline rationing.
- Congress responded in a crisis mode.
- The first industry proposal to local government was: Get out of the way and we will develop Oil Shale! Congress responded with a Proposal for Northwest Colorado to be declared a "National Sacrifice Area", including an Energy Mobilization Board with power to override Federal, State and Local environmental and land use laws. *State and Local governments responded on an adversarial basis.*
- President Jimmy Carter instead got Congress to establish the Synfuels Corp. with \$15 Billion in price guarantees and price incentives.
- In our region 12 projects were underway at peak of cycle (either in planning, permitting or construction).
- An Exxon White Paper suggested a socioeconomic impact of a one-million population increase in NW Colorado by 1990. It appeared that all the construction workers in U.S.A. would be required for the effort if all the companies went forward at the same time.
- The Colorado projects reaching construction or testing: Exxon Colony Project, Unocal, Oxy (CB), CA consortium. The DOE Anvil Points facility in the meantime was pretty much abandoned, except for a look at an asphalt additive by-product.
- The cycle collapse (Bust) started May 2, 1982 with an abrupt Exxon Colony closure. In the Boomtown Blues book, this event was blamed for the U.S. and worldwide recession.
- The Unocal project & Oxy continued their efforts through 1990-92. This somewhat mitigated the "bust" cycle. At the peak of the cycle, the combined population of the 2 most impacted counties (Garfield and Mesa) increased from 1981 to 1983 by 12%, from 112.0 thousand to 125.6 thousand. Then in the next 2 years the combined population dropped back to 111.8 thousand.
- Congress then overreacted and shut down virtually all oil shale research programs, despite recommendations from many sources that research and development activities should continue.

*Was Anything Learned During This Cycle? Yes!*

- Congress in 1975-76 enacted Mineral Leasing Act Amendments at the urging of States and Local Governments. The State share of federal royalties increased from 37% to 50% with priority for local governments impacted by Mineral Leasing activities, such as Oil Shale, Oil, Natural Gas and Coal.
- Congress enacted Payments-In-Lieu of Taxes (PILT) Act to compensate counties for tax exempt federal land thereby giving direct assistance to rural public land counties.
- States in turn enacted Severance Taxes, also with a priority to address socio-economic impacts.
- Local governments in turn enacted Major Impact Land Use Mitigation Ordinances.
- The Colorado Joint Review Process (CJRP) was initiated. This was a voluntary program designed to coordinate and speed up federal, state and local permitting.
- Local Government Energy Impact Programs were established by States with the new Revenue from Mineral Leasing and Severance Taxes. These programs today address the ongoing impacts of mineral development. The Energy Impact Program in Colorado actually started with the formation of the Regional Oil Shale Planning Commission (now AGNC) and the enactment of the Oil Shale Trust Fund (OSTF). From the OSTF \$75 million plus interest was allocated to NW Colorado counties. The \$75 million was Colorado's 37.5% of federal Oil Shale leasing bonuses.
- Negative impacts of the abrupt Exxon Colony Project closure actually resulted in a positive turnaround on State/Local/Industry relationships and communications as Unocal and Oxy proceeded with their projects with local support.
- Local governments also supported continuation of the Unocal and Oxy projects, including proposals to turn them into federal oil shale technology demonstration projects.
- Support for a Federal Oil Shale R&D program was generated in Colorado, Utah, Wyoming, Kentucky, Illinois and California, but to no avail.
- New Paraho Corp. temporarily continued oil shale asphalt testing at Anvil Points to demonstrate the byproduct approach to make oil shale economically viable. Some of the asphalt test strips are still in place with no repairs required.

*Local Government Advice to Industry for the Next Oil Shale Development Cycle: Communicate! Communicate! Communicate!*

The Shell Oil Shale Project is on the right track. Shell Oil is the only company in Colorado who is currently continuing with field-testing. Local governments appreciate these efforts. Their efforts have included ongoing meetings with County Commissioners, Cities, school districts and citizen groups. They have sponsored and organized town meetings. These were very successful from a local perspective. These should continue at the beginning of each phase of an R&D program.

The Department of Energy also appears to be on the right track. The Naval Petroleum and Oil Shale Reserve Office of DOE has prepared a well documented and thorough report indicating the National interest in developing the oil shale resource (trade deficit impact on the economy and national defense interest in a secure oil source.) We believe addressing the socioeconomic and environmental issues in the DOE proposal for a National R&D program and demonstration facility is on target. Virtually all groups and industry involved in the last oil shale cycle have recommended the need for an ongoing federal oil shale research program.

These Groups and individuals back in 1991 were: The Rocky Mountain Oil & Gas Association, The Western Oil Shale Action Committee, Club 20, Associated Governments of Northwest Colorado, The Garfield County Citizen Alliance, Governor Roy Romer, Senator Tim Wirth, Representative Ben Campbell, The Rebuild America Foundation, The Alternate Energy Research Institute, and The Rocky Mountain Institute. There may have been others. These were the ones that I was aware of.

*Recommendation to Address the Socioeconomic Impacts of the Next Oil Shale Cycle*

With the renewed interest in oil shale development, the Department of Energy needs to provide funding for socioeconomic programs to:

- Assemble and update impact data from the last cycle.
- Identify appropriate computer systems/models to assess projected impacts.
- Development of baseline economic data for current activities.
- Help identify and provide revenue streams for local/state government services/infrastructure potentially impacted by oil shale development.

DOE also needs to identify and recommend appropriate federal, state and local policies to encourage prudent and environmentally sound oil shale development.

*Recommendation to Address Environmental Impacts of Oil Shale Development*

The DOE Demonstration program/projects should address:

- Surface disturbance impacts and ongoing reclamation requirements.
- Air Quality impacts.
- Water Quality and Quantity impacts.
- Wildlife protection and mitigation requirements.
- Employee health, safety and training needs.

Regular communications with news media and environmental groups should address the potential environmental impacts of various oil shale technologies.

The Colorado Department of Public Health and Environment should be actively involved in monitoring air quality and water quality impacts.

The State of Colorado Department of Natural Resources and its Wildlife Division should be actively involved in these reclamation and wildlife issues.

The Department of Interior should develop a leasing program to accommodate access to oil shale for research and demonstration project purposes. Any commercial scale leasing proposals must include provisions that recognize the "carrying capacity" concepts for socioeconomics and the environment that are part of the BLM Piceance Basin Resource Management Plan.

*Recommendation to Provide the Funding for Oil Shale Research Costs and Incentives*

We believe it is fortunate that Congress may have already provided a potential source of funding for Oil Shale R&D efforts. This revenue may be currently available from the Naval Oil Shale Reserve (NOSR) lands themselves located in Northwest Colorado. As indicated in the attached letter from the Department of Interior, some \$43.7 million may be accumulated by March 2007 in a U.S. Treasury account from the current natural gas leases on their NOSR lands. These NOSR lands were transferred by Congress from DOE to the Department of Interior with a Congressional priority established for natural gas leasing.

Some of these funds, estimated at \$5.8 million, are earmarked for environmental cleanup of the Anvil Points spent shale pile. Otherwise, we believe Congress has the opportunity for the remainder of these funds to be made available to address the socioeconomic and environmental aspects of oil shale development in Northwest Colorado.

In the future, more revenue should be available from this source. According to industry estimates, additional leasing of the NOSR lands could produce leasing bonuses of up to \$360 million (to be shared 50% federal and 50% state) plus ongoing production leases of an estimated \$32 million annually for at least 20 years. That would be another \$640 million total also to be split 50/50 federal and state. Congress should establish a priority to address oil shale and other energy development impacts in Northwest Colorado from these leasing revenues.

We believe this type of funding is necessary to make sure the DOE research and demonstration projects can proceed without interruptions from fluctuations in the price of oil.

Thank you for this opportunity to testify. I would be happy to answer any questions you may have.

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DEPARTMENT OF THE INTERIOR,  
BUREAU OF LAND MANAGEMENT,  
*Lakewood, CO, February 9, 2005*

Hon. FOREST NELSON,  
*Chairman, Associated Governments of Northwest Colorado.*

Hon. JIM EVANS,  
*Executive Director, Associated Governments of Northwest Colorado.*

DEAR MR. NELSON AND MR. EVANS: This is in response to your letter dated January 5, 2005, regarding the state share of federal mineral royalty payments related to the Roan Plateau area (formerly Naval Oil Shale Reserves Nos. 1 and 3). Your letter requested a response to two questions.

1. Have sufficient funds been accumulated to satisfy the reimbursement provisions of the legislation?

Sufficient funds have not yet accumulated to cover the reimbursement provisions of the legislation. As of December 28, 2004, the treasury account has accumulated \$23,087,790 while the total reimbursement amount is estimated to be \$43,735,001.

This leaves a difference of \$20,647,211. There are two components of the reimbursable costs, environmental restoration and cost recoupment of the United States investment in wells and gathering lines. The cost for environmental restoration is estimated to be \$5,800,000 (-15% to +30% accuracy). The costs to be recouped for the investment in wells, gathering lines, etc., is established at \$37,935,001.<sup>1</sup>

2. When will the states share of royalty revenues resume?

The lands currently leased are producing royalties of approximately \$799,000 per month, based upon a fourteen month average of royalty payments for fiscal years 2004 and 2005. Based upon this average, the remaining \$20,647,211 to be reimbursed will be accumulated in about 26 months, or approximately March 2007. Under the current schedule, the Engineering Evaluation/Cost Analysis of the environmental restoration work is anticipated to be completed by May 2005; with clean-up completed by July 2007.

Since sufficient funds still have not accumulated to satisfy the reimbursement provisions of the legislation, we do not believe that we can initiate or expedite sharing of the royalty payments sooner than March 2007.

We understand and appreciate your concern with this issue.

If you have any questions on this issue, please feel free to contact any of the following: Jamie Connell, Field Manager, Glenwood Springs Field Office at 970-947-2800; Lynn Rust, Deputy State Director, Energy Lands and Minerals, BLM Colorado State Office at 303-239-3885; or Duane Spencer, Chief, Branch of Fluid Minerals, BLM Colorado State Office at 303-239-3753.

Sincerely,

RON WENKER,  
*State Director.*

Senator SALAZAR. And we have that letter, Mr. Evans?

Mr. EVANS. Yes. That is in the written that was submitted.

Senator SALAZAR. Thank you very much, Jim.

Mr. Smith.

**STATEMENT OF STEVE SMITH, ASSISTANT REGIONAL DIRECTOR, THE WILDERNESS SOCIETY, DENVER, CO**

Mr. SMITH. Good morning, Mr. Chairman. It is a pleasure to be here this morning and especially to address you on the dais as our newest Senator and with your new, if momentary, title.

Senator SALAZAR. It is momentary, let me assure you.

[Laughter.]

Mr. SMITH. My name is Steve Smith. I appreciate very much this opportunity to address the committee. I also appreciate the interest shown by Colorado's other Senator, Senator Allard, in this remarks and questions presented earlier.

I am assistant regional director for The Wilderness Society Four Corners States Office. My testimony today, however, reflects thoughtful research and recommendations compiled by staff and volunteers from an array of conservation and citizen organizations.

Perhaps uniquely relevant to today's topic, I live in Glenwood Springs, Colorado, 30 miles from one of America's richer deposits of oil shale. I am also an active member of Club 20's Energy Subcommittee where, along with Mr. Evans and others, we crafted the details of the resolution mentioned several times about the deliberate, but very cautious and careful encouragement of looking into the possibility of oil shale development.

Over the past 17 years living in Glenwood Springs, I have watched the local people and communities there slowly, steadily, and sometimes bitterly crawl out from under what was the disaster of the last oil shale experiment in our county. Generally, our com-

<sup>1</sup>\$37,935,001 includes past DOE costs as outlined in a May 5, 1999, DOE memorandum, entitled, "NOSR Cost Recovery Model and Results"

munities are thriving now, building economies that are diverse, enlightened, and based in large part on the preservation and enjoyment of the unique scenic and untrammelled public lands surrounding us.

We in western Colorado are aware of oil shale's potential, its potential to help provide for the Nation's energy needs, but also its potential to engender false hopes, exaggerated claims, and unfilled promises.

There are at least three basic environmental issues that oil shale development presents, and we urge that this committee of the Senate and Congress proceed carefully in considering any commitment of Federal land or resources in this endeavor.

First, this technology may threaten groundwater quality and the supply of water in the Upper Colorado River Basin.

Second, the current version of the new in-situ process requires very tightly spaced drilling shafts to treat and produce fuel, with surface impacts that approach 100 percent.

Third, the process consumes more energy than it produces by a significant margin.

If other companies decided to pursue development of oil shale using conventional mining and above-ground processing or retorting, the environmental and water resource issues would be multiplied 10- or 100-fold.

An even more immediate concern to the people and communities near oil shale deposits are the impacts that a revived oil shale industry would have on the growth, social structure, public facilities, transportation systems, watersheds, tourism, and public land recreation opportunities that are crucial to our daily lives. Local people have a strong concern about these issues and need to have a strong voice in their governments' decisions.

We commend Shell Oil Company in particular for the careful and deliberate approach the company has pursued so far. We hope that other companies will emulate their model of slow, small research using private financing.

Most basically, Mr. Chairman, we do not really believe that any new Federal funding or significant action is needed at this time. Private research is continuing. The Mineral Leasing Act grants the Secretary of the Interior authority to issue new leases, if interest warrants, and the Department of the Interior is, indeed, in the midst of promulgating rules for a limited public lands leasing program for oil shale research and development.

Those oil shale research and development leases, by the way, should be for truly new research. Companies leasing Federal lands for this research should pay full market value for the use of the land. Leasing tracts should be tightly constrained in size, require continuous and comprehensive environmental monitoring, provide baseline data on energy producing techniques, and on environmental protections necessary to minimize any effects on natural and public values. No lease for research and development should be converted to a commercial production lease.

Such are the small, cautious, and smart steps appropriate to this technology and the limited impact it might have on our energy future. Let the free market work. Be cautious with limited Federal dollars and especially careful with irreplaceable Federal land, and

learn from small, smart experiments before embarking on anything larger.

If there is one thing that might be done, we recommend specifically that the Department of the Interior enter into a cooperative agreement with the States of Colorado and Utah to develop a comprehensive, programmatic, environmental impact statement under the auspices of the National Environmental Policy Act, to evaluate economic, technical, environmental, and socioeconomic issues regarding oil shale development before public lands or resources are committed. This detailed NEPA analysis should be conducted even before implementation of research and development leasing program, certainly before undertaking any larger scale use of public lands or resources for oil shale production.

Thank you again for this opportunity and this generous length of time to discuss and address with the committee this fascinating discussion about this unique resource. Please let us know at any time how we can assist with further congressional discussion of these important questions. Thank you.

[The prepared statement of Mr. Smith follows:]

PREPARED STATEMENT OF STEVE SMITH, ASSISTANT REGIONAL DIRECTOR,  
THE WILDERNESS SOCIETY

Good morning, Mr. Chairman and senators. My name is Steve Smith. It is a pleasure to be with you today, and a special pleasure to see my newest senator, Senator Salazar, on the dais.

I am Assistant Regional Director for The Wilderness Society's Four Corners States Office. My testimony today, however, reflects thoughtful research and recommendations compiled by staff and volunteers from an array of conservation and citizen organizations, including Biodiversity Conservation Alliance, Center for Native Ecosystems, and Colorado Environmental Coalition, and Oil & Gas Accountability Project, among others.

I am especially grateful for the very able advice and assistance that I have received from Jim Martin of Western Resource Advocates, Randy Udall of Community Office for Resource Efficiency, air quality expert Robert Yuhnke, and Kevin Markey.

Perhaps uniquely relevant to today's topic, I live in Glenwood Springs, Colorado, 30 miles from one of America's richer deposits of oil shale. Over the past seventeen years living there, I have watched the local people and communities slowly, steadily, sometimes bitterly, crawl out from under what was the disaster of the last oil shale experiment in our county.

Generally, our communities are thriving now, building economies that are diverse, thriving, and based in large part on the preservation and enjoyment of the unique scenic and untrammeled public lands surrounding us.

With recent news stories about increasing oil and gasoline, and with our continuing and increasing reliance on oil—especially oil imports—to fuel our vehicles, it is apparent that some Members of this Committee and other policy makers have a renewed interest in the development potential of the oil shale resources in Colorado, Utah, and Wyoming. However, there is an old and enduring saying in Colorado about oil shale, "Oil shall have a fantastic future—it always has and it always will."

Almost exactly a month ago today, *The Wall Street Journal* carried a story that reiterated both the enormous resource that is tied up in the shale of the Mahogany Zone of the Green River Formation, and the challenges that are entailed in literally extracting oil from rock. We who live in western Colorado, who lived through the last oil shale boom—and bust—are well aware of this resource's potential. We are aware of its potential to help provide for the nation's energy needs, but we also are aware of its potential to engender false hopes, exaggerated claims, and unfulfilled promises.

Other witnesses appearing before you today are far better qualified than I am to assess both the quantity of shale oil that is potentially recoverable and the quantity that may prove to be economically recoverable. While considering their presentations, however, it seems important to recall that producers and their investors

sank \$5 billion into oil shale last time around, and then abandoned the field on May 2, 1982.

It is important to put today's oil and gasoline prices into perspective. As the last oil shale venture in northwest Colorado was coming apart in 1980, the Office of Technology Assessment projected that the production of oil from oil shale might be economically viable at a market price of \$61 per barrel, and an internal Exxon memo pegged the number at \$108 per barrel, both those numbers in 1980 dollars. Even our current prices of \$50-\$58 dollars per barrel, adjusted for inflation, do not come close to those levels.

I would like to use my time before you today to identify some of the environmental issues that oil shale development entails, and ultimately to urge that this committee, the Senate, and the Congress proceed carefully and deliberately in considering any commitment of federal land or resources to this endeavor.

There are two basic variations of oil shale developments currently contemplated—*in-situ* processing and mining and surface retort processing. Each raises unique concerns.

The technology that Shell and others are pursuing is, as we understand it, an *in-situ* process that heats shale rock to 650-700 degrees Fahrenheit to release the petroleum compounds that are bound to that rock. I have been very impressed by presentations about the imaginative and innovative experimentation the company is conducting on private land in northwest Colorado. That process raises at least two immediate issues, however.

First, from what we understand, this technology may threaten ground water quality. Shell is proposing to prevent ground water contamination through the use of something called an ice wall—in short, they propose to super-cool the area around the extraction cone. This represents a potentially ingenious solution to a very serious issue—but it should go without saying that this committee and the Department of the Interior should insist upon thorough testing, analysis, and peer review of the technology's use before committing the nation to an unproven technology that irretrievably contaminates ground water across a wide swath of Colorado or other western states.

Second, the current version of the new *in-situ* process requires very tightly spaced drilling shafts to treat and produce fuel. The surface impacts of such a process approach 100%; this is a highly industrial operation imposed on previously natural landscapes. The cumulative effects that such a process might have on public lands, were the technology to be transferred there, bear close scrutiny.

Third, the process consumes more energy than it produces, by a significant margin. This heating and cooling process will create huge new demands for energy to extract oil from shale.

The experience in Alberta should be a cautionary note for us. Tar sands development in Canada could not occur without the use of large quantities of natural gas—potentially much of the entire production to be carried by the new pipeline from the MacKenzie Delta. Tar sands development in Canada is one of the principal reasons natural gas exports to the United States will not increase and may even decline over the next ten years.

The question this committee should pose is—where will this energy come from? If the answer is natural gas, that decision will further exacerbate a structural gap between natural gas supplies and natural gas demand between now and 2025. If the answer is new coal-fired electric power plants, then I hope the Committee and the Environmental Protection Agency will be directed to assess the air quality impacts that inevitably will result from both new energy sources and the oil shale process itself. As the Bureau of Land Management's analysis for natural gas development in and near the Roan Plateau suggests, the cumulative impacts of energy and other resource development in this part of Colorado, combined with emissions from nearby areas, threaten air quality in a wide range of Class I areas. At a minimum, we should understand the air pollution impacts of full field development and have in place a mechanism for mitigating those impacts.

Meanwhile, we must put the prospect of a relatively minor contribution that oil shale might make to the nation's energy supply into the larger context of energy production, energy use, and efficiencies in both.

Another recent *Wall Street Journal* article, from March 28, described the discussions and recommendations of 26 former national security advisors who, in essence, encouraged the nation to recognize the full cost of our continuing, disproportionate, and, some would say, debilitating dependencies on oil from any source.

One way to address the increasing cost of oil and the slowing pace of oil production is to use it more efficiently. According to the Community Office on Resource Efficiency, an improvement in the fuel efficiency of the United States' automobile fleet would save 400,000 barrels of oil, more than oil shale is ever likely to produce.

Certainly, efficiency alone will not replace our need for physical, usable fuels. Just as certainly, it can make the sources we have go a lot farther in supplying the sustenance, mobility, and products that we need. My point is that before considering any significant investments in promising but unproven and expensive technologies like oil shale, we need to be sure that we have taken all the easier and less expensive steps possible in improving the way we produce and use fuel from existing sources.

As a Coloradan and a long-time resident of the Western Slope, I also hope this committee will carefully assess how full field development would impact water rights and water-related issues in Colorado and in the upper Colorado River basin. I raise just a few of the many questions that must be asked. Is any water available for a new energy industry in drought years? If so, would the withdrawals for oil shale result in a reduction of flows—or even a loss of flows—in the critical reach just upstream of Grand Junction? If so in turn, what endangered species issues are implicated? If any water is available in drought years, how would oil shale development affect the total amount of water remaining for Colorado's use under the Law of the River?

The recent conversation about oil shale development has revolved around the in-situ processes being developed by Shell. However, if other companies decide to pursue development of shale oil using conventional strip mining and above-ground retorting, the environmental and water resource issues would be multiplied ten or one hundred-fold. The retorted material contains a plethora of toxic substances that would pollute ground and surface water. The material expands during processing, creating massive waste storage problems. The processing itself requires staggering amounts of energy and emits large quantities of both criteria pollutants and hazardous air pollutants. In addition, it goes without saying that the mining areas are near the Colorado River, which provides drinking water to literally millions of people downstream.

One of the factors that must be addressed for any above-ground retorting operations is the control air pollution. Primary among pollution types is the inevitable generation of sulfur and, once that element is exposed to air, the generation of sulfur dioxide. That was an important issue in 1980, when the court held that oil shale operations must comply with direct and regional incremental degradation of air quality. The technologies for control of sulfur dioxide has improved in the past two decades, but not all sources of the pollutant, primarily electric power plants, have taken measures to use them. If oil shale operations add sulfur dioxide to the regional mix, oil shale operators may be able to mitigate those additions by investing in pollution control technologies at existing power plants. Such exchanges of so-called pollution credits must, however, be investigated and integrated into any expanded oil shale program.

An even more immediate concern to the people and communities near oil shale deposits are the impacts that a revived oil shale industry would have on the growth, social structure, public facilities, transportation systems, watersheds, tourism, and public lands recreation opportunities that are so crucial to our daily lives. Local people must be assured that they will have a strong voice in their government's decisions, especially those that have such a potential, based on past experience, for terrible consequences.

We commend Shell for the careful and deliberate approach the company has pursued to date. We hope that other companies will emulate their model of slow, small, research, using private financing. Meanwhile, we urge, in the strongest terms, that this committee and Congress adopt a policy of carefully looking before we leap. There are myriad questions—not just environmental—to be addressed. As Shell's Mr. Terry O'Connor said in the Denver Post just last week, "we think we're about a decade from making a decision on commercial production." We hope that Shell's research is successful and they can find a way to develop this process in an economic and environmentally responsible way. While research by Shell and others continues, we encourage the Congress to take a hard look, based on careful and incremental research and experimentation, at the natural resource and environmental issues that shale oil development poses and begin to identify ways in which impacts can be prevented, avoided, and mitigated.

Most basically, Mr. Chairman, we do not believe that any action is needed at this time. Private research is continuing, and by Shell's own description, the company—operating on private land with its own financing—is years from making the go/no go decision about full field development. Several companies already hold leases. Meanwhile, the Mineral Leasing Act grants the Secretary of the Interior authority to issue new leases if interest demands. Indeed, the Department of the Interior, in cooperation with other departments, is in the midst of promulgating rules for a limited public lands leasing program for oil shale research and development.

Those oil shale research and development leases, by the way, should be truly new research, not continuation of old, unsuccessful techniques. Companies leasing federal lands for this research should pay full market value for both the use of the land and for any minerals extracted from it. Leasing tracts should be tightly constrained in size. Continuous and comprehensive environmental monitoring must be implemented by both the leasing companies and by federal land managers. The research should provide detailed and comprehensive baseline data on energy producing techniques and on environmental protections necessary to minimize any processes effects on natural and public values. No lease for research and development should be converted to a commercial production lease without competitive bidding and additional payments to the treasury.

Such are the small, cautious, smart steps appropriate to this technology and the limited impact it might have on our energy future. Let the free market work, be cautious with limited federal dollars and especially careful with irreplaceable federal land, and learn from small smart experiments before embarking on anything larger.

Specifically, we recommend that, before Congress considers any commitment of federal public lands or resources, beyond research and development projects on very limited financial and geographic scale, the Department of the Interior enter into a cooperative agreement with the States of Colorado and Utah to develop a comprehensive, programmatic Environmental Impact Statement under auspices of the National Environmental Policy Act (NEPA) that would evaluate and review all relevant economic, technical, environmental, and socioeconomic issues regarding proposed oil shale development policies and development proposals.

This detailed NEPA analysis should be conducted even before implementation of a research and development leasing program, certainly before undertaking any larger scale use of public lands or resources for oil shale production.

We think this approach would be valuable for several reasons. For one thing, the most recent comprehensive evaluation of the technologies, economics, resource demands, socioeconomic impacts, and environmental impacts of oil shale development that we could find was a 1980 assessment by Congress's Office of Technology Assessment (*An Assessment of Oil Shale Technologies*, Office of Technology Assessment, June 1980, available at [http://www.wvs.princeton.edu/ota/ns20/topic\\_f.html](http://www.wvs.princeton.edu/ota/ns20/topic_f.html)). Though an interesting and comprehensive document, with much useful information, it was published two and a half decades ago. In the intervening years, much change has taken place, both in terms of the technology of oil shale extraction, and within the region itself.

An environmental impact statement would afford an opportunity for the relevant government entities to evaluate the potential advantages and disadvantages of various technologies and policy approaches, and the potential impacts of various scales of development on the communities and environment of western Colorado and eastern Utah.

Some of the questions to be addressed in an EIS that I mention above. A larger list of questions also would include: What scale of development are we considering: 50,000 barrels/day; 100,000 b/d; 1,000,000 b/d? What are the water requirements of oil shale projects at these different levels? What water quality impacts might we anticipate? What are the potential impacts on air quality? Are their unique pollution control challenges with oil shale technologies? What is the new regional context for regional air pollution and pollution control, compared to 1982? What are the energy requirements of various levels of oil shale development? Will development require the construction of new power plants elsewhere? Will these be coal plants, natural gas, or both? What will the impacts of energy demands for oil shale development be on fulfilling energy demands from other user sectors? What are the workforce requirements? Will new public infrastructure be required, i.e., roads, schools, police protection, etc.? Who will pay for this? These are some of the issues that need to be addressed, and that citizens and policy-makers need to be informed about, before we put policies in place that seek to commercialize the development of oil shale.

These are important issues for our region to understand. For example, the 1980 OTA report noted with respect to socioeconomic impacts of a 1,000,000 barrel per day program the following:

A 1-million-bbl/d industry could not be accommodated without major Government involvement and massive mitigation programs. The participation of Federal, State, and local agencies, the public, and the developers would be essential to minimize the adverse living conditions that would inevitably arise. [Chapter 1, p. 5]

With respect to water demands, the report noted that the region could sustain a 500,000 bbl/d program until the year 2025, "after which water scarcities may limit all regional growth." [Chapter 1, p. 4]

With respect to water pollution, the report noted that, "The potential leaching of waste disposal areas and in-situ retorts after the plants are abandoned is a major concern. If it occurs, the leachates could degrade the water quality in the Colorado River system, a vital water resource in the Southwest . . ." [Ch. 1, p. 4]

These are just three examples of a wide range of issues that need to be addressed before we adopt policies to encourage the development of oil shale.

Of special importance, the framework of an EIS affords the people of Colorado, Utah, and American citizens in general an opportunity to become informed about the status, promise, risks, opportunities and impacts of oil shale development. Because state and local governments will have to shoulder much of the responsibility for dealing with both the socioeconomic and environmental impacts of this industry, they need to have as much information as possible to make informed decisions. Finally, it is to the advantage of policy-makers here in the Congress, as well as within the Executive Branch, to have as much information available as possible about the promise and perils of oil shale development, before any final policy decisions are made.

Whatever our various views on the policy choices before us, I hope that we all can agree that developing as much information as possible, and affording the citizens of the communities affected the opportunity to learn more about the consequences and opportunities of oil shale development, is necessary before we make any hard and fast decisions about the direction we will take. Such an approach is in the best interest of all of us, including industry proponents, the federal, state and local governments, and the people of Colorado and Utah. I hope that this time around, we will be more careful than we were the last time. I urge that we use the framework provided by the National Environmental Policy Act, combined with cautious, sensible deliberations, to inform the decisions we make, before we make those decisions.

Thank you again for this generous opportunity to address the committee and the fascinating discussion that this hearing has promptly. Please let us know at any time how we can assist with further Congressional discussion of these important questions.

Senator SALAZAR. Thank you very much, Mr. Smith, and on behalf of the Energy Committee, I thank all of you for participating and giving us your testimony and this information today.

I will ask some questions of the panel for a few minutes here.

First, Mr. Mut, if you can tell us a little bit more about the time line with respect to the project that you currently are working on. I heard in your comments that you were planning on being in a position where perhaps by the end of the decade, you would be able to develop a plan after you have completed your research and development. Can you tell us a little bit more about your time line with respect to getting to a point of whether or not you can decide if this in-situ technology is, in fact, going to work to develop oil shale?

Mr. MUT. Yes, Senator. There are still a number of things that we need to test, some on a sequential basis and some in an integrated test. To design, construct, and then conduct that integrated test will take on the order of 4 years. In the most optimistic case, if we get the type of response that we are designed to and see the recovery efficiency that we need to see in order to make the process economic, the time between now and the end of the decade would be totally consumed with that process, designing, building, conducting, and evaluating the results of the experiment.

Senator SALAZAR. Mr. Mut, if I may, what are the factors that are requiring the amount of time to be taken to do the further research and development? The reality is that we do know a lot about oil shale. The experiences of the past did not work. This new in-situ process which you have underway is a new process, where you have been working on it for a while. Are there things that could be done to try to speed up that process, or do you think that

you are doing everything that is worldly possible in terms of your schedule so that it is still to the end of the decade before we will know whether or not this will work?

Mr. MUT. Our belief is that our level of knowledge today is insufficient to make a commercial decision today. So one larger scale and almost a magnitude larger integrated test is required.

The real issue, Senator, with getting the quality of information you need is that you need to model the commercial process. By that, I mean you have to have the well spacing far enough apart that you can emulate the commercial process. In order to get the heat transferred to get the type of recovery that you need to measure, it takes about 3 years. So if we made tighter spacing of those heaters in the experimentation, we could get an answer quicker, but then we would have a larger extrapolation to make into commercial. So we are trying to balance the time that it takes to do the experimentation so as to get the information that would be required to make that leap at time of commercial.

Senator SALAZAR. So in summary, then you essentially, from the point of view of Shell Oil out there on the ground building this R&D project, believe you will not be in a position until about 2010 to determine whether or not this technology will work to commercially develop oil shale. Is that correct?

Mr. MUT. That is correct.

Senator SALAZAR. Let me ask a question both of you and Mr. Smith, if I may, Mr. Chairman. Mr. Smith raised a question about the amount of energy that it actually takes to produce the fuel from the in situ heating up of the oil shale. Give us a sense of that concept. How much energy does it take to actually heat up the oil shale to the point where it is commercially producible, and are we putting more energy into the ground to heat up the oil shale than ultimately what we are taking out of the ground? What is your sense of that equation?

Mr. MUT. Well, Senator, I could never make those economics work. If you take the electric energy that is input into the ground, we produce seven times as much energy coming out. When you take the thermal inefficiency involved in power generation into account, that number is cut to about  $3\frac{1}{2}$  to 1. So the energy balance is, say,  $3\frac{1}{2}$  to 1 when everything is calculated into the whole process. So for every bit of basic energy required to process and to generate power, we yield  $3\frac{1}{2}$  units of energy out.

Senator SALAZAR. I have just one more question, and this is of Mr. George. You lived through oil shale probably like nobody else has in this room, watching what happened on the Western Slope back in the 1970's and the 1980's. What is your view of the development currently underway by Shell Oil? Generally how do you respond to some of the concerns that Mr. Smith raised from an environmental perspective?

Mr. GEORGE. Thank you, Senator. Pretty clearly, we would have no interest in repeating the boom/bust cycle. If that was the option and if we go forward based solely upon the influence of price of oil, then we are destined to repeat the same mistake. So even though we have a changing culture and increasingly sophisticated population in western Colorado, it is hard to try to speak for everyone. So we are always going to have people at a different place on the

spectrum of how can we anticipate they would react to some change in the oil shale process in industry.

But I think we could probably say these things, that most of us recognize the role that our part of the country plays in national security in the future. I think we have an understanding, an appreciation for the role that our part of the State needs to play in its own economic growth, but in particular and in addition to the State's and the Nation's economic growth. So I would say most of us would be willing to take a look at a different future than we have seen in the past.

I think most people would say we probably wasted the last 20 years. We should not have quit the science. We should have kept doing what a number of companies did do for a while, to learn as much as we can about the chemistry, the geology, all of these things that we have been talking about today. It is important to do that, and it is going to take a significant role from the Federal Government to lead us to do that. So it would be our thought that stepping up that pace has a lot to be said for it. This would need to be done in many of the ways that Mr. Smith has indicated.

I think all of us have become more sophisticated as the years have gone by about the interconnectedness of the things we do for business, the things we do in the development of natural resources, and how you protect and keep all the other values you have. I think we are getting pretty good at that, and it is the right way to do it. I think many of us believe that the way we would step up the pace in the proper development of oil shale can be done consistent with the use of these other resources and the protection of wildlife and water quality, air quality, and a way of life.

So I think it is a matter of timing and how we have included the population, everybody, in the discussion and the partnership of the State and the Federal Government and everyone else that lives there.

Senator SALAZAR. Thank you, Mr. George.

Mr. Chairman, I just want to make one comment because I said something about Russell George in your absence, and that is that he is truly a model of bipartisanship. He is a good Republican, a wonderful Republican, who was Speaker of the House of Representatives in our State of Colorado, went on to be the director of the Division of Wildlife and now executive director of our Department of Natural Resources, a Harvard graduate, and someone who has done a lot to contribute to the well-being of the people of the State of Colorado. I am just honored to have him here before our committee today and honored to have the rest of the members of this panel as well. Thank you very much.

The CHAIRMAN [presiding]. Well, thank you, Senator, and thank you for doing what you did for me just now. I was not very pleased, but I had another appointment that I should not have had because of this hearing but I had to go do that.

I have a couple of questions. Working with the laboratories, as you have—and you indicated the ones you have, which would have been the ones I would think you would be working with—would you give me a sense? Do they think this is the most practical and feasible and most appropriate technology for the development of shale?

Mr. MUT. Well, Senator, I can only speak to the discussions that we have had about it, which has been limited to our process. We have not opened up the discussion quite that large. But in generic terms, relative to older technologies or other things that were being considered, yes, they believe this is far and away the most logical way to proceed.

The CHAIRMAN. Now, you mentioned numbers in terms of people and the like, and I do not know that you can tell me this, but how much are you investing in some period of time, annually, in this research, this development?

Mr. MUT. Well, we spend tens of millions of dollars each year on this process, and in order to move to an objective of having this technology commercial by the end of the decade, we would have to significantly ramp that expenditure level up.

The CHAIRMAN. What would be the deciding factor in terms of whether that ramp-up occurs or not?

Mr. MUT. It would be a function of the results of our testing, the determination of whether or not environmental protection is accomplished as we have seen in individual experiments and determine whether or not the recovery efficiency that drives the economics and is the whole reason for doing it in the first place is as projected. That is what takes the greatest amount of time.

The CHAIRMAN. Now, I know there is a lot of proprietary interests and potential patent involvement, but I assume that as you work on the environmental part, that you will bring the communities of interest in to at least verify what you are finding.

Mr. MUT. Yes.

The CHAIRMAN. It does not do any good for you to come up with it and then have 3 years of litigation as to whether it is any good, which you might have anyway.

Mr. MUT. That is absolutely correct, Senator. In fact, for the last many years, since 1997 when we started in earnest working in the area on our own lands, we have taken a very steadied approach, informing the community of what is going on, seeking their input, seeking their advice, and keeping them informed as we go along the way.

The CHAIRMAN. Now, where is your demonstration project now? Public or private land?

Mr. MUT. It is on private land.

The CHAIRMAN. That decision was made intentionally, or there was no alternative, no way to do it on public land?

Mr. MUT. I cannot speak for that exactly. Shell has some 35,000 to 40,000 acres in that particular area, so there was no need at that particular point in time to seek Federal lands.

I might add, Senator, that we are not in this as a science experiment. We started this research when oil prices were considerably lower than today, and our objective is to produce oil and gas at prices significantly lower than today's price as well.

The CHAIRMAN. Are there other companies, to your knowledge, that are involved in any way of significance in developing technology in this area?

Mr. MUT. We are unaware of anyone who is doing the types of field experimentation that we are doing. There have been men-

tions. I have seen patents and public statements by other companies that would indicate that they are also interested.

The CHAIRMAN. In the area that you are involved in, you would require a considerable amount of energy to heat the furnaces. What would be the source of that? Electricity or what?

Mr. MUT. Yes. They are electric resistance heaters, much like a hair dryer or a toaster, but significantly more exotic metallurgy. The source of it would be electricity that is generated from a source. It does not really matter where the energy to generate power comes from.

In our process, the assumption we make is that we produce about two-thirds liquid fuels and one-third gaseous fuels. For simplicity, we assume we take a portion of that natural gas and burn it in power generation operations to supply the electricity to heat the subsurface.

The CHAIRMAN. So if this scheme works, you would not be looking for an outside source of energizing power plants. You could do it from within.

Mr. MUT. We could do it from within. We are somewhat agnostic to that. In fact, we would be looking for the best environmental and economic solution. It is very possible that we could use alternatives, including coal that is located in the vicinity, or nuclear in the future. We look at this as a very long-term project because the resources will stretch for decades and decades.

The CHAIRMAN. Now, I was here when we did the Synthetic Fuels Corporation. I am not sure you were, were you?

Mr. MUT. I know of it.

The CHAIRMAN. I was not one of those who thought it was a total failure. I thought we made some bad mistakes, but that was the result of so many people wanting to have input that the ultimate legislation looked more like a Christmas tree than a law. So everybody had to go through too much to build anything.

But the whole reason given then for capture of shale failing was the price of oil, although Mr. George suggests that we will never in the future rely upon price, but that was given as the reason we could not.

I still assume that with your very brief response a while ago to a question where you said that would not be economic or used some nice words like that, you clearly meant that you had to include your company's evaluation of where the price of oil would be at the point in time that you started producing this and thereafter. Is that not correct?

Mr. MUT. That is absolutely correct.

The CHAIRMAN. So it is going to rise and fall, more or less, on whether we have high enough prices of oil. Right?

Mr. MUT. That is correct. The volatility of the market is certainly bound to continue, and I do not either have a personal opinion, nor does our company at this point in time have a position as to whether the types of price levels we are seeing today are sustainable. But this technology was developed for oil prices to be stable in the \$25 range.

The CHAIRMAN. Right. Maybe I am wrong, but I do not know anybody that is really predicting that, even in the rise and fall, it

is going to go back down to \$25. I assume some companies are still expecting that.

Mr. MUT. I do not know.

The CHAIRMAN. You do not have to say.

Mr. MUT. I can only say as a former crude trader, when everybody has an opinion, it is definitely wrong.

[Laughter.]

The CHAIRMAN. Well, the problem is we would love that, but on the other hand, it seems to me that we are beginning to be realistic on the supply demand side, although something like tar sands and shale would add significantly to the understanding of where the reserves were. It would be rather long-term, but it would certainly change it.

Canada has changed it already. They went from a 6 million or 8 million barrel reserve to 180 million almost overnight, which incidentally, Mr. George, was totally related to price. It was plenty high. There was a lot of extra money. They figure they will come in at \$12 after they have been at it for a while. Right now it is \$25-\$30. It seems it is going to happen in this area. It is going to come in less 15 years from now. There is no doubt about it. Is that not correct?

Mr. MUT. I think that is probably directionally correct.

The CHAIRMAN. Yes, just because that is what happens when technology gets perfected.

The other question I have, while you have operated on private land, I think it is really important and I hope that you will consider helping the Federal Government with input as they develop the demonstration research leasing that they are talking about. Clearly, one of the advantages expressed by our Canadian friends for our development is that large parcels of this are owned by the Federal Government, not because of the ownership concept, which somebody expressed, but rather because of the ability to manage access, where people can drill and where people can use land. But that is not going to be very important if we do not handle the leasing right. We do not want to get in a muddle where we have been delaying things 5 years because we have leases that are all messed up. So whatever the industry has to add to what would be right, we would hope that you would consider doing that.

Mr. MUT. Yes, Senator. In fact, we have been very involved with the Department of the Interior, Department of Energy, and Department of Defense in discussions about how to move this process forward. We do see some significantly attractive lands that are currently in BLM hands, and one of our reasons for suggesting moving forward with commercial leasing regimes and land swaps was to determine whether or not an acceptably large tract of land can be put together for commercial utilization.

The CHAIRMAN. Mr. Smith, I do not want for you to think that I have been only interested in technology. I understand what permeates all of this is can it be done in this manner satisfactory to the community and the public lands, the nature of public lands and its relationship to the public ownership, can it be done right, clean.

Was anything said here in my questions that deserve some retort or thought by you? I noticed you wrote down a few things. Does

that mean there are some things you would like to call to the committee's attention that have been talked about?

Mr. SMITH. Thank you, Mr. Chairman. Just a couple.

The CHAIRMAN. Please.

Mr. SMITH. One would be the scale of the amount of land needed. Mr. Mut describes some public lands that might be suitable for a larger scale version of this process. We are very concerned and strongly recommend that the committee and Congress itself and the administration take the very careful, slow, thorough steps of review that each of the members of this panel have recommended before going to a large scale commercial version of oil shale production and especially on public lands because there are so many public and natural values that those contain. So if, indeed, we are looking at the kinds of thousands of acres just described by Mr. Mut, we need to do that slowly and very thoughtfully, using the tenets of the National Environmental Policy Act and other tools available to the administration.

The CHAIRMAN. Well, I do not think anybody would think that if you were moving in the direction you just said, that that would not be a major Government activity as covered under NEPA, whatever those words are.

Mr. SMITH. Thank you.

The CHAIRMAN. I do not see how it could be otherwise, but I am not passing judgment on that now. It seems like that is the case.

Well, let me say that even though it seems like a long way out there, whenever you think that could be, I am interested in making sure that we do things right so that not only your company would be interested, but any company that has a big R&D potential and has a lot of money, a lot of resources would be interested also.

My last observation. We were talking about the price of oil, and I talked about the fact that I did not think that investments would be made on the probability that oil would drop dramatically in the \$25 range or \$20. I would make an observation about your company and most of the major oil companies. They are acting like they expect it to come back down because of the amount of money they are holding in reserve, which is not going unnoticed. It is extremely large in terms of how much is being accumulated. Some hope that it will be invested. That is not our business, but pretty soon it will be and especially when we need R&D in some of these areas. This is not a primary thing on your horizon. It is a minor investment compared to some other investments you are making. Well, I should not say that, but it is not one of your major ones.

In any event, I will, for myself, tell you—and I say this to environmental community too—we are not engaged any longer in some modest debate about the problem America has. This is a big problem. If I were to list crises, I cannot avoid listing this among the three or four that are confronting this country that are apt to bring us to our knees and cause some major disruption. I have got to put this one in there. The dependence on energy has got to be in there. For those who have other interests, which are legitimate, I think we have to understand that there is this big interest of what happens to our country. If we do not find some alternatives here and maximize our own, while conserving to the maximum extent, we as leaders are just fools because you cannot escape the fact that this

is a sorry state of affairs for our great country. Just look at one little thing.

We were speaking of a million barrels a day and the environmental community said that is not very much in Alaska. Canada is going to produce 1 million barrels in their tar sands effort. They hope to get up to 2 million in 3 or 4 years and then maybe 5 million in 7 or 8 years. They think that is terrific and tremendously important. Well, I would just take 1 million. On a yearly basis, that is \$38 billion in foreign trade dollars. 1 million barrels a day is \$38 billion, which is a huge amount and going up. So I think it is important that we pursue this.

My last question is, would your company have any feelings, whether it is here today or in further discussions, about what the tax policies might or might not have to do with your investing in this activity?

Mr. MUT. Well, I think there are a number of things that we would like stability on. We talked about regulatory, et cetera. From the standpoint of taxes, we believe that this type of resource and the technology that is required to exploit it and the R&D that is required to develop that technology would justify treatment of this resource as a nonconventional fuel. We believe that and items like the depletion allowances may be appropriate for this type of really unusual resource.

The CHAIRMAN. We seriously ought to consider that.

Our neighbors have a very expedited depreciation for not only the R&D but the actual investment in production. It is written off in the first year. Imagine that. We do not do anything like that around here, but they do. That is how they got a lot of money invested. Then, of course, they pick it up in their scheme over the next 10 or 15 years, and the royalty goes up dramatically too. We do not have enough coordination to do anything as rational as that around here, I do not think. But it made some good sense. We ought to be asking some companies whether it makes sense out there too. I would think we might need more than the depletion allowance.

Mr. MUT. Well, I was referring to section 29 credits as well.

The CHAIRMAN. Correct, which should be broadened to cover it. We are not sure it does not cover it.

Mr. MUT. We think there is ambiguity at this point. We are not sure it is covered either.

The CHAIRMAN. Senator, did you have anything else?

Senator SALAZAR. I just want to thank the panel.

The CHAIRMAN. I thank you all also.

We stand adjourned. Thank you very much.

[Whereupon, at 12:27 p.m., the hearing was adjourned.]



## APPENDIXES

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### APPENDIX I

#### Responses to Additional Questions

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THE WILDERNESS SOCIETY,  
FOUR CORNERS STATES REGIONAL OFFICE,  
Denver, CO, May 9, 2005.

Hon. PETE V. DOMENICI,  
*Chairman, Committee on Energy and Natural Resources, U.S. Senate, Washington, DC.*

DEAR CHAIRMAN DOMENICI: Thank you for sending supplemental questions on the topic of oil shale following the Senate Energy and Natural Resources Committee's April 12 hearing. Bill Meadows, President of The Wilderness Society, forwarded to me your letter and questions asked me to respond.

I appreciate the opportunity to comment further on this potential energy source and on environmental precautions that must be included in any discussion of it. I apologize for the delay in responding and hope that the following information is still timely and helpful to the committee.

Thank you again for the opportunity to address the committee, both at the hearing and in this form. Please let us know if we can provide additional clarification or assistance.

Sincerely,

STEVE SMITH,  
*Assistant Regional Director.*

[Enclosures.]

#### QUESTIONS FROM SENATOR DOMENICI

*Question 1.* In your testimony, you referred to "the potential to engender false hopes, exaggerated claims, and unfulfilled promises" as was done in the last effort to develop oil shale 25 years ago. Nobody wants to repeat that experience.

How would you suggest we avoid this possibility and keep these new efforts focused on realistic approaches?

Answer. The primary factor that prompted exaggerated claims and an unrealistic pace of oil shale development in the late 1970s was the provision of federal subsidies and inadequately controlled access to federal public lands for companies pursuing the technology. In the end, the production of oil shale could not be sustained, even with artificial federal support, let alone without it.

Any new oil shale research program should be based only in direct investment by interested companies. The production of fuel and other useful products from oil shale must meet the basic test of profitability and sound business investment, best measured by individual companies willingness to use their own resources.

This emphasis on private investment would be even more important in any commercial oil shale development ventures. Full production of oil shale, if it occurs, should be financially sustainable.

That financial sustainability should be calculated at reasonable energy equivalent market prices and not based on high oil price spikes, such as those seen recently, lest the industry again fail when prices drop.

Similarly, access to federal public lands for oil shale research should be very limited in scope and tightly controlled to protect other public lands values. Research tracts should be limited, as contemplated in the Bureau of Land Management's draft oil shale research regulations, to 40 acres or less. Total leased land held by

any one company for research purposes should be limited, and individual tracts should not be combined into larger operations.

These cautious approaches are especially important in that oil shale leasing and activities have been largely dormant for two decades. Federal land managers and Congress should be very careful not to launch or even encourage crash programs in oil shale research or development. It is important to take the time to get companies, scientists, and citizens familiar with both the failures of the past and with any new approaches that higher potential for sustainable success.

Research tracts leasing should be limited in duration, no more than five years. Research leases should not be converted to commercial production leases without additional federal environmental, scientific, and financial review and associated public comment. Transition to commercial production leasing, if it occurs, should be based on competitive bidding and should include stipulations providing for the payment of royalties at least in the amount of 12.5% as with other oil development—possibly higher to account for the intensity of surface impacts on federal land.

Perhaps the most basic consideration in any oil shale leasing program—for research or for commercial operation—is the involvement of local citizens and local elected officials in each stage of review and activity. Extensive citizen review and comment on oil shale proposals will help temper any unrealistic boosterism and will pose fair, realistic, and practical questions about the sustainability of any particular technology.

Any oil shale leasing program—for research or for commercial operation—should require the use of best and evolving management practices, and research leases should be offered only for the testing of genuinely new technologies that overcome the environmental, technical, and financial shortcomings of those used in the past.

The Bureau of Land Management, or other appropriate federal agency or agencies, should conduct a full programmatic analysis of oil shale research and development activities, under the provisions of the National Environmental Policy Act, prior to the issuing of any leases. That analysis should review both potential individual field operations and the compounded and cumulative effect of potential development over the multiple states where oil shale ore lies.

*Question 2.* You commented on Shell Oil's "careful and deliberate approach". How would you suggest we ensure that other companies do the same?

Answer. The approaches, precautions, and requirements outlined above will encourage only serious investment by companies with the resources, talent, and long term commitment to a sound and sustainable program. By basing oil shale development on private funding and on careful planning programs of companies serious about developing sound technologies and committed to protecting the larger environment, the use of federal lands for oil shale research and possible production will be more likely to find success.

*Question 3.* You have provided a long litany of issues that need analysis before decisions are made to commit land and resources to any project.

Do you think the environmental community can support an oil shale program on public lands if these issues can be adequately addressed?

Answer. Energy production for the general benefit of the nation is a legitimate use of select federal public lands, both under the provisions of the Federal Land Policy and Management Act and other relevant statutes and in a sound approach to the husbanding and use of valuable public resources.

Correspondingly, it may be possible to engage in careful research into the potential of oil shale as an energy source while still protecting the many other, more enduring values found on federal public lands. If oil shale research projects demonstrate that oil shale can be produced commercially in an energy efficient manner and while continuing to protect those other public lands values, many environmental organizations are likely to support the careful transformation from research to production.

Some threshold considerations, in addition to those mentioned above, for a limited research program on federal public lands include:

- Leasing should be offered only for research and development of clearly new technologies and not for continued use of old technologies or minor variations on them;
- Leasing must not be a license for speculation. Potential lessees should be required to demonstrate, in advance, how their proposed activities in the particular areas proposed for leasing reduce the environmental impacts of oil shale development or how their technologies or processes improve energy efficiency, contribute to resource conservation, make development of oil shale more economic, or reduce waste outputs;

- No research leases should be offered on any lands in Colorado, Utah, or Wyoming that any federal agency has identified as having wilderness characteristics—wilderness study areas, wilderness inventory areas, or lands with a reasonable probability of wilderness characteristics;
- No research leases should be offered on any lands proposed for wilderness designation in legislation pending before Congress (examples from past Congresses include America's Redrock Wilderness Act, Colorado Wilderness Act, Northern Rockies Ecosystem Protection Act, and Wyoming Wilderness Act);
- No research leases should be offered on any lands designated as Area of Critical Environmental Concern;
- The Bureau of Land Management (BLM) and other federal agencies involved in oil shale research leasing should fully consider new information supplied by citizens' groups or generated by the agencies themselves regarding potential wilderness values before leasing any lands for oil shale research, and the BLM should continue inventorying wilderness characteristics and appropriately managing wilderness quality lands;
- Leases for oil shale research should include strictly enforced non-waivable stipulations mandating that lessees submit a reclamation plan to the appropriate state and federal agencies prior to authorization of any ground disturbing activities. Those stipulations should include the requirement that reclamation activities begin promptly upon lease expiration, termination, or relinquishment. Leases should be issued only in exchange for genuinely adequate bonding or other advance mechanism to ensure the completion of reclamation;
- Leases should contain stipulations requiring lessees to conduct air quality monitoring to establish baseline conditions, modeling to anticipate impacts from lease-based activities, and continuing monitoring to measure and control impacts on air quality, visibility, and human health.
- Similar monitoring and precautions should be required relative to water quality, watersheds and streamflow, wildlife habitat, and the protection of plants and plant communities.

Similar precautions and practices should be applied even more stringently in the event any federal lands are considered for leasing for commercial development of oil shale.

#### QUESTIONS FROM SENATOR BUNNING

*Question 1.* What do you think the federal government needs to do in order to increase development of these resources?

Answer. Any development of oil shale—for research or for commercial production—should be based in requirements that ensure the financial sustainability of such development, respect the wishes and long term needs of affected communities, and complete and enduring protection of other natural and public values on federal lands.

The development of oil shale and tar sands can be increased, and such increase sustained, only if those key principles are considered and engaged in all decisions about the use of federal lands or resources, lest any temporary increase in research or production be just that—temporary.

Some details of this careful approach, emphasizing sustainable increase in development, are suggested above in responses to questions from Senator Domenici.

*Question 2.* What do you think are possible hindrances to developing oil shale and oil sands in this country?

Answer. The primary historical limitations on development of oil shale and oil sands have been financial, social, environmental, and energy efficiency.

Past efforts to develop these resources have been based on extensive federal subsidy, momentarily high oil prices, and inadequately constrained access to federal public lands. Without those artificial supports, sometimes even with them, the financial practicality of development has not been realized. The development of oil shale and oil sands must be based in technologies that are sustainable without subsidy and at reasonable market prices.

Past efforts at development have been crash programs that artificially raised the expectations of affected communities, skewed municipal and state land and services planning decisions, and left individuals and communities hurt financially and socially when the programs failed.

The environmental impacts of technologies used so far have been severe and largely uncontrolled. Resistance to a revival of development will be strong until new techniques are proven and employed for protecting the long term health of the natural and human environment.

The relative inefficiency of extracting liquid fuel from rock is perhaps the most basic technical constraint on development. While recent private experimentation suggests that the proportion of energy produced to energy used is improving, such advances must consider before development can be seen as practical or appropriate.

In addition, energy and government planners must anticipate the comparative value and expense of various energy sources. For example, an increase in the fuel economy of the nation's car and truck fleet, by just one mile per gallon, would, at lower total expense, save 400,000 barrels per day of oil, the equivalent of oil shale's potential contribution at full production.

*Question 3.* Do you know of any problems with developing oil shale and sands in Kentucky?

Answer. I have not found materials specific to the development potential of oil shale or sands in Kentucky, and I recommend relaying this question to the Department of Energy for more detailed response.

Meanwhile, I offer two observations. First, to the degree that deposits in Kentucky are found on public lands, the considerations and constraints suggested above would be appropriate.

Second, whether located on federal, state, or private land, the precautions about careful pace, scale, financial sensibilities, and impacts on local communities, also as outlined above, would be important in any location where these resources might be researched or developed.

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RESPONSES OF JIM EVANS TO QUESTIONS FROM SENATOR DOMENICI

*Question 1.* What is the current population of the area we are discussing for oil shale development?

Answer. The Western U.S. oil shale resources are located in Northwest Colorado, Eastern Utah and Southwestern Wyoming. The areas of greatest concentration where oil shale development has been proposed specifically are within Garfield and Rio Blanco County, Colorado and Uintah County, Utah. In Colorado the latest (2003) population estimates are:

	2003 Population	Square Miles
<i>Primary Development</i>		
Garfield County .....	48,000	2,947
Rio Blanco County .....	6,000	3,221
Sub Total .....	54,000	6,168
<i>Secondary Impact</i>		
Mesa County .....	125,000	3,328
Moffat County .....	13,000	4,742
Rout County .....	21,000	2,362
Sub Total .....	159,000	10,432
5-County Total .....	213,000	16,600

This is approximately double the population of 25 years ago. Most of the growth has occurred in Garfield and Mesa Counties (along the I-70 corridor) and in Routt County (in the resort/ski town area of Steamboat Springs).

*Question 2.* How would you describe the economic base for this region of the State and how does this compare to the base of 25 years ago?

Answer. The economic base of the Northwest Colorado region was, and still is, a mixture of energy/mineral development, tourism and agriculture. The energy/mineral sector includes more than half of Colorado's coal production (about 20 million tons per year), the largest oil producing county in the State (Rio Blanco with the Rangely Oil Field producing about 7 million barrels per year), and the most active natural gas development county (with 21 drilling rigs now operating in Garfield County—more than half of the state total).

There is currently a labor force of 116,000 in the region with \$5.7 billion annual personal income total, and retail sales of \$5.2 billion. Tourism is important in each county, especially in Steamboat Springs which is recognized internationally as Ski Town U.S.A. Mesa County is the major retail center of Western Colorado and has an active economic diversification program.

*Question 3.* Do you feel the socioeconomic problems associated with the oil shale development of 25 years ago can be overcome and can we ensure they are not repeated?

Answer. I am optimistic that the socioeconomic impacts of oil shale development can be dealt with adequately in Colorado once a cost-effective and environmentally sound technology (or technologies) is developed. The key to this type of development is the federal government since the federal government owns more than 80% of the oil shale resources. DOE, DOI and DOD should be encouraged by Congress to develop an oil shale strategy or plan that is not dependent solely upon a high price of oil. From a socioeconomic point-of-view we do not want to wait for another oil crisis (like the Arab Oil Embargo of 1974) that fosters another crash development program with unproven technologies. Such an approach would invite another boom/bust cycle in our region.

Therefore, the federal government should encourage an orderly development of cost-effective technologies. Then, with the Local Government Impact Mitigation Ordinances, Colorado Local Government Energy Impact Program, and Colorado Joint Review Process now in place local governments will have the tools to deal with the socioeconomic impacts of oil shale development.

However, I am concerned that this approach may not be achieved with the aggressive timetable now included in the House-passed Energy Bill. HR6 calls for a commercial scale oil shale leasing program by the end of 2006. This timetable by itself may be OK since BLM is almost ready to initiate an oil shale R&D leasing program which could set the stage for a commercial scale leasing program. However, H.R. 6 also calls for oil shale leases (or sales) within 180 days after adoption of the leasing program. I believe this may be too fast and too inflexible. It also may be unnecessary since the BLM R&D leasing program proposes to allow conversion of R&D leases to commercial leases once a cost-effective technology is demonstrated. I believe expansion of this R&D conversion to commercial scale concept should be encouraged by Congress, rather than a tight, inflexible timeline for commercial scale leases.

To ensure that the mistakes of 25 years ago are not repeated Congress should also encourage industry to move forward with demonstration projects, like what is being done with the Shell Oil Mahogany Project. Congress should consider enactment of many of the recommendations submitted by Shell Oil Company, including a commercial scale oil shale leasing program. Local governments in our region are encouraged by the Shell Oil R&D project which is moving forward independent of the price of oil and which is clearly attempting to minimize potential socioeconomic and environmental problems.

I believe the overall key to a successful oil shale leasing program is already embodied in the adopted ELM White River Resource Area RMP (Resource Management Plan). This RMP has an oil shale resource leasing objective to "provide for a prudent and planned future leasing and development program for the oil shale resource." The 1997 White River RMP includes and carries forward the oil shale management decision developed in the 1985 Piceance Basin RMP for oil shale leasing and Management to be based upon a "carrying capacity" concept for socioeconomic and environmental impacts. Local government believes Congress should recognize and reinforce these management plans rather than specifying a fixed inflexible leasing timetable of 180 days.

Attached, for your consideration, is a copy of the Record of Decision and Approved White River Resource Area RMP, including the oil shale resource decision with Appendix D summarizing the critical carrying capacity thresholds to oil shale development.\*

*Question 4.* You referenced a fund made up of Naval Oil Shale Reserve receipts of about \$44 million. Is this already committed to any other use?

Answer. Approximately \$6 million is committed to DOI for environmental cleanup of spent shale tailings at the former DOE Anvil Points oil shale R&D facility. This is outlined in the February 9, 2005 letter from BLM submitted April 12 with my Congressional testimony. That leaves \$38 million as uncommitted to any other program. However, a Congressional appropriation would be required to access the funds.

*Question 5.* Would you see this funding going solely to socioeconomic and environmental study and compliance?

Answer. No. But I would hope a portion of these funds could be utilized for socioeconomic and environmental impact studies and mitigation, especially prior to the flow of any royalties from future oil shale leases. I believe this would be an appropriate use for these funds because half of the funds are the 50% state share of nat-

\*All attachments have been retained in committee files.

ural gas royalties now being produced from the Naval Oil Shale Reserve (NOSR) lands. Congress required the state share of these royalties to be withheld until DOE is fully reimbursed for its investments associated with the NOSR lands. This was established as a condition of the transfer of these NOSR lands to be managed by DOI with priorities for natural gas leasing. It would also be appropriate for use of these funds as a source for DOI oil shale leasing costs and for the costs of DOE oil shale development strategies and programs.

In addition, the natural gas industry has estimated that potential increased future leasing of natural gas resources from the NOSR lands could produce up to \$1 Billion in additional royalties over a 20-year period. Half of these natural gas royalties would accrue to the federal government and 50% would be the state share. I encourage your Committee to establish a Congressional linkage or priority for use of these funds to address the potential socioeconomic and environmental mitigation costs of oil shale development in addition to existing Congressional priorities already included in the Federal Mineral Leasing Act.

*Question 6.* What do you think the federal government needs to do in order to increase development of these oil shale resources?

Answer. I believe that DOE has detailed a prudent course of action in its Strategic Fuels Analysis released last year. This analysis recommended a coordinated DOE/DOI/DOD program for developing secure domestic energy resources, similar to the effort utilized to develop oil sands in Canada.

*Question 7.* What do you think are possible hindrances to developing oil shale and oil sands in this country?

Answer. The number one problem remains the development of a cost-effective technology. Since 80% of the resource is owned by the federal government, it should be a federal government program to provide incentives to develop the technology.

*Question 8.* Do you know of any problems associated with developing oil shale and sands in Kentucky?

Answer. No. I would hope that any technology that is developed for Western oil shale would also work for Eastern oil shale.

## APPENDIX II

### Additional Material Submitted for the Record

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ANADARKO PETROLEUM CORPORATION,  
WESTERN REGION OPERATIONS,  
Houston, TX, April 25, 2005.

Hon. PETE V. DOMENICI,  
*Chairman, Committee on Energy and Natural Resources, U.S. Senate, Washington, DC.*

DEAR MR. CHAIRMAN: Anadarko Petroleum Corporation (Anadarko) applauds you and the Senate Energy and Natural Resources Committee for initiating discussions on environmentally-acceptable development of domestic oil shale and oil sands. Anadarko believes the United States should undertake immediate action to maximize efforts to identify and produce domestic oil shale, oil sands and all other petroleum resources. In our opinion, prolonged inaction in that regard will only exacerbate current threats to our economy and security fostered by increasing worldwide energy demand, rising imports and diminishing conventional resources.

Anadarko is a publicly traded independent oil and gas exploration and production company with active operations in the Gulf of Mexico, Gulf Coast States, Mid-Continent, Western States and Alaska. Internationally, we operate in Canada, Algeria, Qatar and Venezuela. In 2004, the company produced 190 Million BOE and our year-end reserves amounted to 2.37 Billion BOE.

One of the strategic assets in Anadarko's portfolio is the land acquired by the Union Pacific Railroad under the Pacific Railroad Act of 1862 and 1864. Anadarko acquired these lands through its merger with Union Pacific Resources in 2000. The area includes four million three hundred thousand privately-held mineral acres and over eight hundred thousand surface acres within the state of Wyoming. Much of this acreage traverses the Green River and Washakie Basins, long known for their extensive oil shale resources. Consequently, Anadarko is one of the largest private owners of oil shale resources in the world.

Anadarko believes the forthcoming Energy Bill should contain mandates that would make commercial oil shale production a reality within the next decade and provide the momentum needed for private enterprise to commit to domestic projects of sufficient magnitude to make this happen. We believe there are five important actions which the federal government could institute to advance oil shale production. Those include

- developing a federal oil shale leasing program,
- developing a stream-lined land exchange program to block up federal and private acreage of sufficient size to support commercial oil shale projects,
- fast tracking and streamlining regulatory and NEPA processes,
- facilitating technological research, and
- providing incentives which recognize the tremendous initial capital requirements involved in projects of this magnitude.

Anadarko encourages Congress to direct the Department of the Interior to develop regulations governing oil shale leasing and development. In addition, Congress should amend the Mineral Leasing Act to increase the maximum allowable acreage for oil shale holdings. The current law restricts oil shale leases to one per company and to a maximum five thousand one hundred twenty (5,120) acre lease. These leasing restraints and limitations on lease size will constrain development opportunities.

For example, Anadarko's oil shale acreage in Wyoming is located in a checkerboard pattern wherein federal and some state acreage alternates with the company's private acreage. Because the federal acreage is currently off limits to leasing, Anadarko is limited for potential oil shale development to its own sections of land and only that for which we have access. In addition, the oil shale resource in Wyo-

ming is thinner and more widely distributed than those in Colorado and Utah which puts even more importance on securing larger federal leases.

The Department of the Interior should be provided the authority to streamline the land exchange process involving oil shale resources. We believe such action would promote resource development possibilities and efficiencies as well as create opportunities for responsible environmental management alternatives. In order to make the commitment to initiate a commercial-scale oil shale development project, proponents must first be confident that acquisition of the acreage necessary to justify substantial capital investment will be possible. Pursuant to this need, Congress should appropriate the money necessary to fund an oil shale exchange program.

Congress should also investigate ways to streamline the regulatory and National Environmental Policy Act (NEPA) processes. Consistent and predictable regulatory requirements and dependable specific NEPA timelines must be established to allow investors to enter into sizable financial commitments with the conviction that their investment will not linger due to untimely staff workloads or frivolous objections.

Anadarko prides itself on putting a high priority on protection of the environment and developing energy in a manner compatible with the natural surroundings. By streamlining and establishing definitive timelines, we are not suggesting circumvention of this nation's environmental laws or goals. Our objective is simply to improve the current process and establish a predictable permitting system upon which investors can rely.

Technological advances in this emerging energy opportunity can be vital to reserve maximization, production volumes and product quality. Through its vast networks with private industry, academia, qualified scientists and engineers, the federal government, through the Department of Energy (DOE), is properly positioned to encourage and reward research and technological improvements which attract and stimulate oil shale developers. We believe the current data base and potential oil shale production scenarios of the DOE should be expanded.

Congress should also explore the possibility of financial incentives to help private enterprise manage and endure the tremendous up-front capital burdens associated with oil shale development. The magnitude of these costs can and will discourage potential developers and reduce competition. Incentives that may be worthy of adoption include, but are not limited to:

- production tax credits
- additional federal royalty relief
- accelerated depreciation
- investment tax credits
- depletion allowance
- loan guarantees

Anadarko concurs that it is in the best interests of the nation to secure this vast, stable, long term domestic source of oil. With assistance from Congress in the aforementioned key areas, private enterprise can be stimulated to do its part in realizing that goal.

The men and women of Anadarko Petroleum look forward to working with federal, state, and local governments as well as the key stakeholders to see that these strategic national resources become a viable and dependable part of our nation's economy.

Sincerely yours,

JAMES L. FUCHS,  
*General Manager.*

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STATEMENT OF DEPARTMENT OF ENERGY, GOVERNMENT OF ALBERTA, CANADA

The Government of Alberta, Canada, is pleased to provide this written submission on the Alberta Oil Sands to the U.S. Senate Energy and Natural Resources Committee.

Included herein is a brief overview of the Province of Alberta; our role in North American energy security; the extent of oil sands resources in Alberta including reserves based on currently available extraction technologies; the role the Government of Alberta plays in bringing these valuable resources to market; and, importantly, the direct effect this has had on increasing investment and production. Production of crude oil from Alberta's oil sands has the potential to close the U.S. energy gap.

## THE PROVINCE OF ALBERTA

Albertans are a breed apart. They are driven by the pioneering spirit that first settled the land. They hold dear the ethics of hard work and personal responsibility. They cherish the ideals of family and community that built the province.

Our policies focus on free trade and competitive markets as the best way to allocate scarce resources. Provincial law prevents the government from subsidizing any commercial business entity. The Province has no sales tax, a 10% flat income tax, and no debt—something that has not been achieved anywhere else in Canada, and something of which Albertans are justifiably proud.

Year after year, Alberta's economic growth leads Canada, averaging 3.7% annually over the past 10 years. We lead the nation in job creation, and our unemployment rate is consistently among the lowest in Canada. Alberta's per capita disposable income and standard of living are the highest in Canada. Not surprisingly, we continue to experience the strongest population growth in Canada, with people from all over Canada and around the world migrating to our province to experience the Alberta Advantage for themselves and their families.

## NORTH AMERICAN ENERGY SECURITY

Alberta is rich in hydrocarbon resources—producing over 1.6 million barrels per day of crude oil, and over 15.2 billion cubic feet per day of natural gas.

Both Alberta and Canada are vital to the energy security of the United States—we are reliable, secure and, importantly, stable suppliers of energy to the U.S. In 2004, for the sixth year running, the U.S. Energy Information Administration recognized Canada as the largest supplier of oil (crude and refined) to the U.S.

Approximately 11% of U.S. crude oil imports and 15% of its natural gas consumption come from Alberta alone.\*

## WHAT ARE OIL SANDS?

Oil sands are deposits of bitumen, a molasses-like viscous oil that requires heating or dilution with lighter hydrocarbons in order to flow. Second only to the Saudi Arabian reserves, Alberta's oil sands deposits have been described by *Time Magazine* as "Canada's greatest buried energy treasure," which "could satisfy the world's demand for petroleum for the next century."

Deposits are found in three major areas in northeastern Alberta: Peace River, Athabasca (Fort McMurray area), and Cold Lake (north of Lloydminster), totaling approximately 54,400 square miles—an area larger than the State of *Florida*.

## SIZE OF ALBERTA OIL SANDS RESERVES

Alberta is home to the largest oil sands reserves in the world. Proven reserves<sup>1</sup> of 174.5 billion barrels *are second only to Saudi Arabia*.

Proven Reserves .....	174.5 billion barrels
Probable Reserves .....	311 billion barrels
In-Place Reserves .....	1.4 trillion barrels

This data is on the public record and confirmed by the Alberta Energy & Utilities Board (AEUB), an arms-length regulatory agency. Over 56,000 wells and 6,000 cores were the basis of the analysis.

Since December 2002, these figures were recognized by the *Oil & Gas Journal*, followed by the *U.S. Energy Information Administration* in 2003.

## GROWTH IN OIL SANDS PRODUCTION

Oil sands production in Alberta hit 1 million barrels a day in 2004 (about a third of total Canadian production) and by the end of this decade, we expect production to rise to 2 million barrels a day. *See Appendix 1: Oil Sands potential: 3 million bpd by 2020, 5 million bpd by 2030.*

Annual oil sands production is growing steadily by about 200-250 barrels per day (bbl/d) per year, as the industry matures. Output of marketable production increased to 858,000 barrels per day (bbl/d) in 2003, up from 741,000 bbl/d the year before. It is anticipated that in 2005, Alberta's oil sands production may account for one-half of Canada's total crude output and *10 per cent of North American production*.

\* Appendix and Figures 1-5 have been retained in committee files.

<sup>1</sup> Proven reserves: extractable with present technology and pricing.

## PRODUCTION METHODS: MINING AND IN-SITU

There are two methods of oil sands production methods: mining and *in-situ*. Oil sands mining involves open pit operations. Oil sands are moved by trucks and shovels to a cleaning facility where the material is mixed with warm water to remove the bitumen from the sand. Today, all operating oil sands mines are linked with upgraders that convert the bitumen to synthetic crude oil.

For oil sands reservoirs too deep to support economic surface mining operations, some form of an *in-situ* or “in place” recovery is required to produce bitumen. *In-situ* oil sands production is similar to that of conventional oil production where oil is recovered through wells. Present operating costs, not including capital recovery, vary between \$10-15/per barrel.

The AEUB estimates that 80% of the total bitumen ultimately recoverable will be with *in-situ* techniques. In general, the heavy, viscous nature of the bitumen means that it will not flow under normal conditions. Numerous *in-situ* technologies have been developed that apply thermal energy to heat the bitumen and allow it to flow to the well bore. These include thermal (steam) injection through vertical or horizontal wells such as cyclic steam stimulation (CSS), pressure cyclic steam drive (PCSD) and steam assisted gravity drainage (SAGD). Other technologies are emerging such as pulse technology, vapor recovery extraction (VAPEX) and toe-to-heel air injection (THAI).

In general, oil sands mines operations are found in central Athabasca deposits (around Fort McMurray). *In-situ* production is used in the Cold Lake, south Athabasca and Peace River deposits.

## GOVERNMENT FRAMEWORK

The mineral rights in approximately 97% of Alberta’s 54,000 square miles of oil sands area are owned by the Government of Alberta (i.e., state-level) and managed by the Alberta Department of Energy. The remaining 3% of the oil sands mineral rights in the province are held by the federal Government of Canada (i.e., federal-level) within Native Indian reserves, by successors in title to the Hudson’s Bay Company, by the national railway companies and by the descendants of original homesteaders through rights granted by the Government of Canada before 1887. These rights are referred to as “freehold rights”.

The Alberta government departments of Environment and Sustainable Resource Development administer complementary environmental policies. The Alberta Energy & Utilities Board (AEUB) regulates oil and gas activities in the province.

The Alberta Department of Energy is responsible for administering the legislation that governs the ownership, royalty and administration of Alberta’s oil, gas, oil sands, coal, metallic and other mineral resources. The Department’s main objective is to manage these non-renewable resources to ensure their efficient development for the greatest possible benefit to the province and its people.

## OIL SANDS ROYALTY STRUCTURE

In 1996, Alberta announced a new generic royalty regime for oil sands based on recommendations from a joint industry/government National Oil Sands Task Force (NOSTF). This regime is defined in the Mines and Minerals Act and the Oil Sands Royalty Regulation 1997, as amended (OSRR 97). Royalty is calculated using a revenue-less-cost calculation.

In early project years before capital investment and other costs are recovered, the royalty rate is lower than the rate that is applied after costs are recovered. This helps project cash flows in early years. Once costs are recovered, the Province shares in project profits. Details are provided below.

- In the pre-payout period (before the project has recovered all of its costs), projects pay royalty tied to 1% of gross revenue;
- In the post-payout period (after the project has recovered all of its costs), projects pay royalty tied to the greater of 1% of gross revenue or 25% of net revenue.

Since 1990, oil sands royalties have totaled over \$2.5 billion.

## ANNOUNCED INVESTMENT

Since 1996, when the generic royalty regime was introduced, \$25 billion of investment in the oil sands has occurred. Looking forward, it is expected that new capital investment could range between \$2.5-\$4 billion per year.

## THE WAY FORWARD

To date, only about 2% of the established oil sands resource has been produced. Alberta's oil sands industry is the result of multi-billion-dollar investments in infrastructure and technology required to develop the non-conventional resource. In the last five years alone, industry has allocated \$20 billion towards oil sands development, and the Government of Alberta invested over \$700 million over a 20-year period.

Alberta encourages the responsible development of these extensive deposits through planning and liaison among government, industry and communities to ensure a competitive royalty regime that is attractive to investors, appropriate regulations and environmental protection and the management of the Province of Alberta's rights to oil sands while taking into account some of the barriers—higher technological risk and higher capital costs—faced by oil sands developers.

In 2003 Alberta's oil sands were the source of just over half of the province's total crude oil and equivalent production and over one third of all crude oil and equivalent produced in Canada. Over the last three fiscal years, through to 2003/2004, oil sands development returned \$565 million to Albertans in the form of royalties paid to the Provincial government.

Continuing technology improvements will lead to greater energy efficiency and a reduction in natural gas as a fuel input source. As the future unfolds, the only impediment to oil sands production could be shortages of skilled labour to complete the projects. Oil sands projects will compete for the same skilled workforce as the MacKenzie and Alaska natural gas pipelines.

Development of Alberta's oil sands resources represents a triumph of technological innovation. Over the years, government and industry have worked together to find innovative and economic ways to extract and process the oil sands and energy research is more important today than ever before. Working through the Alberta Energy Research Institute, the Alberta government is committed to a collaborative approach with counterparts in Canada and the United States to spur new technology and innovation programs that will reduce the impact of greenhouse gases and other emissions, and reduce the consumption of water and gas.