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THE LONG-RUN ECONOMICS OF NATURAL GAS

HEARING

BEFORE THE

JOINT ECONOMIC COMMITTEE
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THE LONG-RUN ECONOMICS OF NATURAL GAS

THURSDAY, OCTOBER 7, 2004

CONGRESS OF THE UNITED STATES,
JOINT ECONOMIC COMMITTEE,
Washington, DC

The committee met at 10 a.m., in room SD–628 of the Dirksen Senate Office Building, the Honorable Robert Bennett, Chairman of the Joint Economic Committee, presiding.

Senators present: Senators Bennett, Reed, and Bingaman.

Staff Present: James Brannon, Reed Garfield, Mike Ashton, Colleen I. Healy, Nancy Marano, Chad Stone, and Nan Gibson.

OPENING STATEMENT OF SENATOR ROBERT F. BENNETT, CHAIRMAN, U.S. SENATOR FROM UTAH

Chairman Bennett. The Committee will come to order. I want to welcome everyone to today's hearing.

It's on a very important subject, and I have an opening statement, which I will read, but as I prepared for this, I had a thought come to me out of my previous experience in education. I was something of a student of the Communist revolution in Russia, and I remember that Mr. Lenin had a very strong view about the middleman, the hated middleman, that he thought was a fixture of the decadent capitalist world.

Wheat would cost X-amount at the farm, a loaf of bread would cost so much more in the store. The middleman was making profits that were obscene, and he was going to get rid of that. He had a very simple solution: He shot them.

As a consequence, the Soviet Union never, ever developed a distribution system for its goods and services. I have a little of the feeling, coming into today's hearings on natural gas, that we're faced with the same problem.

Now, we're not shooting anybody, but we have an inadequate distribution system to get ample quantities of natural gas, both in this country and the world, to the people who need it, and that strikes me as one of the major issues that we will discuss here this morning.

With that, I'll get back to the prepared text, but I couldn't resist that particular comment that came to me as I was looking over the testimony that we're going to get today.

As we enter the fourth year of our current economic expansion, and all of the signs look good for the future, there is one black cloud that's threatening to rain on our parade, and that's the spec-

ter of high energy prices. The modern economy runs on energy more, perhaps, than any other single thing.

Most people have taken note of the high oil prices of late, since they eventually trickle down to the consumer in the form of high gasoline prices, and we see them every day as we fill our cars.

But just as worrisome are the high natural gas prices that have beset our economy in the past few years. After a protracted period of low and stable prices, the cost of natural gas has skyrocketed.

What's more, natural gas prices now display almost unprecedented volatility, wrecking havoc on the ability of utilities and other companies to use gas to plan for the future. It's important that we address the problem of high natural gas prices, as soon as possible, and that's the impetus behind this hearing.

The high prices act like a brake on the American economy. They impact every business and household in America, but certain industries have suffered particularly hard.

For instance, the chemical and plastic industries use natural gas as a feedstock, and, therefore, have been particularly hammered by high prices. The Manufacturers Alliance estimates that 90,000 jobs have been lost in the chemical industry alone, since the year 2000.

Also, it's important to remember that there's not a single integrated market for natural gas in this country. We simply do not have the infrastructure to ship gas easily from one region to another, should there develop a localized shortage. That's the thing I was referring to in my comment earlier.

The lack of infrastructure shows no signs of being alleviated in the near future. According to a recently released Energy Administration report, they state that new investment in pipelines actually fell in 2002, the last year for which we have any reliable data.

We don't have to look too far to remember natural gas prices on the East Coast tripling to $20 per million cubic feet, while topping out at $7 in Cheyenne.

We know the proximate causes for the run-up in the cost of natural gas. A few years after prices were deregulated in the 1980's, the Congress passed laws that, in effect, encouraged its use to produce electricity, and that sharply increased demand.

Today, it's the fuel of choice in almost every electric generating plant, but, at the same time, the production from extant wells began to decline, and environmental restrictions made the exploration and drilling of new wells, more difficult. It doesn't take an economist to see that policies that increase demand and decrease supply will sharply increase prices.

Let me make clear: There does exist enough natural gas in the world to meet our needs in the foreseeable future. We're not running out of natural gas, by any stretch of the imagination.

Here in the United States, we have significant reserves in the lower 48 states, as well as Alaska, and there are vast amounts of natural gas reserves all over the world. As I indicated in my opening comment about Mr. Lenin, companies and countries have just begun to contemplate the massive investments needed for a distribution system that will get these reserves to the marketplace, thus creating a truly global market in natural gas.

The pipelines, cooling plants, tankers, and the regasification plants that are necessary, will ultimately cost hundreds of billions

of dollars, and the central question for those of us who are policymakers is, what can we do to facilitate these investments and cause them to happen sooner, rather than later?

Diagnosing the causes of high prices is easy. Forecasting future prices and prescribing policies to alleviate the high prices, is not.

The standard response would be that high prices alone will attract new investment in production, and more conservation by the users of natural gas, and the forces of supply and demand will eventually produce balance.

We have witnessed some of this. The rise in natural gas consumption has tapered off in the last year or two, and the current rig count in the United States is at an all-time high.

However, major new investments to increase supply or conservation will not take place in an environment of major price and policy uncertainty. The latter is only, in part, our fault, and although we've tried to remedy this, the current Congress will most likely get out of town tomorrow without doing anything to ameliorate the situation.

We've also contributed to the former, that is, the lack of new investments by passing laws that stimulate a natural gas demand, without fully thinking through their long-term consequences and dealing with them when they were more knowledgeable.

I will leave the question of what do we do now to our esteemed panel of experts who are assembled here today. The Committee is honored to have you with us. We anxiously await your thoughts on the natural gas market of today and in the future.

Senator Reed.

[The prepared statement of Senator Bennett appears in the Submissions for the Record on page 29.]

OPENING STATEMENT OF SENATOR JACK REED, U.S. SENATOR FROM RHODE ISLAND

Senator Reed. Thank you very much, Mr. Chairman. I want to thank the witnesses for what I know will be very interesting and insightful testimony.

You've been very adept at picking the timing for this hearing, Mr. Chairman, with the reports yesterday of a cold winter and increased energy costs.

As you pointed out, natural gas, because of its environmental qualities and its relative cheapness, has become the fuel of choice. It continues to be such a fuel.

What we're looking at now is high and volatile natural gas prices as a problem, not only for industry, but for American households. Families face higher home heating costs, factories face higher costs that deter plans for expansion and encourage the search for cheaper production opportunities outside of the United States, and farmers are finding it more expensive to fertilize and irrigate crops.

I suspect that we'll learn at this hearing that the conditions that have produced high, volatile natural gas prices are going to be with us for some time. Once a real and sustainable economic recovery takes hold, demand for natural gas will increase even further.

We are likely to find it harder and harder to expand supply from our traditional sources: domestic production and imports from Can-

ada. Rising demand and a limited supply are a recipe for higher prices.

These are also conditions in which unexpected events can produce sharp price fluctuations. I believe very strongly that the best strategy that we have for dealing with these conditions in the natural gas market is to put a much greater emphasis on energy efficiency and conservation.

The National Petroleum Council, in its report, "Balancing Natural Gas Policy," finds that such an approach is vital to the near-term and long-term strategy for moderating price levels and reducing volatility. I know that Mr. Prindle will be testifying that the American Council for an Energy-Efficient Economy has reached similar conclusions.

I do recognize that supply-oriented policies can also have an important role to play in a balanced strategy. These policies include increased domestic production, taking due care, of course, to be environmentally responsible; investments in production research and development; and increased liquefied natural gas imports.

I will be especially interested in what our witnesses have to say about the prospects for LNG. This is an important issue for my State and my region, and I have been urging the Federal Energy Regulatory Commission to develop a regional strategic plan for the siting of new terminals, and to improve their process of addressing safety and security concerns.

While I recognize that environmentally responsible policies aimed at increasing the supply of natural gas may yield benefits, especially in the long run, I come back to my main point: All indications are that energy conservation and increased efficiency appear to be the best solutions, especially in the next few years.

Given the problems we face in the natural gas market, I and a number of other legislators in the Northeast and Midwest, were dismayed to learn that the Bush Administration has decided to discontinue the Interagency Working Group on Natural Gas.

Perhaps this hearing can provide some additional impetus for the Administration and Congress to make a concerted effort to address natural gas and other energy policy issues in a constructive manner.

Again, let me thank the Chairman and the witnesses for what I think will be an interesting and informative hearing. Thank you, Mr. Chairman.

[[The prepared statement of Senator Reed appears in the Submissions for the Record on page 35.]

Chairman Bennett. Thank you.

Our normal procedure is that the Ranking Member and the Chairman, only, make opening statements, but we're joined by Senator Bingaman, and I think we will stretch the precedent to the Senator, if you'd like to make an opening statement. Then anybody who shows up further, we tell them they're too late, but we'd be happy to hear from you.

Senator Bingaman. Mr. Chairman, I don't want you to stretch any precedents on my behalf. Let me just thank you for having the hearing. It's a very important issue, and one that we need to better understand as we head into this winter season.

I appreciate the witnesses being here very much. You have a very distinguished group of witnesses, and I'm anxious to hear them. Thank you.

Chairman Bennett. Very good. We appreciate you being here. We will start with Dr. Daniel Yergin. He's Chairman of the Cambridge Energy Research Associates in Boston, and has testified a number of times.

Then we'll go to Paul Sankey, who is a Senior Energy Analyst for Deutsche Bank in New York, and then we'll go to Logan Magruder, who is the Vice President of Berry Petroleum and President of IPAMS, the Independent Petroleum Association of the Mountain States in Denver.

Finally we'll come back to Washington, DC with Bill Prindle, who is the Deputy Director of the American Council for an Energy-Efficient Economy.

Gentlemen, again, thank you for being here, and we will hear from you in that order.

Dr. Yergin.

STATEMENT OF DANIEL YERGIN, PH.D., CHAIRMAN, CAMBRIDGE ENERGY RESEARCH ASSOCIATES; CAMBRIDGE, MASSACHUSETTS

Dr. Yergin. Thank you, Mr. Chairman, Senator Reed, and Senator Bingaman. It's a pleasure to be here.

Mr. Chairman, I wasn't sure where you were going with your analogy, at first, about the Russian Revolution, but I'm relieved that the Leninist principles will not be applied to witnesses testifying today.

[Laughter.]

Dr. Yergin. I want to congratulate the Committee on holding this hearing. Senator Bennett, I think you've provided a very effective framework for the discussions, and I think that Senator Reed pointed to the importance of conservation.

A central point that I would like to make is that at CERA we work a lot of conservation and efficiency into our projections for the future, and with that, we still see very major supply issues before us. I think, as Senator Bennett identified in the hearing, perhaps the biggest risk to the economic expansion now is energy prices.

This past week, the IMF raised their forecast for world economic growth to 5 percent this year, the best in a generation, in almost three decades, in fact, I believe they said, and pointed to energy prices as indeed the biggest risk.

We tend to focus on oil because it's so much more visible, but as the Chairman pointed out, natural gas prices are very important. Natural gas is almost a quarter of our total energy supply in the United States, and it's very dramatic to see what's happening right now.

Today, the future prices are three times the average prices in the 1990's. We're seeing dramatic changes throughout the energy markets. They're very tight, and natural gas is a very important part of it.

There is a shift from looking to natural gas as a fuel of choice, to "is it a fuel of risk?" Yet this is a time when we're counting on natural gas to be a clean, competitive fuel to meet both economic

and environmental challenges. That is very much embodied in the large number of new power plants that are based upon gas.

The high prices we're seeing are not a failure of markets. It's basically geology that has driven this, a maturity in terms of geology, and yet it's imposing many burdens on our economy.

The term that is applied is a "maturity of supply." Productive capacity in the United States peaked in 1994, and it's lower than that today.

The United States has looked to Canada to be our source of surge supply. Canada meets 16 percent of consumption, but it appears that Canada is flattening out, and we haven't seen large major discoveries in the last few years.

This time, it appears that the drilling rig, by itself, will not solve the problem, as it has in previous decades. This new era of natural gas was really inaugurated with the turn of the new century. Prices went up, and as in the past, the drilling rigs went to work, but in that period of 2000 to 2001, they did not—and this was a surprise for the industry—they did not provide the upturn in supply that would normally have been expected.

We will continue to see a very high degree of spending and effort by the industry, and that's very important, because it's going to be a very major challenge, basically to keep things where they are and not have them slide too much.

The problem, as Senator Bennett pointed out, is that we are on a course of rising demand. That graphic up there shows what's happening, which is an enormous shift to natural gas for electric power generation.

Over the last few years, this country has added something like 200,000 megawatts of electric power capacity. This is a huge number. That is equivalent to a quarter of the entire installed capacity we had in the year 2000.

Almost all of that is based upon natural gas, and so we've built in a rising demand. Gas was selected because it appeared to be an inexpensive fuel and also a very environmentally attractive fuel. We're facing a maturity in our supply on a continental basis, and at the same time, rising demand.

We're going to see a growing gap between supply and demand. How do we fill it? We fill it with additional supplies, which means LNG coming from across the waters, and, over a longer term, Arctic and Alaskan gas.

The challenge is, how do we get there? The United States only has around 3 percent of the world's natural gas reserves; the rest of the world is awash in natural gas supplies.

Natural gas reserves, on a global basis, are as large as oil reserves, yet they're far less utilized. What do we need to do?

First, we need more conservation. Second, we need to keep production from sliding further; we need a stronger effort, and we'll hear about that, I think, from the panel. And, third, we do need to be looking to alternative sources.

Today, LNG provides just 3 percent of our supplies. When we do our numbers at CERA, working in conservation and efficiency, working in the kind of the effort that will be necessary in North American supplies, we see that LNG could be, in order for us to

have a healthy economy, upwards of 25 percent or even 30 percent of our supply by the year 2020—not so far away!

We have to think in continental terms. It's not only the United States; it's a flattening in Canada, an increasing gas demand in Canada, and Mexico now imports 20 percent of its natural gas from the United States.

There is a near-term problem. What happens in the next few years? In a sense, we're confronting that question right now when we could see natural gas in much higher prices, $8 and we could have $10. Look at the prices. The futures markets today are $7 or $8, when we were accustomed to $2 or $2.50. That shows how tight the market is and how susceptible it is, not only to economic growth, but to specific events, in this case, Hurricane Ivan, which has still incapacitated a substantial part of the natural gas from the Gulf of Mexico.

As Senator Bennett said, with higher prices, the impact may be felt in the economy through lost jobs, it will be felt in gas-intensive industries, it will be felt in the export of whole industries.

The term that's used is "demand destruction." Industrial consumers, in order to be competitive in a global economy, have to look to go outside the United States.

We see the additional LNG supplies starting to be available, assuming that permits and construction proceed, in 2008 and 2009. In between is a period of higher prices and a period of risk for the economy, for important segments of the economy.

What do we do in the next few years? In our study, "Charting the Path: Options for a Challenged North American Natural Gas Market," we tried to point to some of the measures that can help to manage natural gas demand and exposure to price volatility during this bridge period of 2004 to 2009.

It begins, certainly, with effective customer education——

Chairman Bennett. Are you about to—could you cut some out?

Dr. Yergin. I'm done in 30 seconds.

Chairman Bennett. Good, we'll give you 30 seconds.

Dr. Yergin. Effective consumer education, flexible gas procurement mechanisms by utilities. Fuel flexibility for new and existing electric power capacity is very important. Resolution of the mismatch in contracting in the natural gas industry, and acceleration of gas production in the near term by streamlining opportunities and permitting processes for activities.

To sum it all up, it's a difficult market environment for the next few years. It's a challenge for the industry, for the public, for regulators, policymakers, and consumers, but there are measures and things that we can do that will provide real relief for consumers in the coming few years, and ensure natural gas's deserved place as a fuel for economic growth and environmental quality. Thank you.

[[The prepared statement of Daniel Yergin appears in the Submissions for the Record on page 36.]

Chairman Bennett. Thank you very much. For those that can't read the chart which was prepared by our staff here, the total line is the generating capacity brought online by fuel type, and it's 30 years or more than 30 years. It goes back to 1970.

[The chart entitled "Generating Capacity Brought Online By Fuel Type 1970–2002" appears in the Submissions for the Record on page 46.]

The yellow at the bottom, is coal. Each new production capacity that came online was coal. Natural gas is the dark blue, which is there, and then the other categories are nuclear, petroleum, and then other.

The petroleum is the orange, and then nuclear is purple. So, you see, as we get into the 1980's, nuclear plays a bigger role as coal starts to shrink.

But look at what happens at the end of the 1990's, the dark blue, which is natural gas, dominates. Coal disappears, absolutely and nuclear tapers off. There's just a little bit of orange in the petroleum there, but there's no question that the new production capability, No. 1, the total line goes up very dramatically, and No. 2, most of that entire total is natural gas.

Dr. Yergin was referring to that chart, and for those that don't have a copy of it, that's what the colors mean, and that's what the bars mean.

Thank you very much.

Mr. Sankey.

STATEMENT OF PAUL SANKEY, SENIOR ENERGY ANALYST, DEUTSCHE BANK, NEW YORK, NEW YORK

Mr. Sankey. Mr. Chairman and members of the Committee, Senator Reed and Senator Bingaman, it's an honor to be invited to address you here in this most august of institutions. I am a former global gas industry consultant and now I'm an equity analyst working on Wall Street, covering the major U.S. oil corporations like ExxonMobil, Chevron, and so on. We'll be happy to answer questions on the policies and strategies of those particular companies regarding the natural gas industry.

The primary reason I'm here, I believe, to address you, is because of a research report that I wrote in the middle of this year, entitled "Global LNG: Exploding Myths," which addressed, as implied, some of the myths surrounding the potential and issues of the global LNG industry, going forward.

If I could start by just supporting the comments of Dr. Yergin, there's no material disagreement at all between any of the members here, I believe, having seen their testimony, on the future of the gas industry, and I will attempt not to cover the same issues that he has already covered so comprehensively.

Just to be clear on LNG, it's the liquid natural gas. It is essentially pure methane. It's a relatively simple process. There's no great technological breakthrough in this area, really, in the last 30 years.

The key improvements in economies that we've seen, regard scale. The LNG plants, from a supply perspective, are getting larger and larger. The ships are getting bigger and bigger, and the regasification terminals are getting larger and larger, which is improving the economics, but the technology is relatively simple.

Basically you have a giant fridge in the gas country with large gas reserves. The fridge makes super-chilled gas, which turns to a liquid, and you then put it in the giant thermos flask, which is es-

sentially the ship, and then attach it to a nozzle here in the United States and you have methane, almost pure methane delivered.

As we have highlighted in the testimony that I delivered to you, looking at the economics of this trade, what I've done there is listed the various countries in the world that have major gas reserves available, and I will illustrate a few, the price of delivered gas available from those countries.

[The chart appears in the Submissions for the Record on page 66.]

To explain the chart somewhat, Trinidad II and III refer to the expansion trends at Trinidad, as an example. You have a breakdown there of the cost of production, of liquefaction, that is, taking the gas out of the ground and then turning it into a liquid, the cost of shipping, and the cost of regasification. You will see that gas is available from Trinidad at around $2 per MMBtu.

I'm sure you're aware that the current U.S. gas price is around $6 per MMBtu, and essentially there's a major profit opportunity here for companies that can develop these projects, and that is, indeed, what they intend to do.

There is a huge amount of gas available. We've covered that, I think, in enough detail, but here, alone, you could probably see a thousand Tcf of gas that's available at these prices, where the U.S. economy now consumes 22 Tcf of gas per year, so you have plenty of gas, really, for the next century.

Conceptually, I want you to think of a 20th Century that was driven by U.S. oil, cheap U.S. oil, cheap U.S. gas, and now a 21st Century that will be driven by international gas, and you have to recognize that while the $2 from Trinidad looks relatively cheap, the reality is that that's more expensive than you've paid in the past, and you're going to have to come to terms with that.

The key issue here is the disconnect between the potential of supply here in these countries, and the reality of the current supply, which is short.

The issue of short supply is related to the arguments that I made about exploding myths. The common view is that there's a problem with regasification capacity in the United States. The reality is that it's not utilized.

The other is lack of international energy available right now. I think there are two primary reasons for that: One, a shortage, globally, of energy that we're all aware of. An interesting subtlety is a major Japanese nuclear crisis, which for the first time began to drag LNG cargoes that were available for delivery into the U.S. market, toward Asia.

There's an important industry point beneath this, which is that the U.S. market historically has been dependent on spot supply of LNG, which is to say, non-long-term contracted volumes that become available through the seasonal pattern of the year, and the fact that as we have now a tight energy supply complex, not least for natural gas, contracted customers in Europe and in Japan, are exercising all their rights to LNG, leaving very little LNG available for delivering into the United States.

As an illustration of the shortage of LNG available globally, this year so far, we've had LNG delivered into the U.S. market from Australia and from Malaysia, which you can imagine is an illogical

trade, frankly. It's a long way and you drive across almost all the gas in the world and it's not a good job driving the ship, because it's so far.

We have under-utilized regasification capacity. As Dr. Yergin highlighted, supply is relatively a short-term problem, and that's really the problem that you face here.

In terms of industry planning, industry planning assumptions are only just moving toward the aggressive developments of LNG. If we take the example of ExxonMobil, they have only just moved their planning assumption for U.S. natural gas, up from previously $2.50 per MMBtu to $3.50 per MMBtu, and as a result, are now approving major investments in LNG.

Another problem is that the scale of the investment requirements in LNG makes this a relatively long-term process. The fastest LNG plant developed, essentially took 6 years from discovery of gas to first delivery. That will be basically Egypt, which will commence delivery next year, and it's illustrative, again, of the issues surrounding global LNG, that that plant will, in fact, deliver into Europe and not into the United States.

As I've said, there is something of a myth that there's a shortage of regasification. I think that, over time, there may be the development of an issue here, but ultimately we've looked at the oil market as the leader. I refer to the conceptual idea of the history being one of U.S. oil, the future being one of international gas.

The oil market is highly dependent on imports through the Gulf of Mexico. It only takes about 10 major import ports to meet 75 percent of the U.S. import requirement. Our ultimate conclusion here is that regasification is not the issue, but that the issue will be the development of supply over time.

As we've highlighted in the testimony, the requirements are huge and they are in difficult countries, from a geopolitical and technical point of view, which is to say, you need a lot more supply here from Nigeria, from Angola, from Algeria, the other countries around the world with major gas supply to provide an investment challenge, and you have to be aware of that, going forward.

I think I will leave it there. I have covered the main issues from my perspective. We would applaud FERC for the work that they've done in accelerating the regasification permitting process. I think you should be aware that there are at least two permitted projects now which are not being developed, because of a lack of LNG supply.

Further, I would just highlight that there are excess ships available for LNG, to underline my primary point, which is that the development of a global LNG supply will be a multi-year process, and essentially there's, in all likelihood, a shortage for the next 2 to 3 years, at the least.

The final point would be that ultimately Dr. Lee Raymond of ExxonMobil expects the U.S. gas market to become as gas-import-dependent as it is now oil-import-dependent, so, clearly, the future is here, and, again, to support Dr. Yergin, you have a 5-year or 6-year interim period where you have a bit of an issue, quite frankly.

[[The prepared statement of Paul Sankey appears in the Submissions for the Record on page 47.]

Chairman Bennett. Thank you very much.

Mr. Magruder.

STATEMENT OF LOGAN MAGRUDER, PRESIDENT, INDEPENDENT PETROLEUM ASSOCIATION OF MOUNTAIN STATES (IPAMS), DENVER, COLORADO

Mr. Magruder. Mr. Chairman and Committee Members, thank you very much for the opportunity to join you today. My name is Logan Magruder, and I'm Senior Vice President of Berry Petroleum's Rocky Mountain and Mid-Continent Regions, and my end of the business is on the production side. We drill wells and we produce, so just to put it into perspective, I'm also President of IPAMS, the Independent Petroleum Association of Mountain States. We have 300 member companies, covering about 13 states in the Rockies, so our focus is the Rocky Mountains.

What I'd like to tell you today is that the Rocky Mountains is a warehouse of natural gas resource that's idle right now, and with Congress's help and policymakers' help, we can probably unleash that resource into the marketplace. We talked about the 4- or 5-year interim period, and the Rockies could play a vital role in that process over the next 5 years.

I'd like to just paint a little picture for you. I'm not going to recite my testimony that I submitted, but we consume about 23 to 24 trillion cubic feet of gas per year in the United States.

We only produce about 19 trillion cubic feet, so, as Mr. Yergin mentioned, the deficit or the deficiency is imported primarily from Canada. There's a tremendous resource in the Rockies right now.

Pipeline take-away was perceived to be an issue. The take-away term, for the layman, that's the ability to get natural gas into a pipeline at known quantity out of the Rockies. Currently, the Rockies is not curtailed by limited pipeline capacity. The Rockies has about 4.6 billion cubic feet. I'm switching from trillion cubic feet to billion cubic feet, because we tend to use that in daily quantities.

The Rockies can move around 4.6 billion cubic feet of gas out of the region right now. We're scheduled to increase that to about——

Chairman Bennett. In what period? Is that 4.6 billion a year? A month? A day?

Mr. Magruder. Per day, OK? The industry is scheduled to increase that to around 6.5 billion cubic feet per day within the next 24 months.

The thing that's hindering our ability to get more natural gas into the pipeline system or into the market is a regulatory constraint right now, and a lot of other issues. There's been a tremendous breakthrough in the Rockies over the past 10 years, from the standpoint of technology and understanding gas-bearing reservoirs in the Rockies.

As a result of that, we're drilling more wells per given area of land. If you take a section of land, 640 acres, typically, 10 years ago or more, maybe we only drilled one or two wells per section of land. Today, we're able to more efficiently complete wells, extract the natural gas, and, as a result of that, we're commercially or economically able to develop the resource on a much tighter spacing, more wells per given section of land.

In a lot of cases, we drill 16 to 32 wells per section, where we were only drilling one or two previously. That's created a tremen-

dous demand on the permitting process for the BLM, the Bureau of Land Management, so that's really where the angst is now, and everybody is certainly trying to make breakthroughs in accessing the Federal lands to be able to drill more and to supply more natural gas.

The Rockies has about 26 percent of the known resource in the United States. There's about 1300 Tcf, trillion cubic feet of gas known, and the Rockies has about 26 percent. We're a large stakeholder.

In the Rockies, we're unique, because 50 percent of the lands are regulated by the Federal Government. BLM is the landlord there.

Twenty-six percent of that 1300-trillion cubic feet is about 338-trillion cubic feet. I think someone mentioned before the hearing, that we have about 160 or so trillion cubic feet of proven reserves. The Rockies alone has probably about two or three times that amount of potential resource available to us right now.

The pipeline capacity is there. We need access to drill wells, basically.

The Rockies is unique. A lot of companies are migrating to the Rockies. It's a long-term supply. It's not a real high decline rate-type production, so it's very attractive to companies.

The industry has the financial capabilities to develop this resource, and we're poised and ready to act, so over this next 4- to 5-year period, I think you can see a tremendous output of natural gas available from the Rockies, and the infrastructure is there, we just need the ability to access and drill.

[[The prepared statement of Logan Magruder appears in the Submissions for the Record on page 95.]

Chairman Bennett. Thank you very much.

Mr. Prindle.

STATEMENT OF WILLIAM R. PRINDLE, DEPUTY DIRECTOR, AMERICAN COUNCIL FOR AN ENERGY-EFFICIENT ECONOMY (ACEEE), WASHINGTON, DC

Mr. Prindle. Thank you, Mr. Chairman, Senator Reed, and Senator Bingaman, for inviting me here today.

My colleagues on the panel have painted, I think, a very expert and comprehensive picture of the gas market situation, and particularly on the supply side, and I'd like to turn the Committee's attention for a moment to the demand side of the equation, because, after all, markets are composed of supply and demand.

Our research shows that over the next 5 years—and I think we've heard that the next 5 years between now and 2010, are really the crucial challenge for natural gas markets—we estimate that energy efficiency can provide more relief to gas markets and more support to the economy than any single resource policy strategy. Certainly we're going to need new supply, but for the next 5 years, we think energy efficiency can be a key swing producer, if you will, a first responder kind of resource.

Based on our analysis, we've developed a four-point policy response for Federal and State governments to consider, that can bring a lot of benefits to the economic recovery, as well as to the gas markets.

We're talking about a $7 billion, 5-year initiative that would generate about $23 billion in private investment in efficiency, and, more importantly, it would create more than $100 billion in direct economic benefits.

Some have estimated that the effective tax that high gas prices have exacted on the economy over the last 4 years or so is already exceeding $100 billion. We think we can get that back in the next 5 years. We think it's worth doing.

By way of background, energy efficiency, of course, has been a key part of the economic growth picture of the United States for the last 30 years. For the last 30 years, we've kept per capita energy use in this country virtually flat, while GDP per capita has gone up 75 percent, so efficiency is really the little engine that could, when it comes to supporting economic growth.

We've done this by reducing the energy intensity in the economy, the number of BTUs it takes to produce a dollar's worth of economic output. If we hadn't done that, we'd have to be producing another 25 percent more on the resource side than we currently produce.

If that were the case, just imagine the predicament we'd be in here today in terms of gas market prices.

Given all the gains we've made in the last 30 years, you might think, well, we've kind of squeezed that barrel dry; there's not much energy efficient potential left. Well, I'm happy to report that that's actually not the case.

We've done analysis, five of the National Laboratories have done major studies in the last 4 years, and several states have done their own analyses, and the general convergence of the analysis on this is that we can reduce energy demand in gas and electricity markets by 20 to 25 percent over the next 20 years. That's below the reference case forecast that EIA produces.

That's why the National Petroleum Council felt confident in calling for a similar level of energy efficiency in their balanced future scenario, and it's also why the Western Governors Association, led by Governors Schwarzenegger and Richardson, have called for a 20 percent reduction in energy use below the baseline forecast by 2020.

Why does efficiency potential stay high when we've made all these gains? Well, first, there are persistent barriers that keep the markets from working perfectly.

Certainly, markets work, but they don't work well enough. Second, technology continues to be on the march.

We have refrigerators today that use one-third the energy of those made 20 years ago. As of 2006, home air conditioners will be roughly double the efficiency they were 20 years ago. Heating systems, water heaters, home appliances, lighting technology, windows, electric motors, industrial processes, and a whole litany of venues has continued to improve their technological efficiency.

This advance in the technological side not only keeps the efficiency potential growing, but it keeps the economy growing through new investment and expanded markets for these products.

Let me focus in a little bit on the research that we've done in this area over the last year or two: Our work started last year as Secretary Abraham was preparing for his Natural Gas Summit in

June, and as the National Petroleum Council, under the Secretary's direction, was preparing its major report entitled "Balancing Natural Gas Policy." We consulted with the Department of Energy and the National Petroleum Council staff during this period, and it became apparent to us that their plate was very full. There were a lot of issues they were looking at, and demand was only one of them.

We decided it would be useful to take a closer look at the demand side of the market to get a more exact idea of what kind of contributions efficiency could make. So we developed a moderate set of projections for the potential contribution that we could get from energy efficiency, and also from renewable energy over this next key 5-year period.

What we found was that we estimate we can realistically drop natural gas demand by about 4 percent below the baseline forecast by 2010. That's not a wild or unattainable number by any stretch. We also estimate, based on a range of expert opinion and analysis, that renewable energy could contribute another 3.6 percent of electricity generation in that period.

What we did was, we worked with the same model that the National Petroleum Council used, which is owned and operated by Energy and Environmental Analysis. We ran this scenario through the same model that National Petroleum Council operated and we found, as you might guess in a tight market situation, that small changes in demand had very large price impacts.

Our analysis showed that wholesale gas prices at Henry Hub would fall about 20 percent in 2009 through this scenario. That was in 2003. We're doing an update in 2004, and we're finding that markets are even tighter and that the price impact would be closer to 26 percent in 2010.

Incidentally, while this forecast was made last summer when gas prices looked soft, we're seeing the markets today confirm what that prediction was. Today's NYMEX spot price is over $7, and it took us to mid-December to get to that price last year. The front-month prices for December through March are now over $9.

This is the highest sustained futures price trend we've ever seen in this country, so it's going to be a rough winter.

As I mentioned, we're talking about a $100-billion net economic benefit from this efficiency and renewables scenario, and this is very consistent with what the National Petroleum Council found.

If you read their report, you'll see those numbers correspond rather well. We found, interestingly, that the majority of the savings come not from direct natural gas savings, but from electricity savings.

You ask why is that. Well, electricity, as Dr. Yergin and others have pointed out, has been the fastest growing source for natural gas consumption.

Chairman Bennett. Can you wrap it up?

Mr. Prindle. I'll try and wrap it up.

Chairman Bennett. Yes, if you would.

Mr. Prindle. Electricity is a key part of the solution, as well. By saving electricity, we actually save more gas, and I can speak more to that in the Q&A, if you'd like.

Why don't we see the markets taking care of this, if there is so much energy efficiency out there? Well, the bottom line is that while free markets are working, they are not working well enough and they're not working fast enough.

We need a policy, a modest policy boost to get the kind of demand-side response that we need to re-balance markets in the next 5 years. We have a four-point recommendation:

The first is to increase funding for Federal programs. The Appropriations Committee could do that in the next 3 to 4 months.

Second, we'd like to see the states expand their public benefits programs for energy efficiency. Rhode Island and Utah are both active in this area.

Third, we'd like to see tax incentives. We almost got there in the bill that the Conferees passed last night, but we didn't quite get there. Hopefully, that will get done in the next year or so.

Last but not least, we need a bully pulpit response. We need people at the highest level of governments to call this out as an important priority for every American.

I'll stop there now, and I'll be happy to answer your questions as they come up. Thank you.

[The prepared statement of Bill Prindle appears in the Submissions for the Record on page 101.]

Chairman Bennett. Thank you very much. Thank you to all of you.

Mr. Magruder, you talked about the permitting process at the BLM. Senator Bingaman and I are both very much involved with the BLM in our various Committee assignments.

One of the things that disturbs me the most about the BLM currently is that by various estimates, as much as 50 percent of the BLM's total budget goes for litigation or for defensive actions so that they can be better prepared for litigation.

Virtually everything they try to do with respect to encouraging development is challenged in the courts by a variety of groups.

What is your experience with the permitting process? Is it substantially slower than it could be? Is there a great barrier there, or are you escaping the kind of litigation attack that has occurred in other parts of the BLM?

Mr. Magruder. Good case in point on the litigation, my company just participated in the Utah lease sale, which was a record sale for the BLM in Utah this past September. It raised $22 to $28 million.

My company accounted for about $8 million of that in anticipation of leases, so it's very important to us.

197 of the 250, plus or minus, parcels that were let in the entire lease sale, were protested or contested immediately, with the Internet and the ability to have just form letters, I mean, the protests were almost instantaneous and simultaneous to the lease.

Our company is obligated to, within 10 days, to pay, in our case, $8 million, for those leases, I think, by law, or just typically, the BLM should issue those leases in 60 days, but it will probably take us at least a year to get those leases. Our money has been parked with the BLM. If they knew there were going to be protests, we probably should have just put a down payment or something like that, but we've taken a lot of the resource, taken it away from the

actual drilling of wells, in that case, and with there is the anticipation that we'll get it through the litigation, but the protests are almost instantaneous.

A good success story is occurring in the Buffalo, Wyoming area, Powder River Basin, which is a huge resource of natural gas. The Appropriations Committee made money available for the Buffalo office.

The Buffalo, Wyoming BLM field office area was handling about 1,000 to 1,500 wells per year. That was their capability. The State of Wyoming Oil ans Gas Conservation Commission can handle about 12,000 permits a year and within a much shorter timeframe. The same type of well on private or state property next door to Federal property is close enough to take a pitching iron and hit a golf ball from one well to the next. That well looks no different and is drilled and completed using the same technique as a well on Federal property. The difference, however, is in the permitting requirements for the Federal well versus the State well.

But through Kathleen Clark's efforts and many people of the leadership in Buffalo, they were able to work with the industry and compromise and come up with a permitting process that has been very successful. They have increased their output from 1,500 wells a year and they are approaching 3,000. That's their goal, and they're almost at that point now.

There are many other cases. Glenwood Springs, Colorado on the Western Slope is a very critical source of natural gas. It has a very efficient process working right now.

But, you go into areas like Jonah, Southwest Wyoming, it's very difficult to get permits. The industry is just poised and ready to go there. The only question is why is there this backlog of permits?

As I mentioned earlier, the technology has improved for drilling more wells per given area. It's triggering the NEPA process and everything that goes along with the obligations of the BLM to manage and steward those lands, and it's just creating a long regulatory process to get a well drilled.

In my experience, sir, I really have not seen a great deal of impact as a result of my proposal, the APD, the application to drill the well, and the outcome. Just timing is the big issue.

Chairman Bennett. Well, I'm very concerned about it. We call it the 37-cent appeal. For the price of a postage stamp, something can be held up for a full year.

The BLM or Forest Service are subject to the same kind of appeal in a variety of environmental issues and inevitably win in court, once it finally gets to court, but people don't file on the basis of merit; they simply file on an attempt to hold things up.

Mr. Magruder. Exactly.

Chairman Bennett. If I hear what you're saying, things that should take place in 60 days, you routinely expect they will take a year?

Mr. Magruder. Yes, sir.

Chairman Bennett. Just to work through that, that's very distressing.

Mr. Magruder. I wish there was some kind of cause and effect. I mean, if there was a valid concern, then certainly it will stand

on its own merits, but if it's just a frivolous lawsuit, then we really need some recourse against those situations.

Chairman Bennett. All right. I will observe the 5-minute rule, and we will look to multiple rounds among those that are here.

Senator Reed.

Senator Reed. Thank you very much, Mr. Chairman. Thank you, gentlemen, for your testimony.

Dr. Yergin, you indicated that you assume energy efficiency in your modeling. Are those energy efficiencies things like Mr. Prindle has talked about, that we'd have to undertake legislatively?

Dr. Yergin. I don't know what, in detail, is in his proposal. As he points out—something, in particular, that critics outside the United States have not necessarily recognized, is that we were a lot more efficient than we are today. The United States has had a steady progression of it, and we're assuming future efficiency. A great deal of it is embodied in new technology, and as you turn over your capital stock, you get more efficient.

Senator Reed. Essentially, the question here for us, particularly, is what do we have to do to encourage efficiency? Do you think there's a role for us to play, as Mr. Prindle pointed out, in terms of accelerating the use of new technology, providing tax incentives and credits? Is that something that is necessary?

Dr. Yergin. Well, I think that certainly has a role. How do you get efficiency, greater efficiency? You get it by jawboning, the bully pulpit; you get it by turning over your capital stock; you get it, as we've seen, through regulation; you get it through price.

Of course, that last one is maybe the least popular way to go about it. I think a lot of it is actually in research and development.

Several years ago, I chaired a task force for the Department of Energy on energy R&D, and it continues to be that the impact of technology is usually underestimated. The question is, how do you promote that technological innovation and the adaptation of it?

Senator Reed. Thank you. Mr. Sankey, I was very interested in your comments on LNG, and particularly the notion that there's excess capacity for regasification and also ships, and that the constraint is the supply.

As you are aware, there is a renewed energy—no pun intended—to develop these LNG facilities in the United States, regasification facilities.

With this over-capacity, are those developments necessary, or what's your view?

Mr. Sankey. No, they are certainly necessary, going forward. I think, in fact, ironically, some of them are just too big to be filled at the moment and that's the problem.

If we're going to see, let's say, LNG accounting for 10 percent of U.S. gas supply by the end of the decade, you're clearly going to need at least one, if not up to probably four more terminals to bring the gas in.

My comment would just simply be that FERC, the Federal Energy Regulatory Commission, has done well here to accelerate the process, and you actually have two permitted terminals, potentially available to begin construction, that actually are not beginning construction because you don't have the supply.

Therefore, I wouldn't, from my perspective, worry so much about the permitting process any longer. I think we've overcome that one. It is difficult to build in the Northeast; it is difficult to add in Boston, but in the Gulf of Mexico, I think, in Louisiana, you can expect to see more.

Senator Reed. Given the national nature of the energy markets here, in fact, the international nature, is it necessary to have terminals in certain places in the country? Or is it simply that three more terminals with adequate capacity, anyplace in the country, could serve the market?

Mr. Sankey. Well, that becomes a question of price. The best place to put a terminal would be where it's most needed, at the extreme ends of the infrastructure, which would be in the Northeast, but, of course, they say that's the hardest place to put them.

Whereas, in the Gulf, where you have tremendous amounts of gas infrastructure and the potential to move gas right across the United States, you're most likely to see the new infrastructure. I think, again, that my view on that would be it would tend to be a market issue. The most efficient, biggest plants will be in the Gulf area where you have the most infrastructure to move the gas, and you'll have niche players with continued attempts to build regasification right at the extreme ends of infrastructure, because you'll get the highest price there, and so, right now, the highest price in the United States is probably in the Boston area. It's a much lower price down at Henry Hub, and you have to keep that in mind.

I would add that there's a seasonal element here, as well, to keep in mind, which is one of the problems you face with LNG in that everyone, globally, consumes gas during winter, and doesn't during summer, and that's simply another challenge.

Senator Reed. You commented on the FERC permitting process. One of the issues that we've seen and observed, is the disconnect between the FERC process and other agencies that have a role to play, for instance, with marine terminals, the Coast Guard, for security, transportation, and access. Do you have any comments on that disconnect?

Mr. Sankey. Well as far as we can make out, the Coast Guard is also approving terminals, and there is the potential for off-shore terminals. The only comment there would be that they are extremely expensive; technologically perhaps slightly untested. There is not one in the world yet.

The net result of this tends to be that they are extremely large in order to justify their expense. From a permitting point of view, they are preferable insofar as they are what are called "over the horizon" so you do not have this so-called NMBI issue with them, but you have the attendant additional expense.

Senator Reed. You also indicated in your testimony that one of the problems with the prices we are paying in the United States is that we rely on the spot market more than long-term contracts.

That would seem to me to be something that could be addressed by the industry immediately.

Mr. Sankey. Yes. I mean you are in a situation where Dow Chemical now has provisionally signed up to take long-term LNG—and it is symptomatic of where we are going here that a chemical

company in the United States will now switch to LNG supply on a term, what we call a "term basis." Again the disconnect right here, right now, is that there are not contracts in place; and you will, if you like, rival buyers of gas globally who do have contracts. Again I would say this winter you may actually see, and I think you are seeing now, declining LNG delivery into the United States into a rising price, and that is simply because the other contractual payers—who may be paying less, in fact,—are taking precedence.

Senator Reed. Thank you.

Thank you, Mr. Chairman.

Chairman Bennett. Senator Bingaman.

Senator Bingaman. Thank you very much.

I think I have identified a difference of opinion among those of you here. Let me just ask a question about that.

Mr. Prindle's testimony states that, "if we rely on LNG as a marginal source for gas, it will tie U.S. markets to a permanent higher cost baseline." Mr. Sankey, I thought I understood you to say that over the long term there is an enormous amount of cheap gas out there, and once the infrastructure has been developed to bring it to market that we were going to see the price of gas substantially lower than current future prices and current prices would reflect.

Am I interpreting your testimony correctly?

Mr. Sankey. No. I specifically made the point that, whilst potential supply of LNG is lower than current future prices, it is also higher than historic prices in the United States. So that your deep history of gas prices being around $1, maybe $2 per MMBtu, you have to recognize that the lowest cost gas from LNG is $2 to $3 per MMBtu. I think actually we are agreeing.

If I could take the liberty of adding on efficiency, I think the single biggest issue that is faced here is actually efficiency in the vehicle fleet, and cars and SUVs and so on becoming less efficient over time, which is obviously a contrary trend to everything else we have seen in energy demand here in the United States, and that would be the focus of where I would make my efforts if I was trying to improve efficiency in the United States.

The point being that very clearly oil prices and gas prices are linked here and you do have a $52 oil price right now that is certainly supporting a very high United States gas price because there is a degree of interchangeability between the use of oil and the use of gas at the margin. As I said, it would help gas prices lower—and I mean natural gas prices—if you could get gasoline prices maybe a little bit higher, or get efficiency of use a bit better.

Dr. Yergin. Senator.

Senator Bingaman. Dr. Yergin.

Dr. Yergin. The picture that I would like to suggest is that we are on a much higher plane for natural gas prices than we have ever been accustomed to in the United States, and that will last until perhaps 2008, 2009, perhaps the year is 2010, until we start to see supplies, new supplies coming in, principally LNG.

The picture in mind is that we will see that prices, given the cost of LNG, of maybe $3.25 or $3.50 will be the platform, or the base, or the plateau for natural gas prices that is higher than what we have had historically but a good deal lower than what we are looking at over the next few years.

Senator Bingaman. We currently have in place OPEC that has a substantial impact on the world price of oil. Is there currently, or in the relatively near future, expected to be something comparable to OPEC in gas producing countries that will essentially dictate to us what we pay for natural gas to heat our homes?

Dr. Yergin, go ahead.

Dr. Yergin. I will give it a try because we have tried to do some thinking and research on that. I think you are holding out the question—and it is an inevitable question—will OPEC be joined by a sibling called OGEC, Organization of Gas Exporting Countries. Probably there will be associations of gas exporters.

The way we look at it, the bigger, the more diversified, the more global, the more flexible LNG markets are in the world, the better off we will be and so will exporters. The countries involved do not overlay completely by any means with OPEC. Trinidad, Australia, others, will be important exporters. Moreover even if you have a larger, more flexible global energy market—this notion of a new global gas market different from what we have today—there is still an inter-dependence between the suppliers and the consumers. They have a pretty strong interest, the suppliers, in a stable relationship with their consumers.

There is a risk there of it. It seems to us that diversification, the scale of the market, and the fact that you still have a great deal of pipelined gas—more LNG—would offset that risk. The bigger risk is this perpetuation of a very tight North American gas market.

Senator Bingaman. Does anybody else have a comment on that?

Mr. Sankey. I would concur with that idea. At the moment, there is essentially a shortage of gas, and that does not tend to encourage or require a cartel to be formed in order to support prices.

Equally I think that the history of OPEC whereby essentially it related to the behavior of foreign companies within now OPEC-member countries has essentially—it is a process that has occurred in terms of the exits of those companies from those countries and a change in the fiscal regimes within those countries which applies both to gas and to oil.

I think the sense of injustice, I would again have to defer to Dr. Yergin on this, but the sense of injustice that caused the formation of OPEC is not necessarily there in terms of the way the gas market operates, and I would equally support all he said about the liquidity of the market and the diversification of supply, again which makes it a difficult proposition.

Senator Bingaman. Thank you, Mr. Chairman.

Chairman Bennett. Let me go back to my opening observation about the importance of an infrastructure and the importance of a distribution system, and see if I have it right or if I overreacted to some of the information that I went through in preparation for the hearing.

In order for a market to be efficient, goods and services—in this case natural gas—has to be able to move freely throughout the market. We try to make markets efficient by lowering tariff barriers. We try to make markets efficient by lowering regulatory barriers.

Let's say LNG shows up in New Orleans and the shortage is in Providence, Rhode Island. Do we have the distribution system that can get the LNG from New Orleans to Providence, Rhode Island, easily?

Suppose there is a sudden cold snap in Montana? How easily can we, in the United States, move supplies around? Mr. Prindle is pushing energy efficiency, and the nice thing about that is that there are no barriers. If you develop a better window that keeps more of the cold out in the form of a thermal barrier, it is available everywhere and you do not have to move it around. You develop a better air conditioner, and everybody sells the better air conditioner, and so on.

To try to attack this problem from the supply side, as opposed to the conservation side, we have to have an efficient distribution system. My sense is that that is not there, and it probably means a fairly significant capital investment on which we hope to get a return later on down the road.

Am I missing something? You who are in this business, Mr. Magruder or Mr. Sankey? How good is our distribution system right now?

Mr. Sankey. Well I would begin, but I would defer to Mr. Magruder on the specifics of the infrastructure. I would say what you do have is a very good pricing system here. You have a very liquid market with very visible pricing that ultimately will solve any short-term dislocations in supply and demand. You should rely on that.

Chairman Bennett. Yes, but do we need—my fundamental question, to try to correct my own ignorance—do we need a significant infrastructure capital investment in this country to get where we want to go to the point where Dr. Yergin is talking about where we can see the price come back down to $3.50 or $4 as opposed to where it is now?

Mr. Magruder, do you have——

Mr. Sankey. Again I will defer to Mr. Magruder, but my primary point, stated in my testimony, was that the infrastructure requirement is abroad. You know, the regasification problem is overstated as the problem here, and the reality is where you need infrastructure is in Angola, and in Nigeria, and in Algeria, not so much in the United States.

Mr. Magruder. I would agree that most of the capital is going to be focused on the liquification end or the point of the source. It has been awhile since I have worked in the Gulf of Mexico, so I am not the correct person to ask to recite current statistics, but you do have those main pipeline systems that were built back in the 1940's after the War that serviced the Northeast, and those major systems are still in there: Texas Eastern, the Texas Gas System, TransCo, all those old main pipelines are in place. The shelf, the central part of the Gulf of Mexico, is on decline.

You have the deep water Gulf of Mexico providing a new source of natural gas, but it just seems logical that the Gulf of Mexico could satisfy the little bit of natural gas that is going to be associated with LNG.

It will be a situation where you are going to utilize the storage capacities you have in the East—the old Consolidated Natural Gas

Systems—and all those old storage fields will probably come in handy to store this product and make it readily available for the winter time during peak demand periods.

I think that is the key to storage, to make sure that you get out of the volatility of a supply and demand situation and make sure you just have enough resource here to go through the winter months and eliminate the volatility.

Chairman Bennett. You smooth the volatility by storage?

Mr. Magruder. Sure.

Chairman Bennett. If you get what you want in the Rockies, you can put that in a distribution system and virtually sell it anywhere in the United States?

Mr. Magruder. Yes. I was about to say, the Rockies is unique in that it is a net exporter of natural gas that distributes to the East, the Central, the Midwest, the East Coast, and the West Coast. We are kind of unique from that standpoint because it is——

Chairman Bennett. The pipeline network as it currently exists is efficient enough that your natural gas could physically go virtually anywhere in the United States?

Mr. Magruder. Yes. We can go, especially with the Kern River Expansion that occurred last year, which had a tremendous impact on the ability to get natural gas out of the Rockies. That was a Bcf alone per day.

Chairman Bennett. My understanding was incorrect. We probably do not need that massive capital infusion in infrastructure in the United States. Whether natural gas comes from the Rockies or whether it comes from LNG in New Orleans, it can physically move rapidly in the United States?

Mr. Magruder. Well, the basic infrastructure is there. The Rocky Mountains, as an example, is putting major capital in place right now with the anticipation of more supply being available out of the Rockies.

As I mentioned earlier in my testimony to you, our current capacity out of the Rockies is 4.6 billion cubic feet per day moving toward 6.5. That is incremental, too. That is a lot, you know, for just one small region.

I am not personally familiar with any new pipeline systems scheduled from the Gulf Coast to the Northeast, but I know that those were some major systems that were installed years ago and they're still there and operational.

Chairman Bennett. Well not to belabor the problem, but I go back to the comment I made where the price can be $20 in one part of the country and $7 in another part of the country. That is a factor of availability.

Mr. Sankey. It is also a tremendous incentive to build infrastructure.

Chairman Bennett. Yes. That is why I am saying, should we not have, or are we not looking at as a Nation additional infrastructure so that the price becomes $7 nationwide?

Mr. Sankey. Well I think Mr. Magruder is saying that where the price dislocations occur, the infrastructure is added. I do not really see an issue there. Remember, the market as highlighted isn't growing.

Dr. Yergin. Last winter in the Northeast we saw with very cold weather and utilities, residential, with everybody pulling on the pipe at the same time, we hit the limits; and we saw prices really reflect the fact that we were at or exceeding capacity.

You look at some regions, and you look at Long Island, whom I think only has one pipe supplying it, and you say from a diversification point of view that is not good; it should have a second one. Then you get into the same morass of regulatory and permitting questions.

I think also from a sort of security diversification point of view, from a national point of view, it probably would make sense to have at least one new LNG facility on the East Coast, and also have one on the West Coast, going to the point, Senator, that you are making of having supply closer to the demand centers.

Chairman Bennett. OK. Thank you.

Senator Reed.

Senator Reed. Mr. Sankey, you indicated that at the present time where the capital should flow is to places like Angola, Nigeria, and Algeria to develop their fields and get supply. What is inhibiting that?

Mr. Sankey. Nothing. It is going now.

Senator Reed. It is going on?

Mr. Sankey. Yes.

Senator Reed. So that is——

Mr. Sankey. Primarily, as I mentioned, there is an issue with planning assumptions of the oil companies where they use a long-term view, and we still have the memory in fact here of 1998–1999 when you saw a $12 oil price still somewhat feeding through into assumptions. Assumptions are only gradually rising about what is a safe future forecast for prices. When you are putting $5 to $10 billion into Angola, you have to have a huge degree of comfort that the price you are going to achieve is going to make a good return for you. The companies find, broadly speaking, that it is better to be conservative than to be over-aggressive.

The global picture here is that in the 1980's you had spare U.S. regasification capacity. OPEC had 15 million barrels a day of spare oil production capacity. Too many refineries in the United States.

We have gone from an over-invested energy infrastructure to an under-invested energy infrastructure. Really we are in the fulcrum period that I mentioned that will see very high prices encouraging more investment, but we are right at that point now.

Dr. Yergin. Senator, the scale of the investment in the upstream has greatly grown. A typical project 10 or 15 years ago might have been $300 million. It is $3 to $5 billion. When it comes to writing a check for a $5 or even a $10 billion project, you do take a deep breath before you do it.

I think that one issue is of course the efficiency of governments. I am not talking about our government, but other governments in terms of their understanding that it is a competitive market; that the price cannot be taken for granted. It is interesting to see a country like Qatar which has emerged as perhaps the fulcrum of LNG because its government has been more efficient in working with international companies and mobilizing the investment in resources that is necessary to be competitive.

Senator Reed. Just a follow-on question that I think is implicit in what you have said; that this growing demand for LNG is not restricted to the United States and North America, that it is worldwide?

Mr. Sankey. Correct.

Dr. Yergin. Yes. If you go to China, they have some growing numbers. Those numbers are going to obviously end up being a lot higher as they get ready for the 2008 Olympics. They want natural gas for environmental reasons. The world is waking up to China as a market for all commodities, and it will be a major market for LNG as well. Europe is going to need LNG supplies as the North Sea declines.

Senator Reed. Thank you.

Thank you very much, Mr. Chairman.

Chairman Bennett. Senator Bingaman.

Senator Bingaman. Thank you, again.

Dr. Yergin, you talked about a built-in rising demand for natural gas over the next several years, as I understood your testimony, and I also thought I heard—perhaps you said this, or Mr. Sankey, or one of you—that 26 percent of the demand for natural gas, or the utilization of natural gas, is by utilities to produce electricity.

We have got a circumstance where several years ago we had a lot of utilities rushing out to build more gas-fired generating capacity because the thought was the price of gas was cheap, and these plants were relatively cheap to construct.

Then the price started going up, and the economy flagged, and people started shutting down some of those plants.

I guess once you have built one of these plants you have an investment there, and there is an incentive to go ahead and use it even when the price of gas is relatively high? I assume that is the case.

Are there policies that we should be adopting that would discourage utilities from going out and further increasing demand for natural gas by further constructing natural gas-fired generation capacity when there are cheaper ways to produce electricity that we are all aware of?

I mean, if we in fact have agreement that we are going into a period here of high natural gas prices and we are looking for ways to take pressure off that price, Dr. Yergin?

Dr. Yergin. You have gone right to a question we are looking at now. The United States are still working out of the over-capacity, as you describe, that it built up when we had that great boom and many thought the so called "new economy"—internet, computers, and everything—meant that we were going to have this great need for electricity.

Lo and behold, you look out toward 2010, 2011, you start to see we are going to need new capacity again. You see people struggling with exactly the question that you have described. What are your alternatives?

Nuclear? It is hard to see any utility committing to new nuclear capacity in the United States in the years immediately ahead. Conservation obviously is an element in it, but it comes down now to the question of the tradeoff between how much gas do you build in

new capacity and how much coal? There is going to be a real interaction.

We think that in the next major wave of electric generation capacity, coal will play a much larger role than people would anticipate right now.

Senator Bingaman. I had a gentleman in my office just 2 days ago who is in the business of building wind generation, generating capacity, and he said that he goes to utilities and says "I can turn this plant over to you, or this production over to you, at 2 cents per kilowatt hour from wind generation," and they turn him down because they already have so much generating capacity of their own, presumably natural gas capacity and other types of capacity, that they have no interest in purchasing wind power at that price.

Dr. Yergin. Actually your State is one of the leaders in terms of wind power. I think that we have seen the cost of wind power—I don't know about 2 cents, but wind power costs have come down. Obviously there are some incentives for that, but it can be competitive.

There are issues about if you get a certain scale of wind power. Wind is intermittent. What do you do about it? Wind is a competitor, but it still seems likely to be a niche competitor rather than base load on a large scale.

Senator Bingaman. He was acknowledging that you had to supplement it with generating capacity from natural gas or something for the time when you can't produce power from wind, but it does seem as though we are into a situation where we are captive of the decisions that have earlier been made about where we are going to have the generating capacity and what kind of generating capacity we are going to, or each utility is going to construct.

The more they decide to construct gas-fired generating capacity, the more we are locked into a growing demand for gas and a high price of gas it seems to me, going forward.

Dr. Yergin. That's right. It was really quite a natural gas band wagon. I think now you are going to see a drive for diversification, and renewables will be part of that.

The numbers in terms of what we use in electricity and growth, even with conservation, are big numbers to be met in the years ahead.

Mr. Prindle. Senator, could I respond to that as well? Ten years ago, most states in the United States conducted what we used to call Integrated Resource Planning. If a utility wanted to construct a new power plant, they basically had to look at all the resource options that were available to them, including energy efficiency, renewable energy, and conventional generation.

With restructuring we have today, we have largely lost that capability. I think that is why you see an increasing mismatch between supply and demand in wholesale markets. There is no rational framework today in which a State or FERC can say, "Well, it looks like we are going to need some new resources, what is the least-cost way to do it?"

I think that is a mistake. Some states have retained that capability, and in fact California, which some could say has seen the most damaging potential fruits of unconstrained restructuring, has actually gone back to a policy where they are requiring utilities to

look first to the demand side and to spend whatever is cost-effective to make sure the demand growth rate is reasonable before they commit to new generation.

Several states are starting to look at that again. We think that is a trend that needs correction; that the restructuring situation in this country has probably swung a little bit too far and there needs to be some kind of resource planning process by which we get the mix right.

Certainly we are going to need new supply, but we need the right mix of demand, renewables, and conventional supply. Thank you.

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

Chairman Bennett. Thank you.

You talked about LNG and the impact it would have. What would be the impact if the Alaskan Pipeline were to finally come about? We import now from Canada. Presumably Alaska could compete with Canada in terms of supply.

If the Alaskan Pipeline were built, what impact would that have?

Mr. Sankey. I would just highlight that in my testimony actually I have included the Alaskan Gas Pipeline in terms of its price, which indicates that it would deliver gas at about $4 per MMBtu. It is actually more expensive gas than the majority of LNG that could come in.

I think that from our perspective regarding U.S. gas you need all you can get. You need Rockies. You need LNG. You need efficiency. You name it. Alaskan Gas Pipeline will be part of that.

I have mentioned planning assumptions several times. ExxonMobil as an example raised its view of gas prices, as I mentioned, from $2.50 in the United States to $3.50 in the United States. The key driver of that decision was a view that the Alaskan Pipeline will not occur in the next decade essentially, and that was the primary reason they gave for that move.

I think that the issues surrounding the difficulties which we have referred to of actual construction, the very high price which to me seems surprisingly high but nevertheless a very high price that is quoted for the pipeline, are all issues that make those companies basically now prioritize LNG over Alaska with a view that Alaska will happen eventually.

Chairman Bennett. Help me out here. You are saying that the prices will come down to $3.50. Your people are saying they have a built-in long-term assumption of $3.50, and Alaska is at $4? If Alaska is at $4, it will never, ever be built.

Dr. Yergin. Alaska is a great resource in terms of natural gas. It has been on the agenda now it seems for, hard to believe, three decades of discussion.

Chairman Bennett. Yes.

Dr. Yergin. You are driven, as we are, as we look at the future, to develop a set of scenarios for the future because there is so much that of course we do not know about the future, by definition. When we look out and we see the Alaska Pipeline would be completed maybe sometime in the middle of the next decade, the impact on prices in our scenarios would not be massive by that point because the supplies would be needed and they could be absorbed.

The risk obviously for the private developers is the downside risk. $50-plus a barrel for oil was not in any company's forecast 2

years ago, nor was $12 in an earlier period, and their fear is what Paul described of what happens if say there is a huge overbuild of LNG, prices crash, and meanwhile you are building, inching along mile by mile with this pipeline.

We should assume that eventually that resource, that very valuable strategic resource to the United States, will eventually reach our markets.

Chairman Bennett. Well if the Alaska Pipeline is approved immediately, let's say in this Congress or in the early months of the next Congress, what impact would that have on people's planning?

I am assuming from what you are saying they are planning? Eventually means a long time away?

Dr. Yergin. It would have some impact. We can see what Paul thinks about this, the tradeoffs, in terms of how aggressively and what number of regasification facilities people would push in the United States.

There will be an effort to balance it. It is also a question of where people apply that limited resource called "capital."

Paul.

Mr. Sankey. Yes, I mean I think it goes to the heart of the problem essentially, which is that the companies continue to plan on low prices and therefore prices are high. If eventually they begin to plan on high prices, prices will go low. When you are playing with $15 billion, which is what they are talking about here, it is better to be conservative and say, "Look, we will wait on that."

The only observation I would make is that the $15 billion price tag seems very high on a very simple per kilometer basis, and I have never fully understood why that is. That would be my other observation, that possibly the $4 price that we are using, which we are deriving from a $15 billion cost, may be too high. Certainly at the moment, even if it was approved within let's say the next year, legally it would take at least 4 to 5 years before you would see the first gas.

Chairman Bennett. Yes, that is true.

Well while I have you, I will take advantage of your being here and go to another totally different subject but one on which you have hinted, the $50 oil.

If $50 becomes the new benchmark instead of turning out to be a spike, and people in Mr. Sankey's world start saying $50 oil is where we are going to live, at $50 a barrel there is more oil in Utah and Colorado through oil shale and tar sands than there is in Saudi Arabia or Iraq. We can efficiently—we can economically get it out under the umbrella of $50 oil, that is, if the environmental groups will allow that to happen, and that is a political decision rather than an economic decision—but let's just assume for the moment that it could happen. Talk about that future.

Dr. Yergin. First some of the people who come in front of your Committee periodically to report on the economy would change their outlook for economic growth in the United States, and those numbers would be lower.

It is remarkable to think that just a little over a half a decade ago the price of oil was $10 a barrel and it was supposed to go to $5, and somehow there is an extra zero in there now and it is $50.

Chairman Bennett. Yes.

Dr. Yergin. I think it will be cyclical.

Right now this is an incredibly tight oil market. The oil market is tighter now than it was on the eve of the 1973 oil crisis. The only time it has been tighter was in those months immediately after Saddam Hussein invaded Kuwait and Kuwait and Iraq were out of the market. That means the market is very vulnerable to anything until we start to see more supply.

I do think what you are pointing to is that there is a lot of pessimism in some circles now about the future of oil. I think that that view is under-estimating again the impact of technology. I think that as we look out, at least over the next 10 or 15 years, we are going to see a widening of the definition of what oil is to include unconventional oil.

You certainly see that Canadian oil sands, which were sort of way over on the side, are now going to be a major source of growth of supply for the United States in a way that had not been anticipated.

I think oil shale is still in another category. The oil price does not have to be $50. It can be $30 and a lot of things become economic that are not at $10.

Chairman Bennett. There are folks at the University of Utah who insist they can get the oil out of the oil shale at $13 a barrel. Unfortunately they have been insisting that for about 30 years.

[Laughter.]

Dr. Yergin. Do they adjust for inflation?

[Laughter.]

Chairman Bennett. No, it stays at $13 somehow. It hangs in there all the way through.

Well I know that is not the subject of the hearing, but I wanted to take advantage of your expertise because we appreciate your being here.

Thank you so much for your testimony. Thank you for the work that went into the formal statements that you have filed with the Committee, which will of course be printed in their entirety in the record, and we appreciate your sharing your expertise with us here today.

The Committee is adjourned.

[Whereupon, at 11:30 a.m., Thursday, October 7, 2004, the Committee hearing was adjourned.)

Submissions for the Record

PREPARED STATEMENT OF SENATOR ROBERT F. BENNETT, CHAIRMAN

Good morning and welcome to today's hearing. As we enter the 4th year of the economic expansion there is one black cloud threatening to rain on our parade, and that is the specter of high energy prices. Most people have taken notice of the high oil prices of late, since they eventually trickle down to the consumer in the form of high gasoline prices. However, just as worrisome are the high natural gas prices that have beset our economy over the past few years. After a protracted period of low and stable prices, the cost of natural gas has skyrocketed in recent years to unprecedented heights. What's more, natural gas prices now display almost unprecedented volatility, wreaking havoc on the ability of utilities and other companies that use gas to plan for the future.

It is important that we address the problem of high natural gas prices as soon as possible. The high prices act like a brake on the American economy, impacting every business and household in America. However, certain industries have suffered especially hard. For instance, the chemical and plastics industries, which use natural gas as a feedstock, have been hammered by the high prices. The Manufacturers' Alliance estimates that 90,000 jobs have been lost in the chemical industry since the year 2000.

Also, it is important to remember that there is not a single integrated market for natural gas in this country. We simply do not have the infrastructure to easily ship gas from one region to another should there develop a localized shortage, and as a result prices across the country often differ greatly. The lack of infrastructure shows no signs of being alleviated in the near future, according to a recently released Energy Information Administration report stating that new investment in pipelines actually fell in 2002, the last year for which we have reliable data. We do not have to hearken too far to remember gas prices on the east coast tripling to over $20 per mcf (million cubic foot) while topping out at $7 in Cheyenne.

We know the proximate causes for the run up in the cost of natural gas. A few years after prices were deregulated in the 1980's the Congress passed laws that in effect encouraged its use to produce electricity, sharply increasing demand. At the same time, the production from extant wells began to decline and environmental restrictions made the exploration and drilling of new wells more difficult. It doesn't take an economist to see that policies that increase demand and decrease supply will sharply increase prices.

Let's be clear about one thing: there exists enough natural gas in the world to meet our needs for the foreseeable future. *We are not running out of natural gas by any stretch of the imagination.* Here in the U.S. we still have significant reserves in the lower 48 states and Alaska. More significantly, vast amounts of natural gas reserves are available all over the world.

However, companies and countries have just begun to contemplate the massive investments needed to get to these reserves and create a truly global market in natural gas. The pipelines, cooling plants, tankers, and regasification plants necessary will ultimately cost hundreds of billion dollars. A central question for policymakers is "what can we do to facilitate these investments?"

Diagnosing the causes of high prices is easy; forecasting future prices and prescribing policies to all high prices is not. The standard response would be that high prices alone will attract new investment in production, more conservation by the users of natural gas, and the forces of supply and demand will eventually balance. To be sure, we have witnessed some of this—the rise in natural gas consumption has tapered off in the last year or two, and the current rig count in the U.S. is at an all time high. However, major new investments to increase supply or conservation will not take place in an environment of major price and policy uncertainty. The latter is only in part our fault, and although we've tried to remedy this, the

current Congress will most likely escape tomorrow without ameliorating the situation. We've also contributed to the former as well by passing laws that stimulated natural gas demand without fully thinking through their long run consequences and dealing with them when they were more manageable.

I will leave the question of "what do we do now?" to our esteemed panel of experts that we have assembled today. The Committee is honored to have you with us today and we anxiously await to hear your thoughts on the natural gas market of today and the future.

Joint Economic Committee
CHAIRMAN ROBERT F. BENNETT OCTOBER 6, 2004

The Pressures on Natural Gas Prices

The price of natural gas has increased sharply in recent years after an extended period of relative stability. Higher prices are due to a number of factors, such as the implementation of policies that have encouraged consumption, the lack of infrastructure necessary to bring more natural gas to the market, the declining productivity of existing wells, and the inability to access natural gas field on federal lands.

There are staggering amounts of natural gas throughout the world but the barriers to accessing and transporting natural gas must be overcome

Natural gas is a vital source of energy—it burns cleanly, is already in use all over the country, and much of the world's reserves can be found in countries that are closer and more stable than the Middle East. The United States is not running out of natural gas but is having difficulty in accessing its supply. The long run solution the United States' energy challenges may well be the greater utilization of liquefied natural gas (LNG). However, a combination of policies and circumstances that simultaneously encourages demand while constraining supply is a recipe for problems.

The effects of high natural gas prices ripple through the economy

The impact of high natural gas prices reaches far and wide, but it affects some industries and regions especially hard. Natural gas accounts for 19% of all electric power generation[1] and nearly all new power plants built in the United States use natural gas to generate power. Hence, electricity prices must inevitably rise with natural gas prices.

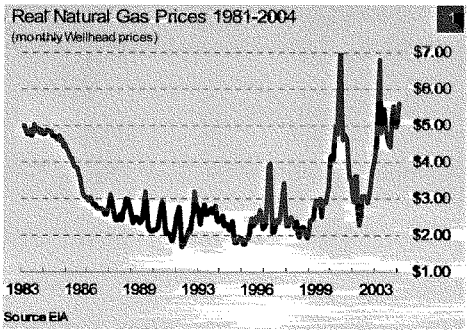
Certain key industries, such as chemicals and plastics, use natural gas as the primary input in the production process. For these industries, diversifying away from natural gas is not an option. The impact of high prices is evident: Employment in the chemical and plastic industries has fallen 12% since natural gas prices first went above $4 per million cubic feet in September 2000[2].

Also, the market for natural gas (both domestically and abroad) is more segmented than is the market for oil, so that a shortage of gas on the east coast cannot be easily resolved by shifting supply from the west coast. As a result, natural gas prices can vary significantly across the country. For example, a cold snap in February 2003 pushed prices on the east coast to $20 per mbtu, nearly triple the $7.22 price in Wyoming.

[1] Energy Information Administration, Monthly Energy Review, April 2003.
[2] Bureau of Labor Statistics, *2004 Employees on Nonfarm Payrolls by Industry Subsectors.*

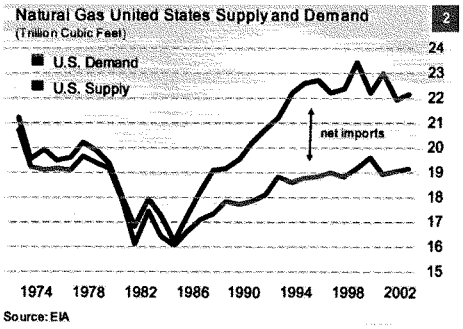
An historical perspective on natural gas prices

This is not the first time the United States has seen steep increases in the price of natural gas. In the wake of the oil crisis of the 1970s and early 1980s natural gas prices surged in lockstep with oil prices. Prices slowly returned to pre-embargo levels by the early 1980s as new exploration and technological breakthroughs in-creased output. Figure 1 shows that since the late 1990s prices have been high *and* volatile.



There has been skyrocketing demand for natural gas...
In the last twenty years the demand for natural gas has taken off. Figure 2 shows that since 1986 the amount of natural gas burned in this country increased by over 40%, a rate that far surpasses the increase in coal or oil[3]. The rapid rise in natural gas consumption owes to two key factors. First, the economy has grown at a healthy clip over the period; real gross domestic product today is more than 40% greater than it was in 1986, in turn increasing the demand for electric power as well.

What makes this growth extraordinary is improvements in energy efficiency of late. In the last 30 years the industrial sector has reduced the amount of energy required to produce one unit of output by nearly 40%. Consumers have reduced the amount of natural gas used per customer by 16% from 1980 to 2001, largely due to improved insulation and more efficient furnaces[4].

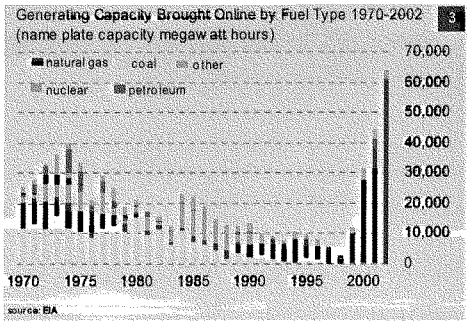


Second, environmental laws passed in the 1980s and 1990s, and their subsequent regulations, encouraged utilities to use clean burning natural gas rather than coal or oil. The Clean Air Act of 1990 created an incentive for electric power plants to invest in either gas-only equipment or fuel switching generators in order to reduce emissions of sulfur dioxide and nitrogen oxide. The Public Utility Regulatory Policies Act, designed with the goal of improving

[3] Energy Information Administration, *International Natural Gas Information,* http://www.eia.doe.gov/emeu/international/gas.html#IntlConsumption
[4] American Gas Association, *Energy Analysis EA 2003-01*, 2003.

the efficiency of energy-producing equipment, encouraged the use of natural gas in energy production as well. Figure 3 shows that since the early 1990s nearly all new utility plants generate power by burning natural gas.

...and supplies have failed to keep pace



While demand for natural gas in the United States has spiked over the past fifteen years, supply has stagnated. Since 1996 domestic production of natural gas has grown at an annual rate well below one percent, and production is still below the peak of the early 1970s. This slow increase is due to a number of factors, a primary one being that the more accessible gas fields in the United States are slowly being tapped out. In order to maintain production, domestic producers are having to drill more wells in existing wells and extract gas more efficiently from existing wells. Both are occurring; the current rig count is now at an all-time high and wells are being depleted at an ever-increasing rate[5].

Another factor limiting domestic production is that gaining access to public lands, where most of the promising natural gas fields lay, has become increasingly difficult. The first step is to acquire a lease to develop a natural gas field, but this alone is not sufficient to begin drilling: Oil and gas leases on Federal land must also comply with the National Environmental Policy Act, the Clean Water Act, the Clean Air Act, and the Endangered Species Act. However, just obtaining leases and complying with the law are often not sufficient to extract natural gas. Litigation has stifled access to natural gas sources as environmental groups have brought numerous lawsuits to prevent even preliminary, noninvasive exploration activities.

One place to turn to increase supply is Alaska, which has 18% of all domestic gas reserves. However, its gas is relatively inaccessible—there is currently no pipeline to transport it to the lower 48 states and the LNG facilities in Alaska are limited. Solving this transportation problem will be neither cheap nor quick, but it will measurably improve supply.

There is no disputing that known natural gas reserves both within and outside of the United States are more than sufficient to satisfy demand for decades to come. However, the cost of accessing these reserves remains high and shows no signs of falling.

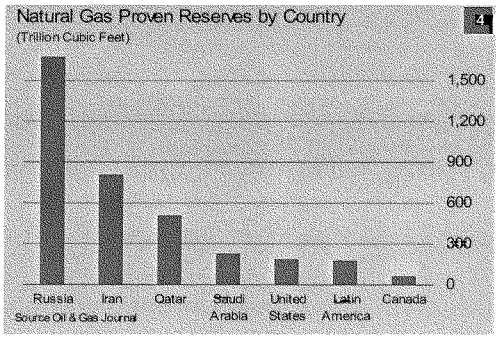
Liquefied natural gas is part of a long-run solution

LNG will undoubtedly play a role in meeting the long-term demands for natural gas, but not in the short run. LNG currently makes up only about 1% of U.S. natural gas consumption, and there is relatively little excess capacity at the four LNG terminals currently in operation.

[5] *Oil Daily,* 3 September 04.

While there are many new terminals planned, regulatory hurdles have made expansion difficult.

However, even if the United States builds additional capacity, the major natural gas producers in the world must expand export facilities. The infrastructure needed to export natural gas is immense; it takes years or even decades to plan, license, permit and construct the necessary pipelines, terminals, cooling facilities, regasification plants, and tankers necessary to produce LNG at the scale necessary to make exports cost-effective. Such projects are only now being contemplated as markets begin to adjust to the idea that the higher demand for natural gas may be permanent.



One upside of an impending world market for natural gas is that the prospects of an OPEC supremacy seems slight. As Figure 4 shows, substantial natural gas reserves exist all over the world, both within and outside of the Middle East.

The government's role in the natural gas market

The government has been an integral factor in the natural gas market in recent years by passing laws encouraging the use of cleaner burning fuels. However, regulation and litigation have also made domestic production more difficult. While demand for natural gas seems poised to increase further, domestic investment in production is not keeping pace.

An environment that simultaneously encourages demand and discourages supply cannot exist indefinitely. Natural gas makes a great fuel; it burns cleanly, the United States has the basic underpinnings of a natural gas infrastructure, and there are truly staggering amounts of natural gas available throughout the world that should last us for at least the rest of the century, according to experts[6]. In order to do so the barriers to accessing and transporting natural gas must be overcome.

[6] Natural Gas: The Next Crisis? J. Bennett Johnston and Vicki A. Bailey *Energy Daily*, 6 October 2004.

PREPARED STATEMENT OF SENATOR JACK REED, U.S. SENATOR FROM RHODE ISLAND

Thank you, Chairman Bennett. I want to thank you for holding this hearing on a very important and timely topic. Natural gas is the most environmentally friendly fossil fuel, and it used to be thought of as relatively abundant and relatively cheap—a fuel of choice in many sectors of the economy. Natural gas instill an attractive, relatively clean-burning fuel, but prices have skyrocketed in the past few years.

High and volatile natural gas prices are a problem right now for America's households and for industrial users. Families face higher home heating costs; factories face higher costs that deter plans for expansion and encourage the search for cheaper production opportunities outside the United States; and farmers are finding it more expensive to fertilize and irrigate crops.

I suspect we will learn in this hearing that the conditions that have produced high and volatile natural gas prices are going to be with us for some time. Once a real and sustainable economic recovery takes hold, demand for natural gas will increase. But we are likely to find it harder and harder to expand supply from our traditional sources—domestic production and imports from Canada. Rising demand and a limited supply are a recipe for higher prices. These are also conditions in which unexpected events can produce sharp price fluctuations.

I myself believe very strongly that the best strategy we have for dealing with these conditions in the natural gas market is to put a much greater emphasis on energy efficiency and conservation. The National Petroleum Council, in its report, Balancing Natural Gas Policy, finds that such an approach is vital to the near-term and long-term strategy for moderating price levels and reducing volatility. I know Mr. Prindle will be testifying that the American Council for an Energy-Efficient Economy has reached similar conclusions.

I do recognize that supply-oriented policies can also have an important role to play in a balanced strategy. Those policies include increased domestic production, taking due care to be environmentally responsible; investments in production research and development; and increased liquefied natural gas (LNG) imports.

I will be especially interested in what our witnesses have to say about the prospects for LNG. This is an important issue for my State and my region and I have been urging the Federal Energy Regulatory Commission to develop a regional strategic plan for the siting of new terminals and to improve their process for addressing safety and security concerns.

While I recognize that environmentally responsible policies aimed at increasing the supply of natural gas may yield benefits, especially in the longer run, I come back to my main point. All indications are that energy conservation and increased efficiency appear to be the best solutions, especially in the next few years.

Given the problems we face in the natural gas market, I and a number of other legislators in the Northeast and Midwest were dismayed to learn that the Bush Administration has decided to discontinue the Interagency Working Group on natural gas. Perhaps this hearing can provide some additional impetus for the Administration and the Congress to make a concerted effort to address natural gas and other energy policy issues in a constructive manner.

I thank the Chairman and look forward to hearing from the witnesses.

Testimony to the Joint Economic Committee

United States Congress

By Dr. Daniel Yergin, Chairman,

Cambridge Energy Research Associates

October 7, 2004

Daniel Yergin *is Chairman of Cambridge Energy Research Associates. Dr. Yergin is a Pulitzer Prize winner and recipient of the United States Energy Award for "lifelong achievements in energy and the promotion of international understanding." With 200 employees around the world, CERA is one of the world's leading consulting and research firms in its field. Dr. Yergin received the Pulitzer Prize for General Nonfiction for his work* The Prize: The Epic Quest for Oil, Money and Power. *The book has been translated into 12 languages. He is also author of* Commanding Heights: the Battle for the World Economy, *which has been translated into 13 languages. Both were made into major PBS series. Dr. Yergin serves as CNBC Television's Global Energy Expert. He is a member of the National Petroleum Council and the U.S. Secretary of Energy's Advisory Board. He is a Director of the United States Energy Association, and a Trustee of the Brookings Institution. Dr. Yergin received his BA at Yale University and his Ph.D. from Cambridge University.*

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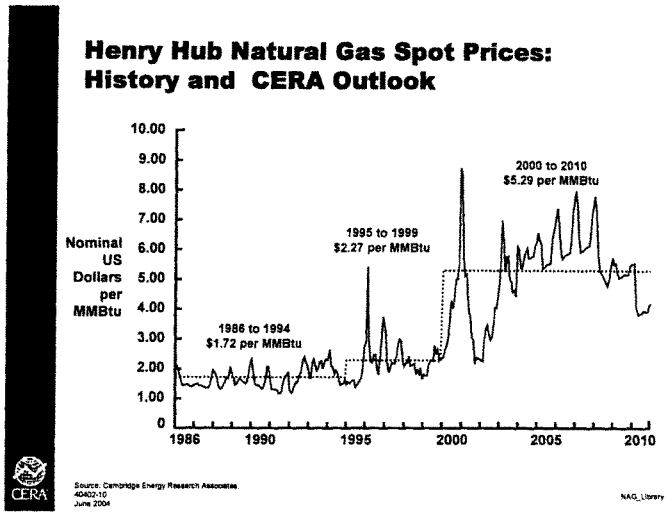
Introduction: The Current Natural Gas Crisis

Natural gas is critical to the American economy. It provides almost a quarter of the total energy on which our economy runs. Yet, seemingly overnight, at least in the public's perception, natural gas has shifted from the "fuel of choice" in North America to the "fuel of risk"— from a plentiful, relatively inexpensive fuel to one marked by uncertainty, volatility, and record price levels. This comes at a time when natural gas is being counted on as a clean, competitive fuel to meet economic and environmental challenges, embodied in part by the dramatic embrace of natural gas for a large fleet of new power plants.

The higher and volatile gas prices are not a failure of markets. Rather they are the result of a disappointing geological experience over the last several years, compounded by issues involving access to resources. With upward pressure from demand, prices are performing their essential function—signaling the change in conditions to both producers and consumers. Prices for the next three to four years are expected by Cambridge Energy Research Associates (CERA) to exceed $5.00 per MMBtu—more than double levels of just a few years ago (see Figure 1 "Henry Hub Natural Gas Spot Prices: History and CERA Outlook"). These prices are adding to the burdens of consumers and shifting the competitiveness of key industries that depend on natural gas. Yet it is important to understand that producers have limited ability to significantly increase gas production in the near term without access to new sources and new areas.



The Gas Supply Crunch

The reason we are in a crisis is not that demand has surged—it is that supplies are stagnant. Unlike crude oil, there is at this time little capacity to import natural gas from overseas. The natural gas resource base in North America has been developed for many decades; many of the largest fields are in decline.

- In the lower-48 United States, we have not been able to increase gas production for a decade. Productive capacity peaked at 55 Bcf per day in 1994, and has been creeping ever downward, and stands at 50 Bcf per day now.

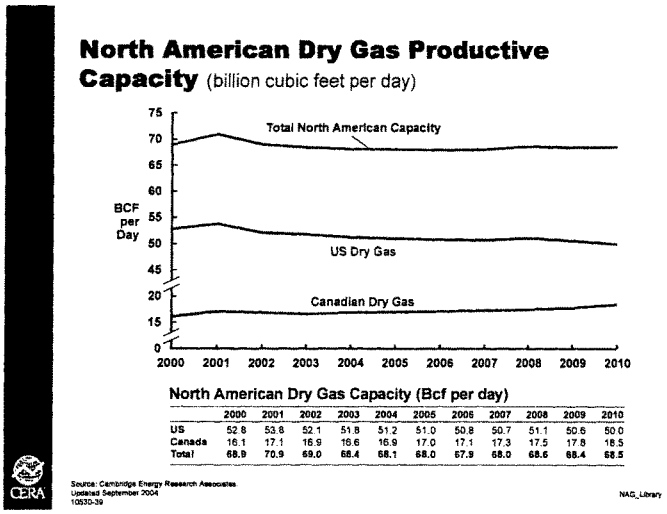
- Over recent years, Canada has become a major source of gas – some 16 percent of US consumption is met by imports from Canada today. The U.S. market has become a North American market. Canada, however, is witnessing a shift -- from strong growth in western Canadian production to a flattening of production in recent years. CERA expects only modest growth from Canada over the next several years, which, when combined with growing Canadian demand, translates to declining exports to the US.

- There have been no new, large discoveries of natural gas in Canada and the United States in the past few years, though not for lack of effort, if you look at industry spending

There is strong evidence that simply adding more drilling rigs will not solve the problem, as it has in previous decades.[1]

The response to a surge in drilling following higher gas prices in 2001 provided a bellwether for the new difficulties in adding new supplies even with higher prices and drilling rates. Gas prices spiked in the winter of 2000/01 owing to colder-than-normal weather. The gas industry responded to higher prices, putting over 1,000 rigs to work drilling for gas by the summer of 2001, up from fewer than 700 rigs drilling the year before. But this large surge in effort added very little productive capacity—less than a 4 percent increase in US production—which quickly eroded by 2002. This was a surprise in an industry accustomed to the stimulus of pricing usually leading to a relatively fast response in terms of higher production. For 2004, drilling has returned to record levels for onshore drilling but US gas productive capacity is expected by CERA to fall from 2003 levels. This is in spite of industry efforts, which will yield very strong spending and drilling efforts for the foreseeable future, North American natural gas productive capacity is not expected to grow meaningfully, and United States gas productive capacity appears now to be in permanent decline (see Figure 2 "North American Dry Gas Productive Capacity).

[1] See CERA Decision Brief *Can We Drill Our Way Out of the Supply Shortage?*



North American Dry Gas Capacity (Bcf per day)

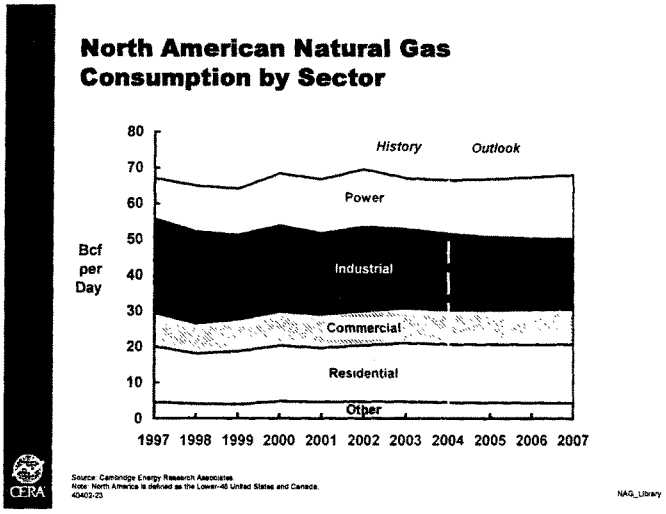
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
US	52.8	53.8	52.1	51.8	51.2	51.0	50.8	50.7	51.1	50.6	50.0
Canada	16.1	17.1	16.9	16.6	16.9	17.0	17.1	17.3	17.5	17.8	18.5
Total	68.9	70.9	69.0	68.4	68.1	68.0	67.9	68.0	68.6	68.4	68.5

The Gas Demand Imperative

At the same time, North America is set for a large increase in demand for gas to fire electric power plants. Over the last few years, the United States has installed nearly 200,000 megawatts of gas-fired power plants. To give you some context, this is equal to one quarter of the total installed capacity that was already in place in the United States in the year 2000. These gas plants were planned and built because they are more energy-efficient and cleaner-burning compared with older coal or oil plants. Few of these plants were designed to burn alternate fuels.

Many of these power plants are not heavily utilized today. However, with these plants now in place, demand for natural gas will grow steadily as economic growth inevitably pushes the usage of these plants higher.[2] With supplies unable to grow in the near term, power demand is squeezing price-sensitive industrial demand out of the

market, with negative consequences for competition and employment in gas-intensive industries in the US and Canada (see Figure 3 "North American Natural Gas Consumption by Sector").



Comparing the demand imperative to the supply outlook creates a stark picture. The potential demand for gas (if gas were to remain at $3.50 per MMBtu) is set to continue to outstrip continental supply—and the gap is on track to widen (see Figure 4 "US and Canadian Supply and Potential Demand"). The North American market is now dependent on LNG to fill this gap, and to the extent that LNG supplies fall short of expectations, gas prices are set to exceed levels cited earlier.

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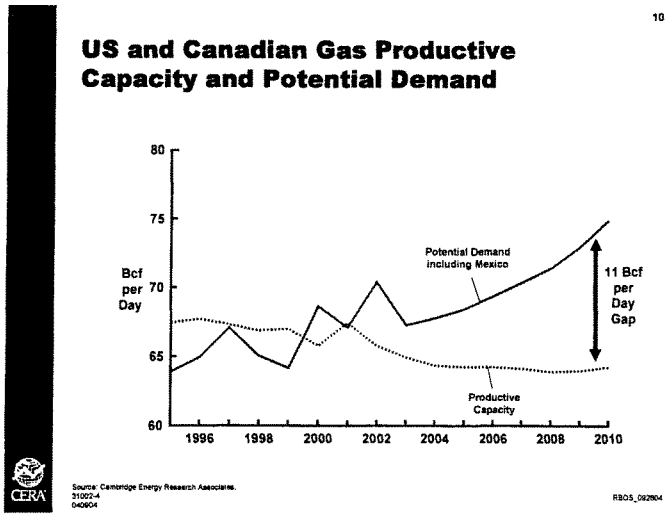
[2] CERA North American Gas Watch, *Diverging Fundamentals Challenge the North American Gas Market,* Summer 2004.



The Challenge of Getting through the Next Few Years

It used take about 6 months to a year from a strong price signal for new natural gas supplies to arrive to market—the time it took to revisit drilling programs, get drilling permits, and drill and connect new gas wells. But now the maturity of the North American resource base means we can not "drill our way out" of the current shortage in the customary manner – although ongoing substantial drilling will be required to make up for declining output in order to keep U.S. production at current levels of about 50 Bcf per day in 2010.

By contrast, there are many parts of the world that are awash with gas. Outside North America global natural gas reserves are growing. Moreover, projects are now underway to bring these new global resources to North America in the form of liquefied

natural gas (LNG).[3] And there are huge quantities of stranded gas in Alaska, and gas as well in the Canadian Arctic.

How might the supply picture evolve? The North American gas industry will need to work hard to keep production from sliding further. Significant new supplies in the next decade and a half will come from continued exploration and production in North America. But LNG will be needed to play an important role. After gas from the United States and Canada, it will be the third major supply source. Today, LNG provides 3 percent of U.S. supplies. By the year 2020, that share could be 25 to 30 percent.[4]

The challenge is that LNG – as well as Arctic gas—are all long-lead time projects. Four new US LNG projects have received the needed permits—but it will require about three to four years for the construction to be completed. CERA estimates that the soonest LNG could provide significant price relief is 2008, with 2009 a more likely date. Gas from the Canadian Arctic could reach the market by 2010, we estimate; Alaskan gas would arrive well into the next decade.

It is important to note that Mexico, too, has committed to build gas-fired generation and construct new LNG facilities to fuel these power plants.

The challenge before the United States lies between now and the arrival of substantial new volumes of LNG on North American shores. This is a multi-year period when CERA expects that a tightening of the balance between supply and demand could lead to even higher and more volatile prices for the continent. Much like three decades

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[3] CERA LNG Watch *Maintaining Momentum*, Summer, 2004; and Daniel Yergin and Michael Stoppard, "The New Prize, *Foreign Affairs*, November-December 2003.

[4] See CERA North American Gas and Power Scenarios *Rearview Mirror Scenario—Annual Update: Navigating the New Hybrid.*

ago, now we are facing a period in which natural gas risks becoming a seemingly scarce and highly priced fuel. Then, however, in contrast to today, it was the result of irrational regulation that kept the wholesale price of natural gas too low to cause producers to search for new gas supplies.

An event as simple as an abnormally hot summer or cold winter could push prices well above recent levels, to the $6.50 to $8 per MMBtu range in the summer and above $10 per MMBtu during a particularly cold winter.

At these price levels, consumers and businesses will experience both higher natural gas prices and higher prices for electricity in regions where natural gas is a significant fuel source in the power sector. The impact will be felt through lost jobs. Key industries have already been hard hit by these higher natural gas prices, including the ammonia-based fertilizer industry, petrochemical industry, pulp and paper, primary metals such as steel, and other sectors that depend on natural gas. Many of these industries have no fuel alternatives. Unfortunately, CERA expects that natural gas demand growth in the power sector will come at the expense of more constrained industrial sector consumption – what is described as "demand destruction." Indeed, industrial consumers are already examining off-shore locations for new plants.

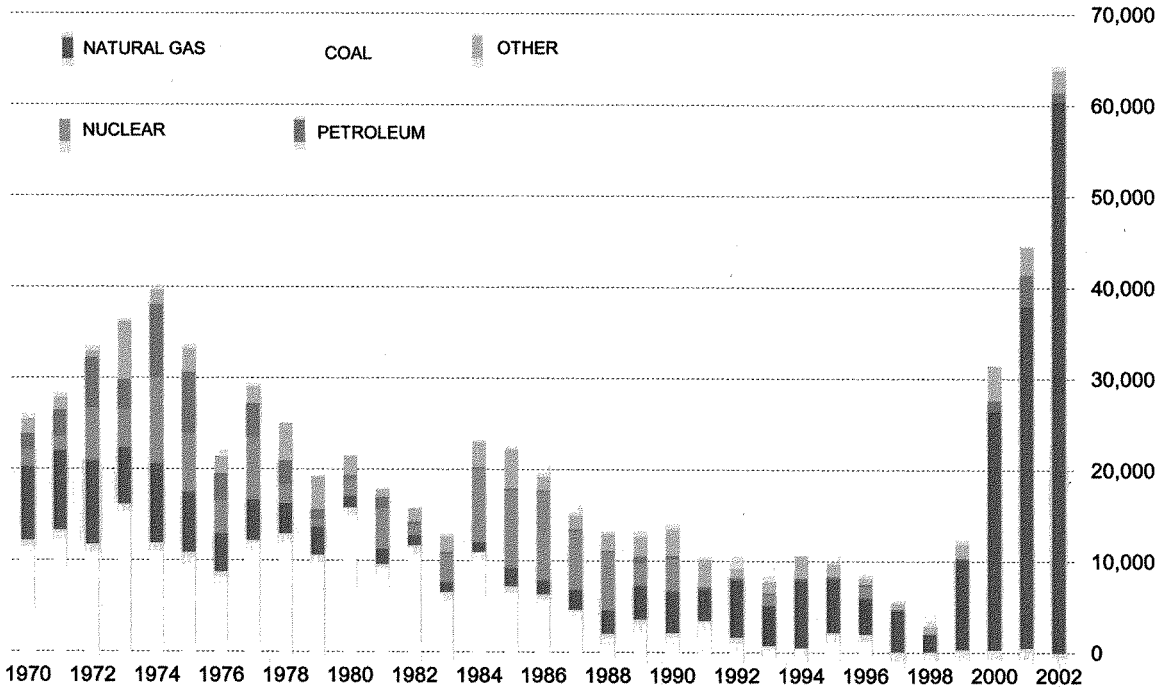
To CERA, it is clear that, without measures to boost supplies or temper demand, the market is locked in a strong price environment. In our new study, *Charting a Path: Options for a Challenged North American Natural Gas Market*, CERA identifies measures that the US can draw upon to manage natural gas demand and exposure to price volatility during the bridge period of 2004 to 2009:

- Effective customer education and flexible gas procurement mechanisms by utilities
- Fuel flexibility for new and existing electric power capacity
- Resolution of the mismatch between the short-term contracting bias of consumers and the need for longer-term commitments to underpin new natural gas infrastructure, such as Arctic and LNG supplies, and
- Acceleration of gas production in the near term by streamlining permitting for activity—rather than encumbering it—in areas that are already open for gas production, and applying flexibility in areas with various restrictions for gas production.

The challenge is before the industry and regulators and policymakers—and indeed for the nation—to manage a difficult market environment over the next few years while new supply arrangements can be made. Critical decisions, some implemented for just a few years, could provide some real relief for consumers in the coming few years and ensure natural gas' deserved place as a fuel for economic growth and environmental quality.

Generating Capacity Brought Online by Fuel Type 1970-2002

(name plate capacity megawatt hours)



source: EIA

Testimony
Before the Joint Economic Committee
United States Congress

The Long-Run Economics of Natural Gas

Testimony of
Paul Sankey
Senior Energy Analyst
Deutsche Bank
New York, NY

Global Equity Research

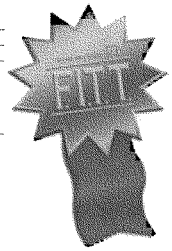
Industry Focus

North America US
Energy Integrated Oil

22 July 2004

Global LNG

Exploding the Myths



Deutsche Bank

F.I.T.T. Research

Fundamental, Industry, Thematic, Thought Leading
Deutsche Bank Equity Research's Research Product Committee has deemed this work F.I.T.T. for our clients seeking differentiated ideas. Here our global oils team issues the latest in its series of annual probes into the liquefied natural gas (LNG) market. This year's focus is on clearing up widely held misconceptions.

Fundamental: a global LNG market model is our foundation

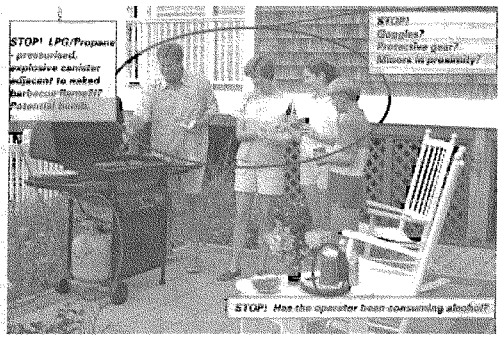
Industry: LNG boom? What LNG boom?

Thematic: no problems with US regasification or market access

Thought Leading: lifting the veil of assorted other illusions

In terms of LNG, we favour the first movers

"Not in my backyard" – more shocks over US gas safety



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DISCLOSURES AND ANALYST CERTIFICATIONS ARE LOCATED IN APPENDIX 1

North America US
Energy Integrated Oil

Deutsche Bank

22 July 2004

Global LNG
Exploding the Myths

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Fundamental: a global LNG market model is our foundation
Last year we identified a long-term secular trend: LNG will be the oil of the 21st Century. This year, we once again delve into global LNG supply/demand trends to form our updated near-term and long-term outlook. Growth has generated interest; interest has generated myths.

Industry: LNG boom? What LNG boom?
Despite huge global gas prices, no major new "greenfield" LNG project is starting up this year. Gas reserves are abundant and there is considerable spare LNG shipping capacity, yet few new developments. Growth in LNG is strong, but hardly impressive from a low base (oil demand growth is greater than gas demand growth this year). This report looks at why there is not more development. The answer lies in the scale of the challenge.

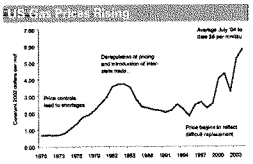
Thematic: no problems with US regasification or market access
The economic opportunity of $6 US gas is overwhelming. Our analysis focuses on the winners of the clear themes: a higher sustained US gas price, a massive need for development expenditure, and a lack of action that will reward the first movers of the past five years.

Thought Leading: lifting the veil of assorted other illusions
As a "hot topic" LNG has quickly developed its own set of myths. Our LNG theme this year is to explode these myths, the biggest of which is a perceived problem with US regasification capacity – which there is not. The four existing terminals have yet to sell out. LNG is safe, and the public in the US Gulf Coast supports its development. We do not see a significant issue with access to the US gas market.

In terms of LNG, we favour the first movers
Until sufficient LNG supply is developed to meet the need for gas in the US – at least five years – natural gas prices will be high. Companies that can begin to meet the market's needs are the winners – select US E&Ps, early-moving LNG suppliers that are now successfully supplying gas (Shell, BP, BG, TOTAL and Repsol) and companies moving now to develop nearer-term supply (Marathon, ExxonMobil, ConocoPhillips). The theme of major LNG project investment is a good one for developers such as Halliburton and Technip, and the chemical company, Air Products.

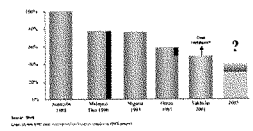
F.I.T.T. Research

US Gas Prices Rising



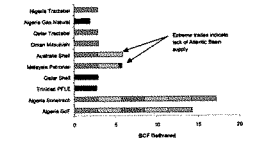
Source: DOE, World Bank]

The industry now wastes less money



Source: Shell, Wood Mackenzie

January to June 2004 LNG deliveries to Lake Charles



Source. Waterbourne LNG report

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Figure 1: World LNG supply and demand balance – projects and players

Demand (Mt)		1990	1995	2000	2004E	2005E	2006E	2007E	2010E	2015E	2004-2007 CAGR
Japan	Japan Inc. utilities esp Tokyo Electric	32.4	43.6	53.4	57.7	58.3	60.2	62.1	67.6	75.6	2%
South Korea	Kogas	2.1	7.1	15.0	20.2	25.2	27.8	30.4	38.1	48.4	15%
Taiwan	CPC	0.7	2.5	4.3	5.9	6.4	6.9	7.4	9.0	13.5	8%
India	Petronet				2.0	5.7	6.6	7.6	10.5	16.0	56%
China	CNOOC						2.0	2.5	7.1	13.0	
Asia		**35.2**	**53.2**	**72.7**	**85.9**	**95.6**	**103.5**	**110.0**	**132.5**	**166.5**	**9%**
Belgium	Tractebel, Shell	3.2	3.6	2.5	3.0	3.1	3.3	3.5	4.2	5.0	5%
France	GdF	8.1	7.0	9.0	9.2	8.8	9.4	10.0	11.8	14.0	3%
Greece	DEPA			0.4	0.5	0.5	0.6	0.6	0.8	1.2	11%
Italy	ENI, BG	0.2	1.0	1.6	3.6	3.7	5.0	6.4	10.4	10.8	21%
Portugal	Galp		0.0	0.2	1.3	1.6	1.9	2.1	2.8	3.7	17%
Spain	Gas Natural, BP, Cepsa	3.9	3.4	6.9	13.9	15.5	16.2	15.8	18.8	35.2	7%
Turkey	Botas			3.3	2.9	2.1	2.5	2.9	4.0	6.0	-1%
UK	ExxonMobil, Lattice, BG					2.6	6.1	9.5	19.9	27.2	
Europe		**13.4**	**15.0**	**23.9**	**34.3**	**37.9**	**44.9**	**51.8**	**72.7**	**103.0**	**15%**
US East Coast	BG, Trac'bel, Shell, BP, Chevron, AES	1.7	0.4	4.9	12.7	15.0	18.7	27.7	45.0	70.0	30%
US West Coast	El Paso, Shell, Bolivia LNG								5.0	10.0	
USA		**1.7**	**0.4**	**4.9**	**12.7**	**15.0**	**18.7**	**27.7**	**50.0**	**80.0**	**30%**
Puerto Rico	Repsol			0.3	0.7	0.9	1.0	1.2	1.5	2.5	20%
Dominican Republic	AES				0.7	0.7	0.7	0.7	0.7	0.7	0%
Mexico	Shell, Marathon, ConocoPhillips						0.9	3.5	11.3	15.8	
Brazil	Petrobras, Shell								1.9	4.0	
Americas		**1.7**	**0.4**	**5.1**	**14.1**	**16.5**	**21.3**	**33.2**	**65.5**	**103.0**	**33%**
Total demand		**50.2**	**68.6**	**101.8**	**134.3**	**150.0**	**169.7**	**195.0**	**270.6**	**372.5**	**13%**
% Annual Growth			6.4%	8.2%	7.3%	11.7%	13.1%	14.9%	12.5%	6.6%	
Asian Market Share		70.0%	77.6%	71.4%	63.9%	63.7%	61.0%	56.4%	49.0%	44.7%	-4%

Supply Brownfield (Mt)		1990	1995	2000	2004E	2005E	2006E	2007E	2010E	2015E	2003-2007 CAGR
Abu Dhabi	Adnoc, BP, Mitsui, TOTAL	4.5	4.5	5.1	5.4	5.5	5.5	5.5	5.5	5.5	1%
Algeria	Sonatrach	24.5	24.5	23.8	19.5	20.0	20.0	21.0	24.4	26.4	3%
Australia NWS	Woodside, BP, Chevron, BHP, Shell, MIMI	3.0	7.2	7.3	7.6	7.6	7.6	7.6	7.6	7.6	0%
Australia NWS IV	Woodside, BP, Chevron, BHP, Shell, MIMI				1.5	3.5	3.5	3.5	3.5	3.5	33%
Australia NWS V	Woodside, BP, Chevron, BHP, Shell, MIMI								4.2	4.2	
Brunei	Brunei Coldgas, Shell, Mitsubishi	5.1	5.5	6.7	7.0	6.6	6.6	6.6	6.6	6.6	-2%
Indonesia Arun	ExxonMobil, Pertamina	11.9	11.5	6.0	5.8	5.6	5.1	4.6	3.0	1.1	-8%
Indonesia Bontang	TOTAL, Unocal, BP, Pertamina	11.1	13.8	21.2	19.1	22.5	22.5	22.5	22.5	22.5	6%
Indonesia Bontang I	TOTAL, Unocal, BP, Pertamina								3.5	3.5	
Libya	Sirte	1.2	0.8	0.8	0.6	0.5	0.5	0.5	0.5	0.5	-4%
Malaysia	Petronas, Shell, Mitsubishi, Sarawak Govt.	6.6	9.5	15.3	15.0	15.0	15.0	15.0	15.0	15.0	0%
MLNG Tiga	Petronas, Shell, Mitsubishi, Sarawak Govt.				4.0	6.8	6.8	6.8	6.8	6.8	19%
Nigeria LNG I-III	NNPC, Shell, TOTAL, ENI			4.5	8.7	8.7	8.7	8.7	8.7	8.7	0%
NLNG Plus	NNPC, Shell, TOTAL, ENI				5.1	8.1	8.1	8.1	8.1	8.1	17%
NLNG Plus Plus	NNPC, Shell, TOTAL, ENI						4.1	4.1	4.1	4.1	
Oman	Shell, TOTAL, MIMI, Numerous Korean			2.1	6.7	6.7	6.7	6.7	6.7	6.7	0%
Oman II Qalhat	Oman Govt, Oman LNG, Union Fenosa						1.5	3.3	3.3	3.3	
QatarGas	QGPC, ExxonMobil, TOTAL, Marubeni, Mitsui			6.6	8.7	9.2	9.2	9.2	9.2	9.2	2%
QatarGas II	QGPC, ExxonMobil, TOTAL							3.5	15.0	15.0	
QatarGas III	QGPC, ConocoPhillips								7.5	15.0	
Rasgas	QGPC, ExxonMobil, Kogas, Itochu, Nissho Iwai			3.8	6.7	6.7	6.7	6.7	6.7	6.7	0%
Rasgas T3 & 4	QGPC, ExxonMobil, Petronet, UK				3.5	6.3	9.4	14.1	14.1	14.1	59%
Trinidad I	BP, Repsol, BG,Tractebel, Govt. of T&T			3.0	3.3	3.3	3.3	3.3	3.3	3.3	0%
Trinidad II, III & IV	BP, Repsol, BG,Tractebel, Govt. of T&T				6.7	6.7	11.9	11.9	11.9	11.9	21%
Trinidad V	BP, Repsol, BG,Tractebel, Govt. of T&T								4.0	4.0	
Kenai USA	Phillips, Marathon	1.2	1.2	1.4	1.3	1.3	1.3	1.3	0.8	0.4	-1%
Brownfield Supply		**69.1**	**78.5**	**107.1**	**136.2**	**150.7**	**164.0**	**174.5**	**206.5**	**215.7**	**9%**
% 5 year Annual Growth			2.6%	6.4%	7.4%	7.1%	8.1%	8.2%	6.5%	5.6%	3%
Supply Greenfield					**9.9%**						
Angola	ChevronTexaco, Sonangol, TOTAL, BP, ExxonMobil								2.0	8.0	
Bayu Undan	Phillips, Shell, Woodside					1.5	3.0	3.0	3.0	3.0	
Egypt LNG I	BG, Petronas, EGPC					0.7	3.5	3.5	3.5	3.5	
Egypt LNG II	BG, Petronas, EGPC						1.8	3.5	3.5	3.5	
Egypt LNG III+	BG, Petronas, EGPC, Apache								4.0	4.0	
Egypt SEGAS LNG	EGPC, Union Fenosa, Eni					5.3	5.3	5.3	5.3	5.3	
Egypt SEGAS II	EGPC, Union Fenosa, Eni, BP								5.3	5.3	
Equatorial Guinea	Marathon							0.2	4.0	4.0	
Snoehvit	Statoil, TOTAL, GdF								4.2	4.2	
Sakhalin	Shell, Mitsubishi, Mitsui							1.0	9.6	9.6	
Tangguh	BP, Mitsubishi, BG							1.0	6.0	10.0	
Iran	NIOC, Reliance, BP									4.0	
Venezuela	Shell, Mitsubishi									6.0	
Gorgon	ChevronTexaco, Shell, ExxonMobil								5.0	7.5	
Nigeria Brass River	ConocoPhillips, ChevronTexaco								4.0	4.0	
Total Supply		**69.1**	**78.5**	**107.1**	**136.2**	**158.2**	**177.6**	**192.0**	**265.9**	**299.6**	**10%**
Bolivia	*Repsol, BG*								*4.0*	*8.0*	
Peru	*Hunt Oil, PlusPetrol, SK*								*4.0*	*4.0*	
Iran	*NIGEC*									*4.0*	
Indonesia Sulawesi etc	*Pertamina*									*4.0*	
NAGV	*Shell, Woodside*									*4.0*	
North Slope	*BP, Phillips*									*8.0*	
Yemen	*TOTAL*								*2.0*	*5.0*	
Unlikely									*8.0*	*32.0*	

Source: Deutsche Bank

Asia delivers strong sustained growth in LNG demand, led by Taiwan, China and India.

Southern Europe drives forward the European market - with stellar growth from Spain, Portugal, Greece and Turkey.

US gas market shows major expansion in the 2002-2007 timeframe as two terminals reopen. Huge annualised growth. The wave of new LNG regas projects will sustain the growth story.

Overall market growth is strong, even if from a relatively small base.

Asia's market share falls - dramatically. The Atlantic Basin-US market is where the big action is

Will Indonesia succeed in maintaining its market share as Arun declines? BP's Tangguh is vital.

Shell's Malaysia picks up the market share?

Shell's Nigeria and Oman also huge success stories.

Qatar moves to become the world's biggest LNG player from nothing in 1995 to 60 Mt per year in 2010.

Trinidad is the jewel in BP's LNG crown - huge returns into the US market. Repsol also well exposed.

Best returns are in expansion projects...

Bayu-Undan major success for ConocoPhillips.

Egypt emerges as major new player - BG shows the way. Dominates 2005

Can Marathon take the mid-cap challenge and make Equatorial Guinea work? Market says BG will, but Marathon won't - doesn't make sense...

Supply grows faster than demand, as market moves from excess tightness.

Bolivia referendum great result for Repsol. Now for a choice of export port...

Executive summary

Outlook: developing supply is the challenge

LNG boom? What LNG boom?

Despite huge global gas prices, riding at $5+ per mmbtu ($40 per barrel), there is no major new project starting up this year to supply the global market with LNG. Literally trillions of feet of gas reserves are available at these prices. There is currently considerable spare LNG shipping capacity...but few new developments. LNG market growth of 20%-30% annually is hardly impressive from a base of 4mmboe/d of LNG production – or just 5% of the global oil market (80mmboe/d). Growth this year of around 1mmboe/d in the LNG market is just half the growth of the oil market in absolute energy terms. Boom? What boom?

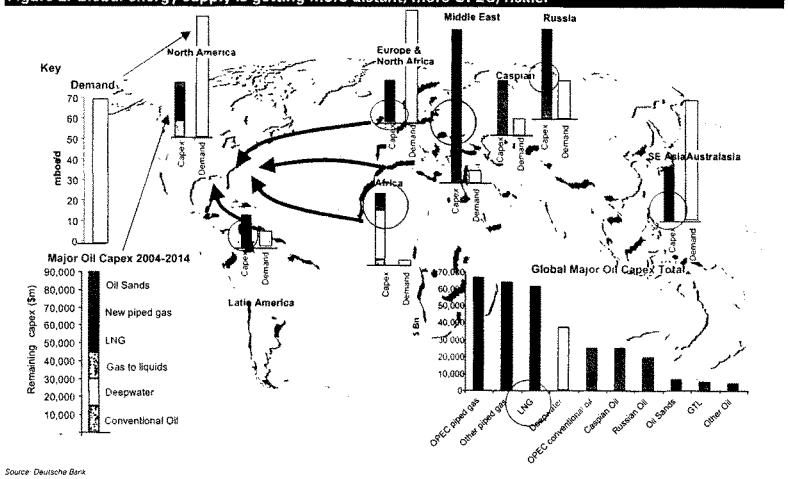
Exploding the myths

The most widely held misconception is that there is a problem with US regasification capacity – there is not. The four existing terminals have yet to sell out. LNG is safe and the public in the Gulf Coast of the US supports its development. Neither currently, nor longer term, do we see a significant issue with access to the US gas market. Rather, the terminals are extremely expensive, and to lower unit costs, have to be extremely large.

Developing supply is the challenge. Several permitted regas terminals are slated at 1.5bcf/d of capacity (250kboe/d), which would require huge LNG projects to fill; the fastest LNG project expansions – e.g. Nigeria LNG – took six years from first delivery to reach that scale. To extend the example, prior to first delivery, the Nigerian project was 30 (thirty) years in development between gas discovery and first LNG. This is because there are multiple partners and developing governments to convince, multi-year planning and construction cycles...and potentially, based on planned start-ups, everybody will start attempting to build simultaneously.

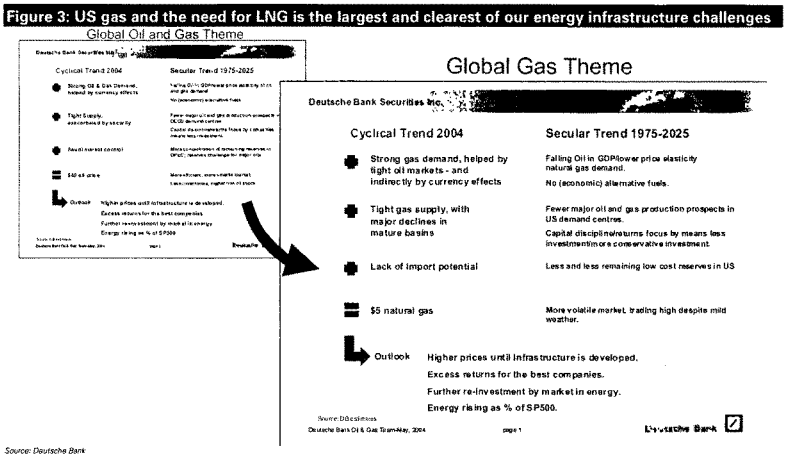
The LNG challenge fits our key overall oil and gas theme: the globe is under-invested in the infrastructure required to meet strong demand for oil and gas. OECD (ie North American and European) oil and gas is in secular decline. Replacement energy is distant and requires huge development expenditure. US gas and the LNG challenge is the most obvious, and largest, of these challenges.

Figure 2: Global energy supply is getting more distant; more OPEC; riskier



Source: Deutsche Bank

Figure 3: US gas and the need for LNG is the largest and clearest of our energy infrastructure challenges



Source: Deutsche Bank

The winners: companies that can begin to meet the market's needs

Between now and the development of sufficient LNG supply to meet the need for gas in the US, natural gas prices will be high. This is a five-year period at least. Companies that can meet the *current* market's needs are winners.[1]

- **US E&Ps with good growth and contained costs:** Our US E&P team highlights the following companies with strong leverage to higher gas prices: EOG (Buy, PT $57); XTO (Buy, PT $32) and Devon (DVN, Buy, PT $64).
- **Early-moving LNG suppliers that are now successfully supplying gas:** Several European companies are in this position owing to their moves over the *past* five years – RD/Shell (RD.N, PT $57, Buy), BP (BP.N, PT $53, Hold), BG (BG.L, PT 340p, Hold), TOTAL (TOT.N, PT $105, Buy) and Repsol (REP.N, PT $25, Buy).
- **Companies that are moving now to develop mid-term supply:** Here we cite Marathon (MRO, PT $40, Buy). ConocoPhillips (COP, PT $82, Hold) has a major start up at Bayu Undan by 2006. ExxonMobil (XOM, PT $46, Buy), leveraging the huge low cost potential of Qatar, is aggressively moving to dominate a global business with no anti-trust issues. ChevronTexaco (CVX, PT $99, Buy) has the highest potential risk/reward in LNG, with plenty of opportunity but little *concrete* progress to date.
- **Developers:** The basic thesis that LNG projects need major investment is good for developers, such as Halliburton (HAL, PT $40, Buy) Technip (TECF.PA, PT Euro 130, Buy) and Chiyoda (6366.T, PT ¥750, Buy). Chemical company Air Products (APD, PT $60, Buy) also fits this theme.

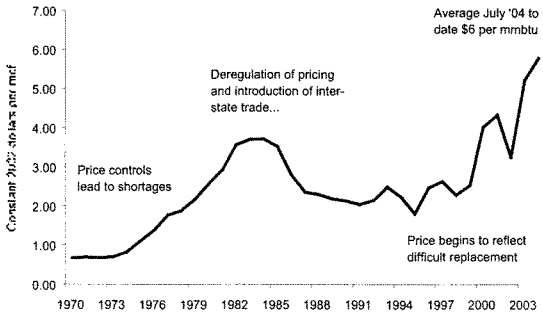
Valuation

Supply is not available on the scale required to seriously dent the high price environment

Point 1: There is a myth that LNG threatens the US gas price in the medium term. It does not. Supply is not available on the scale required to seriously dent the high price environment that is borne from strong demand and the ongoing declines in supply in the US gas market. Weather may alter the seasonal picture on a short term-cyclical basis, but the secular trend towards higher US gas prices is undeniable. In the medium term, the picture is positive for the earnings of US E&Ps and US-oriented service companies.

[1] Share prices for recommended companies as of the close, Tuesday, 20 July:
US E&Ps: EOG $62.80, XTO, $29.15, DVN $69.64
European oils: RD $51.96, BP $55.43, BG 347.5p, REP $22.40
US oils: MRO $37.57, COP $79.28, XOM $45.90, CVX $94.77
Service/chemical companies: HAL $31.43, TECF.PA EUR 111.8, 6366.T ¥718, APD $51.62

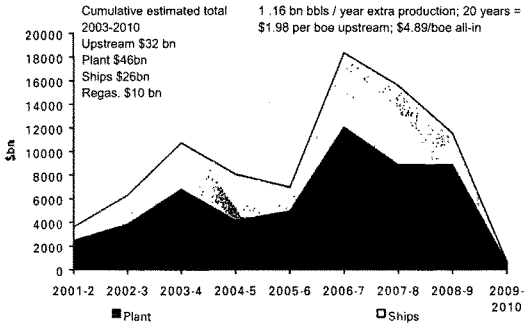
Figure 4: Real US gas prices: rising



Source: DOE, World Bank

Point 2: with LNG deliverable globally at $3 per mmbtu, the higher US gas price represents a huge opportunity that companies will rush to fill. We reiterate our longstanding forecast of major increases in LNG capital spending over the coming years (and decades). Companies exposed to this are: Halliburton; Technip; Chiyoda and Air Products (all BUYS). Additional plays on the theme are Saipem (SPMI.MI, Hold, EUR 7.6) and Chicago Bridge and Iron (CBI, not rated), as well as Daewoo Shipbuilding (062660.KS, Not Rated).

Figure 5: Estimated Capex in global LNG 2001-2010

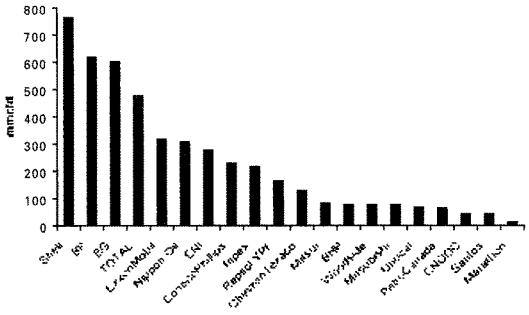


Source: Deutsche Bank

Euphoria over some of the lower return elements over the business may be overstated. We deny the sustained potential for a major traded spot market in LNG and consider the "LNG Chain" of contracts to be strengthening and tightening as projects become bigger, more capital intensive, and therefore more bound by contractual links. If the speculative, or spot, market was really here, surely one of the permissioned US LNG regasification greenfield projects would have started construction – they have not.

Certain LNG-exposed companies will make no more money from higher gas prices, and will be threatened by rapid growth, as they are essentially utility businesses. These are LNG shippers (e.g. Golar LNG, not rated and Teekay Shipping, not rated) and LNG regasification plays (Cheniere, not rated). However, these companies may be attractive take-out candidates within the theme of more tightly integrated contractual chains, for example if ExxonMobil needs a quick fix to its lack of US regasification capacity or if organic development proves too time-consuming and frustrating.

Figure 6: Growth in gas into LNG production, 2003-07E



Source: Deutsche Bank

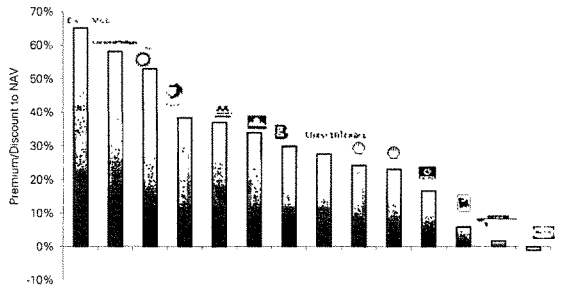
Among the conventional gas producers, where the highest returns and highest leverage to higher gas prices are to be found, the relative growth is with the traditionally dominant plays, Shell, BP, BG, TOTAL, ExxonMobil, Eni and ConocoPhillips. These companies have invested heavily over the past five years and should now reap the rewards. Based on valuation, we currently have Buy recommendations on Shell, TOTAL, and ExxonMobil.

Risks: project development and management

Mismanagement could lead to enormous value destruction

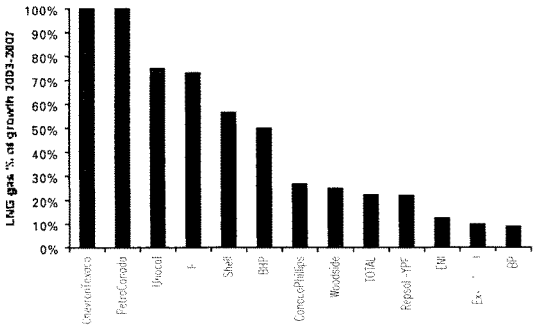
Companies need to invest billions and must successfully manage the process to avoid enormous value destruction. Projects are in risky places, either technically, such as the extreme Northerly Barents Sea for Statoil's Snoevhit; politically, such as Angola or the Middle East (Qatar); or from a labour dispute point of view, such as Trinidad. Companies that mismanage projects in development and operation can literally cost shareholders billions. Investors must be convinced that they are entrusting their money to top quality managements, or be rewarded with an appropriately risked entry price. Unable, as we are, to judge managements objectively ourselves (at least in print) we point to NAV premium/discount as *de facto,* as a representation of future re-investment skill, the markets' valuation of management quality.

Figure 7: NAV premium/discount – market view of management quality



Source: Deutsche Bank, companies shown only integrated majors with LNG project exposure

Figure 8: Who needs LNG? Relative exposure to growth from LNG

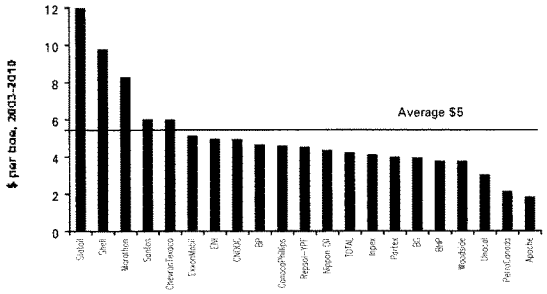


Source: Deutsche Bank

Who *needs* LNG? Companies with LNG growth and little other volume growth drivers are the more leveraged to LNG as above – ChevronTexaco and PetroCanada reveal themselves to be dependent on LNG for providing any kind of growth. Eni, BP and ExxonMobil are notable for having high levels of LNG growth in absolute terms that do not dominate their overall growth profiles.

An alternative risk calculation is capex per boe of production. Of course, this is problematic because pure boe production numbers do not capture returns on capital expenditure, nor investment this decade for growth next. Nevertheless, a first glance of approximate capex dollars per boe of additional production 2003-2010 throws up some interesting exposure to relatively high levels of capex for relatively little production over the next 10 years, particularly for Statoil and Shell. However, we stress that current pressure on book returns is likely to lead to longer-term high free cashflow as LNG drives gas delivery in the 21st Century. In other words, high capex for the next decade is not *necessarily* a bad thing, assuming projects are on time, on budget and perform with long lives. However, history says the market will pay for growth now, not capex now.

Figure 9: LNG capex per boe of LNG gas production 2003-2010



Source: Deutsche Bank. Capex is upstream and gasification plant, but not ships or regasification.

Key corporate picks

Buying into LNG potential – key picks

Top LNG picks:
Halliburton
Technip
Air Products
Shell
TOTAL
ChevronTexaco
Repsol

Kellogg Brown and Root (KBR) is the dominant builder of LNG infrastructure globally, accounting for more than two-thirds of liquefaction capacity additions in the past 20 years. Currently held within the **Halliburton** company (Buy, PT $40), we think KBR could be spun out within the next year. Halliburton currently trades at a 30% discount to rivals Schlumberger and Baker Hughes, and at a major discount to pure play LNG stories such as BG and Chicago Bridge and Iron. Buyers of Halliburton shares gain a rare discount entry to LNG construction growth over the coming decade. Equally, France's **Technip** (Buy, price target Euro 130) is the best value European play on LNG procurement and construction growth.

LNG should be a significant driver of growth in EPS for **Air Products** (Buy, TP $45) between now and 2006. The company's leading position in the LNG heat exchanger market provides derivative exposure to LNG growth. While LNG heat exchangers are a small part of Air Products' operations, LNG growth lifts the Equipment segment profits to an estimated 2%-3% of EPS by 2006, from breakeven in 1H04. Air Products is one of our top picks in the chemical sector.

Australia N.W. Shelf; Brunei ColdGas; Malaysia LNG; Nigeria LNG; Oman LNG; Russia Sakhalin II LNG; Australia Gorgon LNG; Venezuela LNG – no company has a more comprehensive or sizeable spread of LNG exposure than **Shell** (RD.N Buy, PT $47). We have continued to underline the asset base of this giant company as a key rationale for our Buy rating; it is *the* dominant LNG play – with major upstream, plant, shipping, and regas positions. The key project to watch is Sakhalin II, which is currently under development. With a tie-up with **Sempra** to take Russian LNG to the US West Coast, the project looks to be the major greenfield start-up of the next five years. **TOTAL** (Buy, PT $105) also has a very strong global LNG position with exposure to both Asian & Atlantic Basin markets.

Like Shell, **ChevronTexaco** (Buy, PT $99) remains undervalued against the prevailing oil, gas and refining environment – both trade on just 25% premium to NAV at $23 (ExxonMobil trades at 58% premium currently). The challenge for ChevronTexaco is turning its capital recycling programme, of selling down US gas assets to invest in international gas assets, into actual steel, concrete and US LNG supply. To date, the company only has a very large inventory of unsold gas on its books. The next three years will determine whether ChevronTexaco can turn its LNG potential into LNG earnings. Now trading on just 10.6x 2004E earnings, and 7.3x cashflow, we think the market is discounting future failure.

Repsol (Buy, PT Euro 20) is another discount play on LNG potential. The Bolivians have voted "yes" to permitting Pacific LNG exports on the 18 July, and the prospects for this project look better than ever for commercialising Bolivia's 50tcf plus of gas into the high-priced North American market. With some 16tcf net, Repsol is Bolivia's biggest gas reserves holder. We currently value their stake in the base Bolivia Margarita gas project at only Euro 225m - the developing and expanding Trinidad LNG project is in our Repsol NAV at Euro 2bn. With additional exploration in LNG hot spot, Equatorial Guinea, this year, even at our Euro 20 target price, Repsol would trade at just 5.7x 2004E cashflow vs. the European midcaps on 7.1x and Petrobras at 6.3x. Buy.

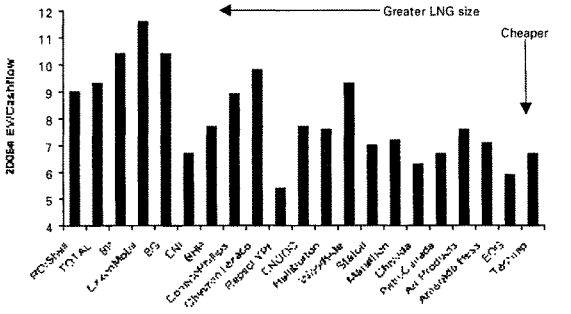
Figure 10: Major LNG companies and valuations

LNG Producers	Ticker	Recommendation	Market Cap.($ Bn)	Net Debt	EV	Est. % LNG 2005*	2004E P/E	2004E CFx	2006E P/E	2006E CFx	Comment
RD/Shell	RD.N	Buy	174.58	14.01	188.58	20%	11.5	7.5	17.2	9.0	Global range of major LNG projects
TOTAL	TOT.N	Buy	122.80	8.40	131.20	22%	12.7	8.2	18.3	9.3	Global range of major LNG projects - smaller stakes than Shell
BP	BP.N	Hold	198.60	15.86	213.86	12%	13.8	8.6	21.3	10.4	Dominant in highly profitable Trinidad. Adding Tangguh, Indonesia
ExxonMobil	XOM.N	Buy	296.90	-2.26	294.65	8%	15.0	10.0	19.9	11.6	Very highly reliant on Qatar - major expansion pre-2010
BG	BG.L	Hold	22.60	0.58	23.18	35%	16.9	9.2	20.5	10.4	The pure LNG play amongst major oils - no refining or chemicals dilution
ENI	E.N	Hold	77.90	13.32	91.22	8%	12.0	6.6	12.6	6.7	Strong upstream, also service leverage through Saipem and Snamprogetti
ConocoPhillips	COP.N	Hold	54.20	13.48	67.68	8%	8.8	5.5	18.5	8.9	New growth with Bayu Undan, aggressive position on US regas
ChevronTexaco	CVX.N	Buy	96.50	4.10	101.00	4%	10.6	6.8	20.6	9.8	Potential is there, challenge is delivery, first step, Gorgon
Repsol-YPF	REP.N	Buy	27.10	4.88	31.98	10%	9.7	5.2	11.8	5.4	Bolivia referendum result could turn project into major winner
CNOOC	0883.HK	Hold	17.50	-0.12	17.38	15%	11.5	7.4	13.5	7.7	The China play on LNG - partner of choice for China access
Unocal	UCL.N	Hold	10.19	3.25	13.44	18%	13.3	4.9	na	na	Good position at Bontang in Indonesia - leads the US E&Ps
Woodside	WPL.AX	Buy	8.50	0.79	9.29	25%	19.1	11.7	17.5	9.3	Australia's LNG operator
BHP	BHP.AX	Buy	57.60	4.71	62.31	8%	15.3	10.4	10.8	7.7	North West Shelf niche position
Statoil	STL.OL	Hold	27.10	3.16	30.26	6%	11.3	5.8	16.5	7.0	Can costs be controlled at Snoevhit - looks like a major risk
Marathon	MRO.N	Buy	12.50	3.73	16.23	5%	11.2	6.0	14.3	7.2	Equatorial Guinea is now a development challenge - can MRO deliver?
Apache	APA.N	Hold	15.25	2.25	17.50	2%	11.0	4.8	na	na	Egypt position
PetroCanada	PCZ.N	Hold	11.40	2.81	14.21	2%	8.7	5.0	15.3	6.7	Trinidad position
Amerada Hess	AHC.N	Buy	8.30	3.10	11.40	2%	11.8	5.4	23.2	7.1	Small stake in the ballooning costs of Statoil's Snoevhit is worrying
EOG	EOG.N	Buy	7.38	1.19	8.57	2%	16.7	5.9	16.7	5.9	Trinidad position
Service/Chemical Companies											
Halliburton	HAL.N	Buy	13.39	3.02	16.41	15%	35.5	11.8	18.9	7.6	(2005E P/E, EV/EBITDA) Key play is KBR - top LNG constructor
Chiyoda	6366.JP	Buy	1.11	0.00	1.11	40%	16.4	9.1	14.8	6.3	(Fiscal years) Chiyoda highly leveraged to LNG growth
Air Products	APD.N	Buy	11.60	2.40	14.00	2%	19.7	9.2	15.0	7.6	Small but growing element of business
Technip	TECF.PA	Buy	2.21	0.18	2.39	5%	22.1	7.6	54.9	6.7	Benefits from LNG construction growth
Memo, not covered:											
LNG Shippers											
Golar LNG	*GLNG.OL*		*0.97*	*na*	*0.97*	*100%*	*18.4*				*Consensus P/E - pure play on LNG shipping, but spare capacity currently*
Teekay Shipping	*TK.N*		*3.06*	*na*	*3.06*	*20%*	*7.4*				*Consensus P/E - primarily a crude oil shipping play*
LNG Service											
Chicago Bridge and Iron	*CBI.N*		*1.36*	*na*	*1.361*	*60%*	*20.3*				*Consensus P/E - good leveraged play on cryogenic tanks*
Daewoo Shipbuilding	*042660.ks*		*2.14*	*na*	*2.14*	*50%*	*9.7*				*Dominates new build LNG tanker business*
LNG Regas											
Sempra	*SRE.N*		*8.20*	*na*	*8.204*	*5%*	*10.6*				*Consensus P/E - interesting utility play on LNG imports to US*
Cheniere	*LNG.A*		*0.36*	*na*	*0.362*	*100%*	*na*				*Consensus P/E not available - leveraged pure-play with first mover status*

* Estimated % of capital employed for LNG producers, estimated % of order backlog for service companies

Source: Deutsche Bank estimates, company data, Bloomberg

Figure 11: EV/Cashflow 2006E by LNG size



Source: Deutsche Bank estimates

[2] Additional share prices for recommended companies as of the close, Tuesday, 20 July: E.N $103.09, 0883.HK HK$3.65, UCL $38.88, WPL.AX A$17.30, BHP.AX A$12.90, STL.OL NOK 86.3, APA $46.50, PCZ $44.42, AHC $83.19

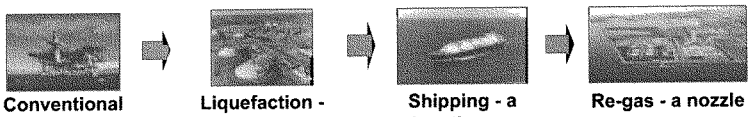
Global LNG: overview

Technically a simple story. Financially a scale challenge

In characterising LNG as "the oil of the 21st Century" (*LNG: going, going, gone Global*, May 2003), we identified a long-term secular trend based on the abundance of remaining gas reserves, mostly discovered in association with oil (Explorationist comment, "Oh no! It's gas"). Quite simply, in the absence of an economic alternative to oil and gas as the primary fuel of global economic activity, and allowing for the decline in major oil provinces, still-abundant international gas will be the fuel of the 21st Century. The most economic, clean and safe means to transport this international gas is liquefied, in ships, simply because major remaining gas reserves are distant from major current i.e. US and Europe, and future i.e. Asia, gas markets. Pipeline economics collapse relative to LNG over long distances.

Figure 12: LNG, easy as $1bn, $2bn, $3bn

No change in chemical make up of gas - simply (almost) pure methane chilled and then re-heated



Conventional "Upstream"

Supplies gas - large quantities required. Best projects have large, simple reservoirs, hopefully with associated oil. Approx. ~3 tcf of gas required for a 3 Mt 20 year project = 300 mmcfd delivered

Same process as gas production for pipelines.

Liquefaction - a giant fridge

Using the same technology as a refrigerator - just on a giant scale, a "train" takes 450 mmcfd of gas to produce 3 Mt of super-cooled gas liquefied at -160 degrees, and reduced in volume by 1/600

Shipping - a giant thermos

Liquid is pumped onto a ship, confusingly scale is measured here in cubic metres - gas is a nightmare when it comes to unit conversions. Typical ship is 135,000 m3 and delivers 2.85 bcf of gas. Note this is around 1/4 the size of energy delivery of a super tanker of oil (2 mbbls of oil, vs 0.4 mbbls o.e. of LNG).

Re-gas - a nozzle

Regasification is the most basic part. The ship is attached to the storage tanks and offloaded. The liquid gas will boil naturally back to gaseous form. This is also the safest part of the process.

Source: Deutsche Bank, Wood Mackenzie.

However, the capital intensity of LNG is such that while costs have been driven down, the overall investment required for a 5Mt per annum LNG train is around $5bn, which delivers just 500mmcfd of gas – around 1% of the US market for gas. The global energy industry faces a vast investment requirement.

The quantities delivered for such an investment in LNG are considerably less than the equivalent delivery of oil, and a simple conclusion is that if LNG is to be the oil of the 21st Century, then global energy costs, and capital employed in energy, must rise.

A major investment, but returns are good...eventually

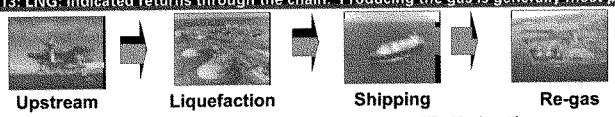
Will returns suffer? Yes and no. In the short term it is clear that the major LNG investment is dilutive to book returns, simply because of the large up-front capex that is required. It is important to note that current capex outlines for major oil companies are basically ex-LNG. ExxonMobil, ChevronTexaco and ConocoPhillips all advise that current capex guidelines do not include the potential for further major, lumpy, LNG investment. For example, if ChevronTexaco succeeds in progressing Angola LNG and Port Pelican regas, which would like be a simultaneous process, then annual capex will be as much as $1bn, or approximately 15% higher than current guidance.

To complicate returns further, there is the different financial nature of different projects. Key amongst these is the potential for project finance to take investments off balance sheet. Equally, when oil markets were very low and Russia was making debt very expensive, Shell financed Nigeria LNG with equity. Qatari trains have been financed with bonds. BG has made aggressive use of off-balance sheet financing. To add to the difficulty in making generalisations, different projects make their return in different parts of the chain - be it upstream, plant, or shipping.

However, broadly speaking:

1) Returns are around 12% IRR.

Figure 13: LNG: indicated returns through the chain. Producing the gas is generally most profitable



	Upstream	Liquefaction	Shipping	Re-gas	*Total*
		← *Returns are being impacted by difficulties in getting investments off the balance sheet* →			
"Typical" Investment (5 Mt project)	US$1bn (29.7%)	US$1.25bn (37%)	US$0.8bn (23.7%)	US$0.325bn (9.6%)	*US$3.375bn (100%)*
"Typical" Return	15-**20%** or above	8-**12%** if "tolling" 10-20% otherwise *Players trade-off upstream and liquefaction returns depending upon project specifics*	8-**10%**	8-**10%** "Utility businesses"	*13.7% (weighted average)*

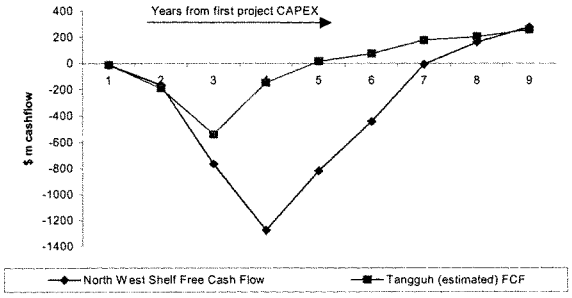
BG typically quotes an integrated return of 12-13% from its LNG business

Source: Wood Mackenzie, Deutsche Bank

2) Returns are destroyed by project delays. With the amount of capital expenditure involved in LNG, it is vital to get free cashflow flowing as fast as possible in order to enhance returns. Delays to projects, which occur frequently, will destroy returns. The ability of company management to successfully develop projects on time and on budget is absolutely vital.

Note, delays to the commencement of first spending on a project are more or less irrelevant to returns, as most LNG gas has long since been discovered and the exploration expense is very small compared to overall project costs. The key is to manage spending and development from the moment of first real capital expenditure – ie project management. The experience of Canadian oil sands projects says that a sudden rush of expenditure into a particular global energy theme causes considerable delays and horrendous cost over-runs. There is clearly a danger of this occurring in global LNG, and it underlines our view that supply remains tight.

Figure 14: Project management is vital to avoid value destruction

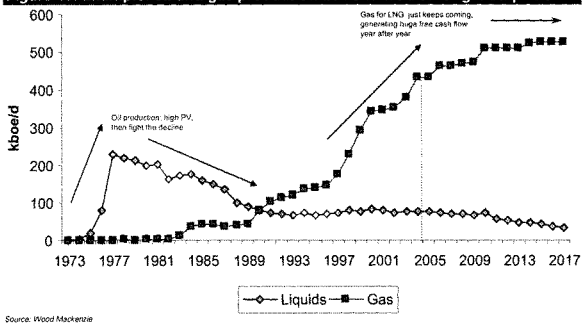


Source: Wood Mackenzie, Deutsche Bank

3) However, if successfully developed, the long-lived nature of LNG projects makes them free cashflow machines once they are built. (see [Figure 13]). Furthermore, most 12% returns calculations are based on fairly aggressive discount rates (i.e. 10%). Reducing discount rates, given the length of time (20 years plus) that an LNG plant is operational, makes returns look even more attractive.

Why do discount rates matter? Because LNG plants are built on top of huge gas reserves. They go on and on (of global LNG plants built since 1968, only Arun has gone into decline, and gas was flared in large quantities for many years there). In the example given in Figure 13, TOTAL's production at Bontang in Indonesia is comfortably sustainable through 2050, long after the plant is fully depreciated.

Figure 15: Example: oil and gas production at TOTAL's Bontang LNG plant

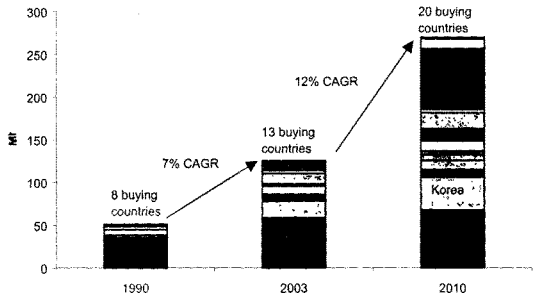


Source: Wood Mackenzie

Demand + returns = growth is strong...from a low base

The LNG market is growing fast, from a low base. As global gas prices have increased, LNG unit costs have declined. The result is strong expansion for LNG demand, from an increasing number of markets.

Figure 16: Market is growing fast and fragmenting



Source: Deutsche Bank estimates

Last year we highlighted the fact that the gas price has now globalised owing to the influence of LNG, whereby the Japanese nuclear crisis, in a chain reaction, reduced the available quantity of LNG for delivery to the US (*LNG: Going...going...gone global,* May 2003). Equally, based purely on available reserves and its relatively clean characteristics as a fuel, we described LNG as "the oil of the 21st Century." Needless to say nothing has changed in a year to alter that view.

In fact, the problem for LNG is meeting near-term expectations. The modern era of globally traded LNG has coincided with a global shortage of gas (and oil) that has left prices in all markets much higher than the ultimate global clearing price of LNG, which we take to be the price of LNG delivered from Qatar. In a piece of geographic elegance, the distance from Qatar to the *East* Coast USA is equal to that from Qatar to the *West* Coast of the USA (think global). Qatar is the location of the huge North Field, the largest known gas field in the world, at around one quadrillion feet of gas (one thousand trillion = one quadrillion), or around 50 years of US natural gas consumption. For 2008 delivery, ExxonMobil claims it can deliver gas from its Qatari expansion projects to any gas market globally for $3 per mmbtu, for a ~15% return.

Figure 17: LNG markets by type and growth (LNG volumes consumed 2003–2010)

Energy Short, Mature		Energy Short, Growth		Decline Replacement, Mature		Coal Replacement, Growth	
	'03 - '10		'03 - '10		'03 - '10		'03 - '10
Japan	58 - 68 Mt	South Korea	19 - 38 Mt	East Coast US	5 - 15 Mt	China	0 - 7 Mt
		Taiwan	6 - 9 Mt	Gulf Coast US	10 - 30 Mt	India	0 - 10 Mt
Italy	2 - 10 Mt						
France	9 - 12 Mt	Spain	12 - 18 Mt	UK	0 - 20 Mt		
Belgium	2 - 4 Mt	Portugal	0.2 - 3 Mt				
		Greece	0.4 - 1 Mt				
California	0 - 5 Mt	Turkey	3 - 4 Mt				
Boston	2 - 3 Mt						
		Island markets:					
		Puerto Rico	0.5 - 1.5 Mt				
		Dominic. R.	0.2 - 0.7 Mt				
		Shouldn't be importing gas:					
		Mexico	0 - 11 Mt				

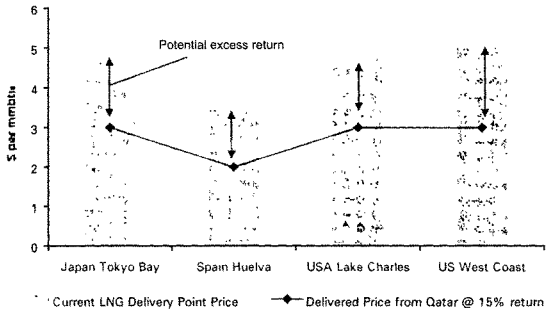
Total Global Market Growth 2003: 125 Mt, 2010: 270 Mt = 12% CAGR

2003 ~17 bcf/d, ~4 mb/d), 2010 (37 bcf/d ~8 mb/d)

Source. Deutsche Bank

For example, the key LNG pricing points from an intra-LNG global trade perspective will be Tokyo Bay; Huelva in Spain; Lake Charles in the US; and potentially, Baja Mexico for California supply (think global). Allowing for the relative proximity of Spain, LNG is currently an outstanding investment proposition. If Qatar makes 15% at $3 gas, then current returns, depending on the precise nature of the upside profit split, would be extremely large – say post tax 30%-40% into any of the three global pricing points (adding $2 to netback prices takes pre-tax returns to 50%+). Even ignoring upside against current prices, the base case 15% IRR is in itself an extremely good return on the $5bn cost of an LNG project, in this era of 4% bond yields.

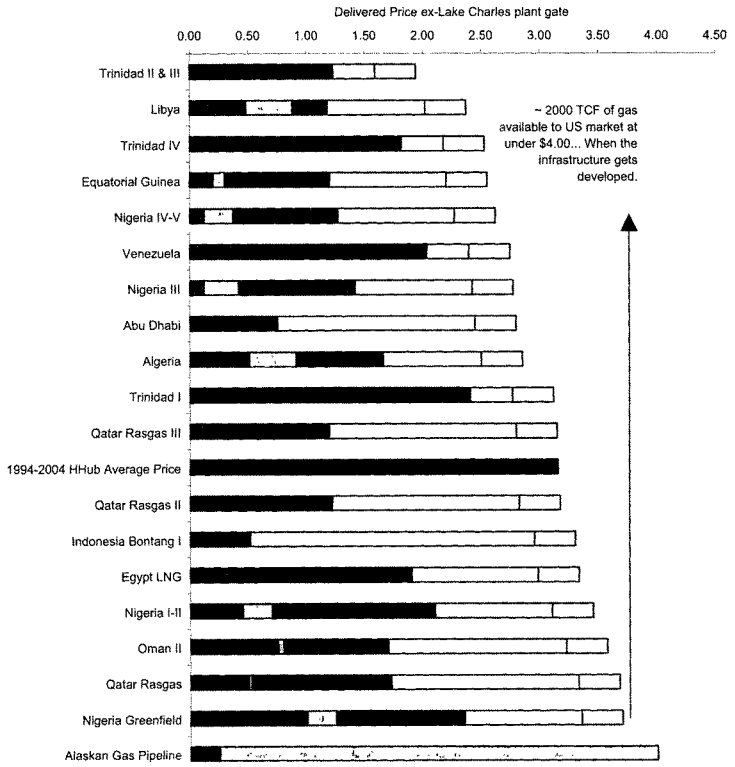
Figure 18: How Qatar would compete today – if the capacity was available



Source: Deutsche Bank estimates, Gas Matters, IEA, DOE

So, as in other areas of the energy market, the prevailing price of oil and gas now wildly exceeds the planning assumptions of the companies, and there is an overpowering economic rationale for building additional LNG capacity. This is even more so the case in the US, where there are few alternative gas supplies to meet the scale of the demand challenge. LNG is clearly the long-term US gas solution.

Figure 19: LNG cost stack for delivery to the US Gulf: huge quantities at competitive prices



Source: Deutsche Bank. Alaskan Gas Pipeline cost is based on transport from Prudhoe Bay to Chicago

The most obvious manifestation of this is the welter of US regasification projects that are being swiftly progressed through the US permitting process. Equally, a similar market, the UK, now has a similar rush to add capacity. However, the development in regasficiation is actually the first, rather than the last part of the chain. Effectively this is establishing a market for the gas. Some companies are planning regasification terminals well ahead of their ability to supply their own LNG – the current tightness in global LNG supply suggests they will not find it easy to fill their terminals if they do indeed go ahead.

The US experience of Sempra is telling. The company successfully won the permits some time ago to build a major LNG regasification terminal in Louisiana, with few if any local opposition issues, and became the first company to have the right to add new regasification capacity to the US gas market. Since then, nothing has happened. No supply.

Furthermore, the expense of the terminals means they will not be built without supply – a company committing to a speculative LNG terminal would be taking a horrible risk on $600m of investment that at best will earn a utility return. The chain in LNG is stronger than ever – it is a capital commitment chain.

So, given the economic rationale and the scale of the opportunity, there is no shortage of LNG project concepts *per se*. However, actual physical development is not enormously high, when considered, for example, against activity in global oil. Global oil and gas demand both grew at around 2% last year, which in the light of the far greater size of the global oil market (whereby absolute growth in oil demand, at ~1.5mmb/d in 2003 was three times greater, than gas, at ~0.5mmb/d). Furthermore, the natural declines in oil, which are far less of an issue for gas production (ex-US and North Sea), present a picture of a global gas market that is not developing as fast as a prediction made five years ago would have foretold.

Given the economic arguments, the inter-related questions become

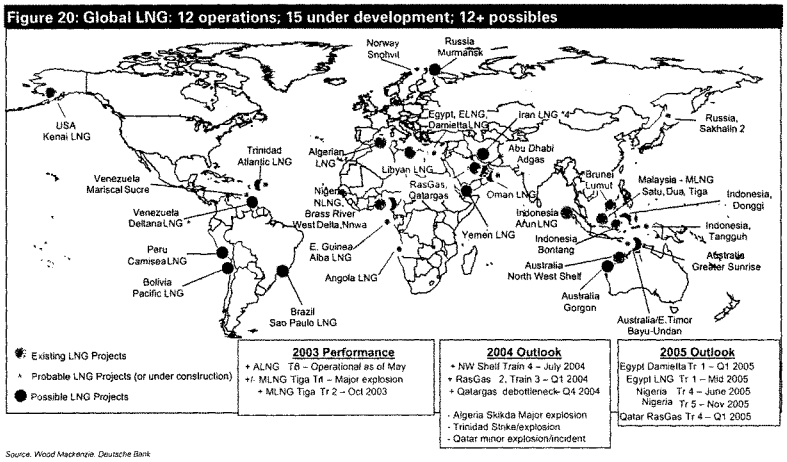
1. Why there is not more LNG being developed currently?

2. Can the potential rush of LNG projects really be simultaneously developed?

Why is there not more LNG growth?

The lack of near-term supply in LNG is a function of the complexity and size of putting together a LNG project. There is a large inventory of projects under development.

Figure 20: Global LNG: 12 operations; 15 under development; 12+ possibles



Source: Wood Mackenzie, Deutsche Bank

However, historically the industry has peaked at the addition of around four trains per year, averaging nearer two. This has represented a global LNG market growing at around 6Mt per year in the past decade. Growth in 2004 is expected by Deutsche Bank to double this rate, at around 12Mt.

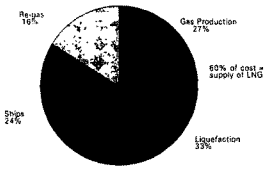
As we have highlighted, there is a myth, actually being propounded by companies as well as less-informed investors, that you can build the regasification terminal and the supply will come (for "exploding myths" see below). In fact, the supply is the relatively expensive and tricky part – lobster fishermen in Maine are no less challenging than lobster fishermen in Angola – albeit for different reasons, and the investment in Angola is much larger.

Figure 21: Costs and efforts are dominated by supply of gas, not regasification, which is the *easy* bit

The LNG business is basic but extremely expensive - 5 Mt "single train" plant

Upstream	Liquefaction	Shipping	Re-gas
5 Mt * $200 per tonne capacity =	5 Mt * $250 per tonne capacity =	5 ships * $180 m per ship =	US$50m per 100 mmcfd of capacity =
US$1000 Bn	US$1250 Bn	US$900mn	$600 m

A generic "greenfield", integrated 5 Mt LNG project has a capital cost of ~US$3.75bn



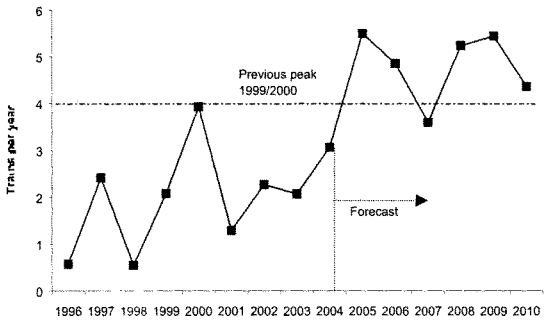
$5 bn = ~ 0.5 bcf/d of gas delivery.

US market ~60 bcf/d

Source: Wood Mackenzie, Deutsche Bank

How fast can the supply grow? One of the interesting data points for future commitments to build LNG gasification plants comes from Air Products, which dominates the market for heat exchanger technology and the heat exchangers necessary to build LNG gasification. Until recently, the company has seen surprisingly little new order action given the implied requirement for new plant – although this is accelerating and is for much larger trains.

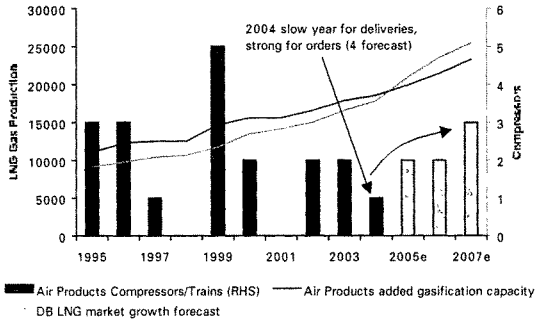
Figure 22: Annual capacity additions in global LNG



Source: Deutsche Bank estimates

The build time on Air Products' compressors is approximately 18 months. From that point it takes one to two months to ship the compressors and then around 12 months to install at the site, and will then need further work. On balance, between an order and first LNG is around three years at best. The fact is that 2004 comes as a lull in deliveries.

Figure 23: Air Products' trains built per year, supply created per year

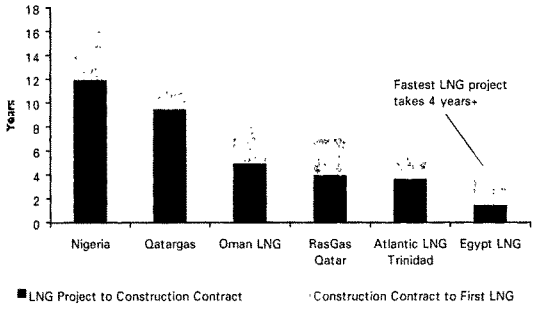


Source: Air Products, Deutsche Bank

Air Products' peak performance was seven heat exchangers in a year, notionally a huge addition of some 42Mt of LNG in a given year for the new, super-large trains that are being developed by ExxonMobil at QatarGas II, for UK and US-oriented LNG projects. In fact, the company expects a large number of orders this year, four, for larger trains that will start up around 2009. However, there is no mistaking from the order book that we are currently suffering from a fairly muted number of orders between 2000 and 2003.

Of course, the Air Products experience is just one part of a complex set of developments. The very fastest developments now take around four years from decision to invest to first LNG, assuming they are delivered on time. We can be comfortable in our forecast for 2008 LNG delivery, as we have established the order book. There are no projects beneath our radar screen that will suddenly appear – it cannot be done. We have based our outlook for LNG supply on this background information.

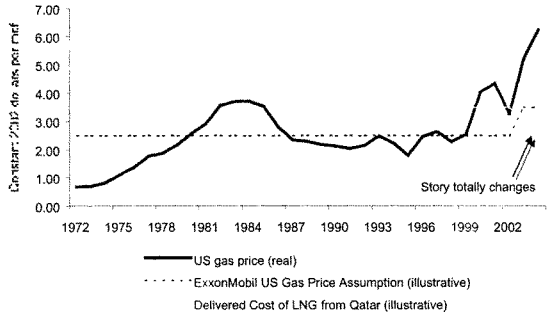
Figure 24: Speed of development in global LNG: better but a long term process



Source: BG

The length of time to develop LNG has combined with the overhang from the 1998/99 oil price crash and global oil industry consolidation. From a Major Oil company perspective, the reason for the relatively limited number of orders is partly a function of their five-year planning horizons. These mean that the oil price crash of 1998/99 and the low gas prices seen in the US market prior to 2000 are only just becoming discounted from the planning process. For example, only recently have we seen the super-major oils, which drive LNG development, move their planning assumptions from the $16 range to the $20 range, regardless of the $40 oil price.

Figure 25: ExxonMobil's US LNG switch



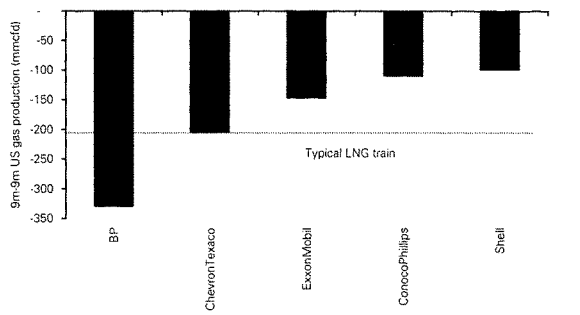
Source: DOE< Deutsche Ban estimates

While ExxonMobil does not publish an oil price planning assumption as such, it *has* publicly raised its assumption for the US gas price, to ~$3.50 per mmbtu. The effect on commitment to LNG projects to serve the US markets is dramatic when combined with the lowered costs at Qatar. Historically a LNG sceptic, Lee Raymond (CEO of ExxonMobil) now leads the industry in terms of planned volumes into the global LNG market.

As a further example, it should be remembered that Trinidad's Atlantic LNG, a relatively recent development, was built with aggressively low costs because it was assumed to be likely to make a loss during the Boston summer low price season. Nobody was planning for today's price to be over $6 per mmbtu.

This underlines our thesis that global oil and gas, particularly US gas, is under-invested. Combined with much lower price elasticity of demand, whereby there is sustained strength in demand despite high prices, we are currently in a phase of higher oil and gas prices, while developments are underway to reverse a sustained period of under-investment since 1998 (see Figure 3).

Figure 26: The need for LNG: only offsetting declines



Source: Company Data, Deutsche Bank

Based on this LNG analysis, there is no ready solution to the shortage of US gas before 2010, given the precipitous decline rates in US gas production. In fact, the developments that are currently planned by ExxonMobil, ChevronTexaco and ConocoPhillips only serve to replace the gas production they will lose over the interim period between today's decline rates and 2009/2010 LNG delivery.

Conclusion: while overwhelmingly an attractive proposition from an economic standpoint, LNG is a major infrastructure challenge that will not be developed in sufficient quantity before 2010 to alleviate the high US, and global, gas price. Growth rates appear high but are from a low base. The grand theory that says LNG is the oil of the 21st Century is intact, but the century is just that, and LNG is being introduced in the decade 2000-2010, which is just the beginning.

Global LNG: exploding the myths

Myths and facts in global LNG

The global oil market will grow by twice as much as the global gas market this year – but LNG is the hot topic. Clearly there is huge potential – however, myths have quickly developed. In this section we discuss some of the key misconceptions surrounding global LNG.

Figure 27: Exploding the myths – US LNG as an example

Myth	Fact
The LNG market is bottle-necked because of a lack of US regasification capacity: safety concerns and "nimbyism" prevent more capacity being added.	**Spare US regasification capacity is under-utilised because of a lack of LNG supply - at any price. Strong government and local support, particularly in the Gulf of Mexico, means there is clearly excess potential regasification capacity.**
Once sufficient ships and regas can be developed to deliver to the US, abundant international LNG is available at $3 per mmbtu.	**There are also currently spare LNG ships looking for supply.**
Already US gas prices are increasingly under pressure from LNG imports up 100% in the past year.	**US gas prices are still well above $5 per mmbtu despite a mild summer. Yet LNG only supplies around 1.5% of US gas demand - and supply is having to come from Australia to achieve that.**

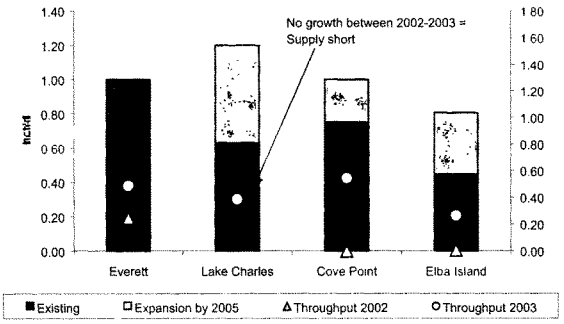
Source: Deutsche Bank estimates

Myth: US regasification is insufficient to meet demand

Fact: there is no shortage of US regas, nor is there likely to be any in the future. This is perhaps the biggest single myth currently propounded regarding LNG: the difficulty seen in adding US regasification capacity, and the idea that this will represent a major bottleneck in the development of the US LNG market.

1. First, currently there is spare capacity in US regasification terminals.

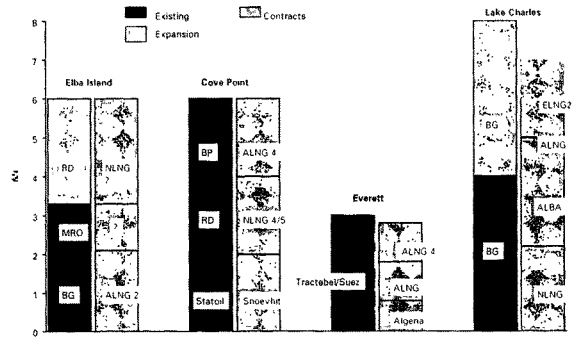
Figure 28: Plenty of spare capacity at existing US regas terminals



Source: Waterborne LNG report, Deutsche Bank

2. Second, even current expansion plans are not filled contractually, with Marathon and BG both holding excess capacity at existing plants. Even ignoring the fact that several major projects are planned without firm supply, existing commitments are not filled. Yet current plans for regasification are seeking to add extremely large quantities of additional capacity, with a further wave of capacity additions in their wake.

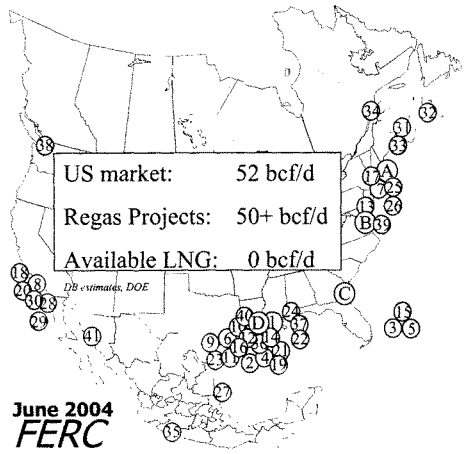
Figure 29: Corporate commitments to US regasification terminals, 2006



Source: Energy Bar Association, Deutsche Bank estimates

3. Third, with support from the highest levels of US government, both the FERC and the Coast Guard have accelerated, and in the case of FERC relaxed, their permitting requirements. Projects are quickly being approved. In fact, there are far too many regasification projects currently being progressed.

Figure 30: FERC's list of current and future regasification plants: shortage? You're kidding...



Existing Terminals with Approved Expansions

A. Everett, MA : 1.035 Bcfd (Tractebel – DOMAC)
B. Cove Point, MD : 1.0 Bcfd (Dominion – Cove Point LNG)
C. Elba Island, GA : 1.2 Bcfd (El Paso – Southern LNG)
D. Lake Charles, LA : 1.2 Bcfd (Southern Union - Trunkline LNG)

Approved Terminals

1. Hackberry, LA : 1.5 Bcfd, (Sempra Energy)
2. Port Pelican: 1.6 Bcfd, (Chevron Texaco)
3. Bahamas : 0.84 Bcfd, (AES Ocean Express)*
4. Gulf of Mexico: 0.5 Bcfd, (El Paso Energy Bridge GOM, LLC)
5. Bahamas : 0.83 Bcfd, (Calypso Tractebel)*

Proposed Terminals and Expansions – FERC

6. Freeport, TX : 1.5 Bcfd, (Cheniere / Freeport LNG Dev.)
7. Fall River, MA : 0.8 Bcfd, (Weaver's Cove Energy)
8. Long Beach, CA : 0.7 Bcfd, (SES/Mitsubishi)
9. Corpus Christi, TX : 2.6 Bcfd, (Cheniere LNG Partners)
10. Sabine, LA : 2.6 Bcfd (Cheniere LNG)
11. Corpus Christi, TX : 1.0 Bcfd (Vista Del Sol/ExxonMobil)
12. Sabine, TX : 1.0 Bcfd (Golden Pass/ExxonMobil)
13. Logan Township, NJ : 1.2 Bcfd (Crown Landing LNG – BP)
14. Lake Charles, LA: 0.6 Bcfd (Southern Union – Trunkline LNG)
15. Bahamas : 0.5 Bcfd, (Seafarer - El Paso/FPL)
16. Corpus Christi, TX: 1.0 Bcfd (Occidental Energy Ventures)
17. Providence, RI : 0.5 Bcfd (Keyspan & BG LNG)

Proposed Terminals – Coast Guard

18. California Offshore: 1.5 Bcfd, (Cabrillo Port – BHP Billiton)
19. Louisiana Offshore : 1.0 Bcfd (Gulf Landing – Shell)
20. So. California Offshore : 0.5 Bcfd, (Crystal Energy)
21. Louisiana Offshore : 1.0 Bcfd (McMoRan Exp.)
22. Gulf of Mexico: n/a (Compass Port - ConocoPhillips)

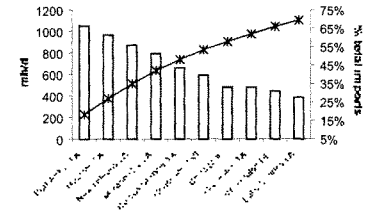
Planned Terminals and Expansions

23. Brownsville, TX : n/a, (Cheniere LNG Partners)
24. Mobile Bay, AL: 1.0 Bcfd, (ExxonMobil)
25. Somerset, MA : 0.65 Bcfd (Somerset LNG)
26. Beimar, NJ Offshore : n/a (El Paso Global)
27. Altamira, Tamulipas : 1.12 Bcfd, (Shell)
28. Baja California, MX : 1.0 Bcfd, (Sempra & Shell)
29. Baja California - Offshore : 1.4 Bcfd, (Chevron Texaco)
30. California - Offshore : 0.5 Bcfd, (Chevron Texaco)
31. St. John, NB : 0.5 Bcfd, (Canaport – Irving Oil)
32. Point Tupper, NS 1.0 Bcf/d (Bear Head LNG - Access Northeast Energy)
33. Searsport, ME : n/a
34. St. Lawrence, QC : n/a (TCPL and/or Gaz Met)
35. Lázaro Cárdenas, MX : 0.5 Bcfd (Tractebel/Repsol)
36. Gulf of Mexico : 1.0 Bcfd (ExxonMobil)
37. Mobile Bay, AL: 1.0 Bcfd (Cheniere LNG Partners)
38. Cherry Point, WA: 0.5 Bcfd (Cherry Point Energy LLC)
39. Cove Point, MD : 0.8 Bcfd (Dominion)
40. Port Arthur, TX: 1.5 Bcfd (Sempra)
41. Puerto Libertad, MX: 1.3 Bcfd (Sonora Pacific LNG)
** US pipeline approved; LNG terminal pending in Bahamas*

Source: FERC Deutsche Bank

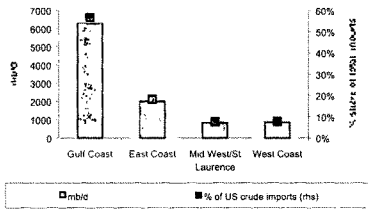
Ultimately there should be relatively few sites – the 16mmb/d US oil market is served by around 10 major import ports, with more than 50% of imports coming through the Gulf Coast. Given that LNG does not even come close to representing the scale of the oil import challenge, 32 terminal projects for LNG is ludicrous. If the entire current US gas market was imported, it would represent 8mmb/d of oil equivalent – manageable with around 12 ports. Our numbers are conservative – we have not included oil products in our comparison, which account for a further 3mmb/d of imports, through the same channels.

Figure 31: Top 10 US crude oil import ports



Source: EIA

Figure 32: Crude imports by coast



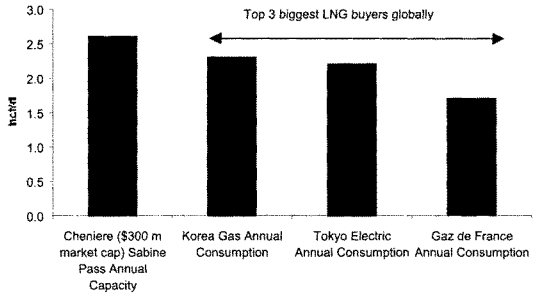
Source: EIA

With the four existing LNG sites, and allowing for the at least two sites likely to progress in Mexico, but not allowing for any additions in Canada, there may only be a need for three or four more sites of the scale of current projects. Most US regasfication projects are large to begin with, typically 1.5bcf/d, and talk about expansions to 2.5bcf/d, e.g. ChevronTexaco's Port Pelican; Cheniere's Sabine Pass. The largest oil import port in the US handles the equivalent of 6bcf/d of gas equivalent. Cheniere, planning for 2.6bcf/d, is thinking big.

That means that no more major regas terminals need to be permissioned – beyond those already approved by the FERC. (Canadian projects follow local government permitting and have stronger local support. However, they are distant and require additional pipeline infrastructure to reach US markets.) Certain niche opportunities, however difficult in terms of local opposition and permitting difficulty, such as in the North East US, are likely to be pursued, regardless. That is because the economic opportunity is so overwhelmingly strong. North East markets enjoy an even greater premium price than wider US gas markets, and as such provide enormous potential returns for those who can go through the pain of the NIMBY. Many are currently undertaking that process. Some will surely succeed.

Establishing which terminals progress is a function of which terminals can get supply of LNG. This is where a market leader such as Cheniere may struggle – beyond its tremendous success in signing a full capacity and capex commitment with ConocoPhillips (1bcf/d + all capex undertaken by ConocoPhillips) and Dow Chemical (500mmcfd offtake) for its recently approved Freeport project. Cheniere is now progressing two plants of tremendous scale in LNG terms – at 2.6bcf/d, each one represents a bigger buyer than any existing LNG buyer in the market, such as Korea Gas (2.3bcf/d), Tokyo Electric (2.2bcf/d) or Gaz de France (1.7bcf/d), the three biggest global LNG buyers). Again, this speaks to our key point: regasification is not the issue, supply is.

Figure 33: A new mega-volume player? Cheniere needs one...



Source: Deutsche Bank. Volumes shown are LNG purchases. Cheniere is currently progessing THREE major projects for US LNG regasification

Scale is huge because the costs are high, either for projects being developed in the swamps of Louisiana, with the associated construction costs, or offshore Gulf, with the associated higher capital and operating costs. A typical LNG regasification plant in Europe might be a 300mmcfd project with a $250 m cost. Port Pelican is $600m at least, as a major offshore project with attendant construction costs, and therefore must target huge volumes to make unit costs reasonable. Equally, where construction is not hampered by NIMBY-ism, which to date is primarily in Louisiana, the topography is swamp – hence the lack of back yards. Again, construction costs are very high and as a result, major quantities will need to be imported.

To repeat, there is no issue with regasfication capacity in the US market.

Myths: LNG is unsafe and unpopular; the FERC is suspending approvals because of safety issues and LNG ships are ideal for terrorists

Fact: LNG is relatively safe and is supported by locals in sufficient areas of the US to meet the need for additional regas and the FERC recently posted a safety briefing on its website[3] that concluded that it might conceivably be possible to cause an LNG explosion, though extremely difficult.

Subsequently the erroneous story circulated that the FERC would not permit any more regas terminals until more work was done on safety. This is not true and the FERC has subsequently approved Freeport LNG in Texas.

Figure 34: There's a propane canister in every back yard...and they are relatively dangerous

LNG - Liquefied Natural Gas	LPG (Liquid Petroleum Gas i.e. Propane/Gas Canister)
Frozen, liquefied gas - ie not explosive. Unpressurized - ie container not under pressure, ie not explosive	**Pressurised gas ie explosive**
Lighter than air - ie does not hang in clouds but dissipates quickly. Requires gasification and then containment (ie indoors) as natural gas to present a risk of explosion.	**Heavier than air - ie hangs in clouds, does not dissipate naturally. Will explode outdoors.**
High degree of safety required under global standards set by Japanese	**Fragmented safety standards in industry dominated by emerging markets**
Highly maintained fleet of ships	**Fragmented, less controlled fleet of older, less maintained ships**
Never present in back gardens. Never exposed to naked flames (would extinguish naked flame)	**Present in almost every US back yard. Frequently adjacent to exposed to naked flames - ie adjacent to a barbeque**

Source: Deutsche Bank estimates

One of the most bizarre objections to LNG has been the possibility that terrorists may use the ships as "Trojan horses" to enter the US. Unfortunately, in a world of pre-9/11 security, it does seem that Al-Qaeda operatives may have used Algerian LNG tankers as a means of entry to the US. However, most of them entered by more conventional means and if anything, LNG tankers are less attractive modes of transport to terrorists because of their high profile and high safety requirements (Coast Guard escort into Boston with a closed harbour. Boston anyway no longer takes Algerian deliveries.) Again, the more fragmented global oil trade would seem to provide a more worrisome potential target. There has to be a recognition that the US cannot depend on imported oil and gas for more than 50% of its needs, and have no ships landing from the Middle East. Security has to be as tight as possible, but no more so for LNG than for any other import ship.

[3] *Consequence Assessment Methods for Incidents Involving Releases from Liquefied Natural Gas Carriers, www.ferc.gov*

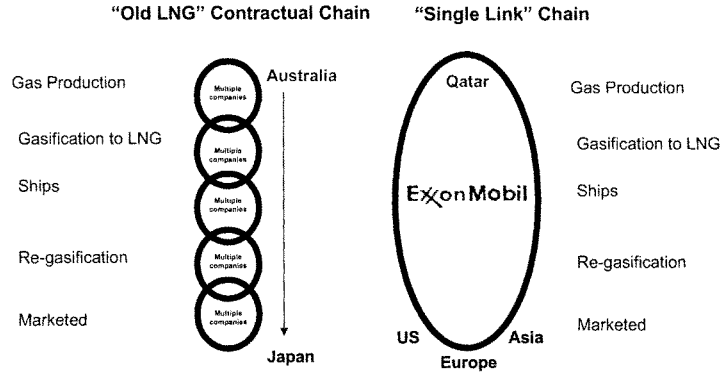
Myths: there is a "new LNG" model that has destroyed the LNG "chain", buyers have the power...and there is a spot market developing in LNG

Fact: the "LNG chain" is now stronger than ever. The cutting edge model is the "single link" chain model. This is a threat to buyers. It also effectively prevents a spot market.

The leading edge of volume growth is now ExxonMobil in Qatar and Shell in Sakhalin II, Russia. These companies are now building the upstream, pipeline, gasification, LNG ships, LNG receiving terminals and marketing the gas themselves. By contrast, the "old LNG" model on the North West shelf was partnership produced gas sold to partnership ships and marketed by Japanese partnerships to multiple buyers. In the ExxonMobil Qatar model, the company is seller and buyer of the gas. BG is using a similar tactic, highlighting not only its position as a major future producer of LNG, but also as a major future buyer.

It is worth noting that a chain, by its nature, is flexible. As such, "single link" players can move LNG to wherever prices are most attractive, potentially leaving uncontracted buyers short of gas, i.e. the US market currently. Under "single link" LNG, buyers must move to secure their own supply. Japanese utilities are increasingly entering the "single link" model themselves, by moving upstream into the model. At ConocoPhillips' Bayu Undan, Tokyo Electric and Tokyo Gas have participated in the "single link" model to supply themselves with gas. This is not a spot market – it is the opposite.

Figure 35: The "LNG chain" is strengthening as scale increases



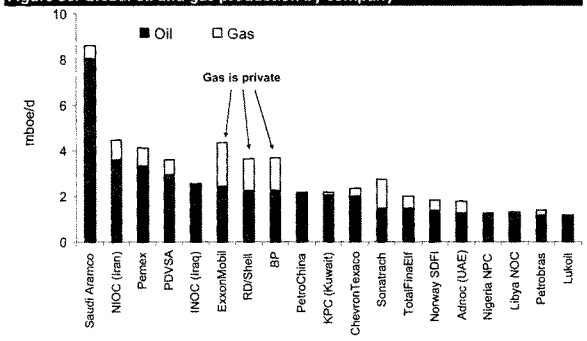
Source: Deutsche Bank estimates

One of the key reasons that the chain is strengthening in LNG is that the scale of individual projects is increasing, making the need for certainty in terms of commitments absolutely vital. Seven million tonne trains and $1bn regas proejcts cannot be built on a speculative basis. The relatively small scale of energy delivered in LNG compared to the capital commitment means that a spot market will only develop amongst those who get their developments wrong. Those who hope to buy LNG on a spot basis from ExxonMobil are certainly getting it wrong.

Myth: the next development is Gas OPEC

Fact: no governments could cartelise an early-phase market in development without killing it. Global gas is developing as a private opportunity. The real question is whether we are on the cusp of the development of a gas Standard Oil – as global gas transport monopolies are currently under development. Nodes of production and means of transport to controlled points of distribution are all absolutely necessary to allow for the development of global LNG in this first phase. As we have already stated, in viewing LNG as the oil of the 21st Century, it must be recognised that we are still at the beginning of the century. The chained model described above, where, for example, ExxonMobil dominates the lowest cost supply from Qatar and has the lowest cost delivery of that gas anywhere globally, will allow companies to dominate their own LNG supply routes to their own advantage. This is absolutely necessary because of the scale of the capital requirement. The consumer will benefit from lower priced cleaner energy than is currently available. Companies are moving to supply a major global need for clean fuel, and are can only do that by contractually protecting their financial commitment.

Figure 36: Global oil and gas production by company



Source: PIW and Deutsche Bank

The latest move by the FERC, in attempting to encourage more US regasficiation development, has been to remove the need for new US regas terminals to offer open access. This is a classic example of local government encouraging early phase market development, by making it extremely attractive to developers, by facilitating the protection of their return on investment.

Of course, that may ultimately lead to a major low cost producer, such as Venezuela or Qatar, delivering into one huge monopoly terminal to the exclusion of other suppliers. A supplier could then theoretically make a monopoly profit while driving out alternative supplies. According to the major potential suppliers from Qatar, such as ExxonMobil and ConocoPhillips, this model should be in place by 2010 – at which point the FERC will need to exercise extremely close scrutiny on gas market behaviour. Equally, in the much longer term, excess profits from LNG may come under scrutiny from needy host governments – this would be Gas OPEC. According to the schedule of the oil market, that should occur from around the beginning of 2060.

Myth: the LNG industry has made a breakthrough on costs

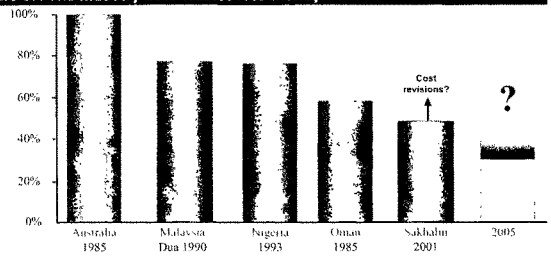
Fact: the industry has just stopped wasting money. The original "new LNG" model, which we identified in 1999, was a means of highlighting how the Trinidad LNG project was different from previous LNG projects built under the Japanese utility model. The primary 'difference' regarding "new LNG" was lower costs. Through several initiatives, the Trinidad plant had lower capital costs than had become the LNG norm. There was no technological breakthrough, there was no major innovation other than in driving down costs to the very minimum, mostly simply by applying standard operating procedures in the oil business to the arcane world of Japanese-utility-dominated Asian LNG. With Japanese utilities selling gas at $24 per mmbtu, and primarily concerned with security of supply, cost was low on the list of priorities. The North West Shelf gas project was a high watermark in terms of excess cost and poor returns for LNG. Shell now uses it to benchmark its improved cost performance.

1. At Trinidad, netback pricing was introduced whereby the price received by the gas producers was set by back-calculating from the price at which the gas was sold. While totally standard practice in the oil market, this was a LNG innovation. The risk of netback pricing (because of fluctuating US gas prices) meant that costs became a priority. Previously they had not been.

2. Competitive tendering was introduced at Trinidad for the technological process and for the first time since the late 1960s. The "Phillips Cascade" method was chosen as the LNG process, and by re-introducing competition amongst technologies, costs at Trinidad took a step down. Competitive tendering was hardly a stunning innovation...what was stunning was that it wasn't being used until the late 1990s in the LNG business.

3. Where Trinidad got it wrong was scale. Cautiously put together, the project did not have a very large site and was developed as a niche plant. The developers did not realise how high the US gas price would go. In fact, the higher US gas price, and global gas price, is a bigger factor in the competitiveness of LNG than any reduction in costs. US gas prices have risen 200% from long-term historical averages in 2004, LNG costs have been driven down, but primarily future cost savings will be due to scale. At best, we estimate unit costs may have another 20% to fall.

Figure 37: The industry now wastes less money



Source: Shell

Chart shows EPC cost, normalised on location relative to NWS project

Source: Shell, Wood Mackenzie

Myth: there is excess LNG supply

Fact: the LNG market is tight and there is no major supply overhang developing, far from it. Historically, the LNG trade was based on security of supply, with Japanese utilities leading the development of the industry as a reaction to oil price shocks. As a result, the industry was built with a considerable amount of spare capacity, with the Japanese running contracts to buy gas over a 20 or 25-year period with around 10% flexibility on annual volume offtake. Broadly speaking, as a result, the LNG business developed with around 10% spare capacity at mid-cycle.

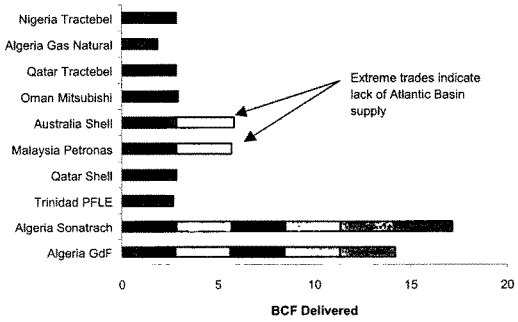
Three major factors have tightened global LNG supply over the past five years.

1. Having found itself with huge excess quantities of LNG in the Asian economic crisis of 1998, South Korea began to run down its excess contracted LNG volumes. South Korea optimised its position in the supply and demand balance by offtaking spare Japanese cargoes on a spot basis. However, the major nuclear scandal at Tokyo Electric shut down 17 nuclear reactors and resulted in a tightness of LNG supply into the cold winter of 2002/03, which left the Koreans scrabbling for LNG volume. As a result of the energy shortage the country found itself in, the Koreans and Japanese have moved to commit to more volumes, and there has been relatively little spare LNG available.

2. More extreme weather in Europe, particularly the super-hot summer of 2003, and normal winters have sucked in LNG to supply strong demand for gas.

3. On the supply side, a surprising number of plant outages. These started with a pipeline issue at Bontang in 2002, continued with an explosion and outage at the brand new Malalysia Tiga project in 2003, then saw a major explosion at the Algerian Skikda plant in 2004, and outages in Qatar and most recently in Trinidad. All these elements have conspired to tighten the global LNG balance just as oil has become an expensive alternative fuel. At the same time in 2004, there is no new project start up, but the first demand from India and US terminals such as Cove Point. That is, demand is outstripping supply.

Figure 38: January to June 2004 LNG deliveries to Lake Charles



Source: Waterbourne LNG report

There are around four LNG ships currently idled – indicating, when combined with spare capacity at US regasification facilities, that there is a lack of available supply. Equally, an analysis of the provenance of LNG currently being delivered into the US markets shows some extremely distant trades, and to that extent implies that Atlantic Basin LNG supply is short.

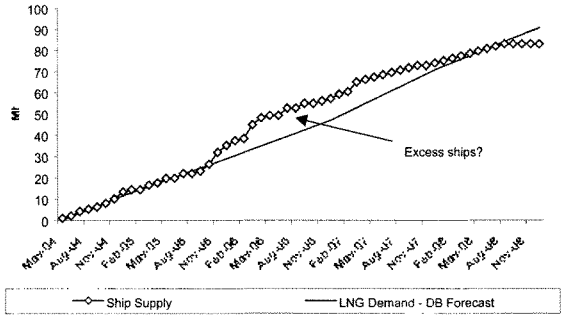
Myth: there are insufficient ships to meet future demand for LNG

Fact: there is currently a surplus of ships and arguably there is a bigger surplus developing in the near future (see Figure 39). The "speculative build" has been much faster to develop in the world of shipping – with its higher risk capital – than in the world of LNG supply.

It has to be said that precise matching of the ship capacity vs. demand line is not possible as ships can deliver more or less LNG depending on the length of their voyage. An alternate explanation of Figure 39 would be that the LNG industry is entering a phase of longer ship voyages, which fits with the development of such trades as Egypt-USA and Qatar-USA, rather than the more logical, economic and profitable Trinidad-USA or Venezuela-USA.

As an aside, the failure of Venezuela to develop LNG for the delivery into the US market is one of the great missed opportunities of recent times. Venezuela's LNG industry has been on the drawing board since the early 1970s – and it was potentially profitable then! It is rightly to the embarrassment of Venezuelan petroleum executives that smaller Trinidad, with less gas reserves and a less established oil industry, has succeeded in developing the largest Atlantic Basin LNG plant over the past seven years. Having said that, Trinidad itself was many years at the development stage before commitment was made to the plant development.

Figure 39: LNG ship supply and Deutsche Bank's global LNG demand forecast



Source: Clarksons, Deutsche Bank estimates

Myth: LNG will crash (or cap) the US gas price

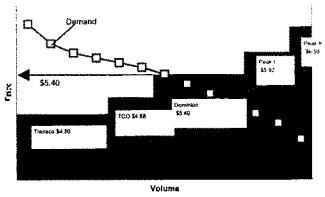
Fact: insufficient supply potential into the US markets makes LNG a marginal, regionalised fuel until beyond 2010. Shorter term, the price impact of LNG onto the highly regionalised US gas market is impossible to predict. A marginal cost of supply curve is extremely difficult to create accurately into a declining gas market that is rapidly shifting in terms of cost of supply and price of demand.

1. Existing incumbents are leaving their production behind (i.e. ExxonMobil, ChevronTexaco selling out of US onshore). However, aggressive newer players (XTO, Encana) are entering to re-vitalise many mature areas. Whilst production per well and other measures are clearly falling, the new era of aggressive investment in US domestic gas – at a higher gas price assumption – is only beginning.

2. Furthermore, the impact of new infrastructure on marginal price curves is large and unpredictable. There is an argument that says that Enron and its impact on the US gas transmission business has prevented the development of sufficient US pipeline infrastructure to meet supply and demand efficiently, hence today's extreme price environment. Major price disconnections are possible, but are unlikely to last long. BG is quite open that it was surprised at the price impact individual cargoes of LNG had on Lake Charles' local pricing, but that they would add infrastructure to alleviate the problem of a single offtake pipeline.

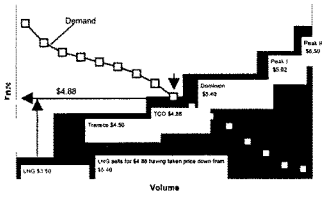
3. Regionally speaking, LNG is likely to have a fairly dramatic impact on prices, at times disproportionate to the additional volumes being delivered, because it will shift the marginal supply curve, potentially away from a relatively small volume of gas production at a relatively high price (see Figures 38 and 39). Equally, the net effect may simply be to free up relatively high priced gas that may not find a market elsewhere.

Figure 40: Before LNG, gas prices to marginal supply



Source: Energy Bar Association

Figure 41: After LNG, a potentially significant shift as it enters at the lowest part of the supply curve



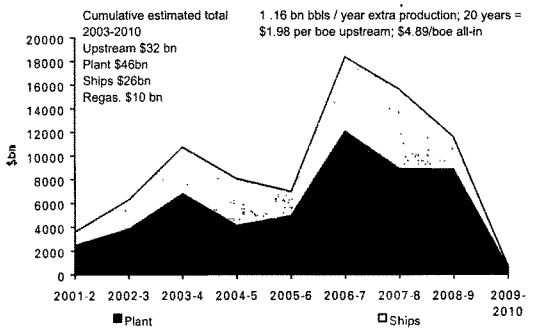
Source: Energy Bar Association

Who wins?

With gas prices high and volumes tight, who can deliver?

With LNG deliverable globally at $3 per mmbtu, the higher US gas price represents a huge opportunity that we think companies will rush to fill. We reiterate our long-standing forecast of major increases in LNG capital spending over the coming years (and decades). Companies with exposure to this are Buy-rated stocks: Halliburton; Technip; Chiyoda, and Air Products. Additional plays on the theme are Snam (SRG.MI, EUR 3.5, Hold), Chicago Bridge and Iron (CBI, not rated), and Daewoo Shipbuilding (Not Rated).

Figure 42: Estimated capex in global LNG 2001-2010E



Source: Deutsche Bank estimates

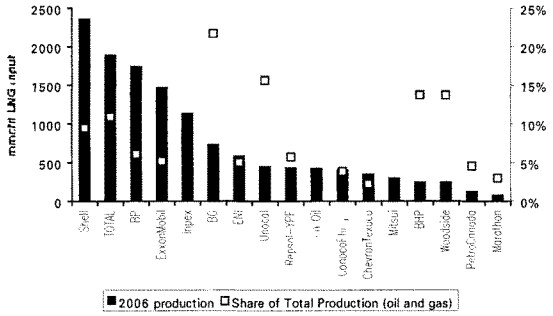
Euphoria over some of the lower return elements of the business may be overstated. We deny the emergence of a major traded spot market in LNG and consider the "LNG chain" to be strengthening and tightening in future, as projects become bigger, more capital intensive, and therefore more bound by contractual links. If the speculative, or spot, market was really here, surely one of the permissioned US LNG regasification greenfield projects would have started construction – they have not.

Certain LNG-exposed companies will make no more money from higher gas prices, and will be threatened by rapid growth, as they are essentially utility businesses. These are LNG shippers (Golar LNG, not rated; Teekay shipping, not rated) and LNG regasification plays (Cheniere LNG.A, not rated). However, these companies may be attractive take-out candidates within the theme of more tightly integrated contractual chains, e.g. if ExxonMobil needs a quick fix to its lack of US regasification capacity and if organic development proves too time consuming and frustrating.

Amongst conventional gas producers, where the highest returns and highest leverage to higher gas prices are to be found, the relative growth is with the traditionally dominant plays. These are Shell, BP, BG, TOTAL, ExxonMobil, Eni,

ConocoPhillips – companies that have invested heavily over the past five years and should now reap the rewards.

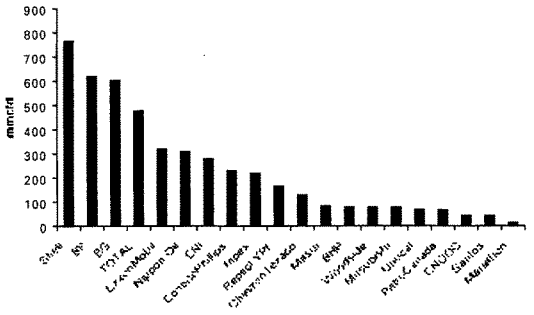
Figure 43: Gas into LNG production 2006E



Source: Deutsche Bank

Key growth names in LNG are the same names that dominate the industry in terms of overall value. The exception is the rise of ConocoPhillips and the lack of growth from Unocal. Our analysis shows that Repsol and ChevronTexaco also show growth in the 2007E timeframe.

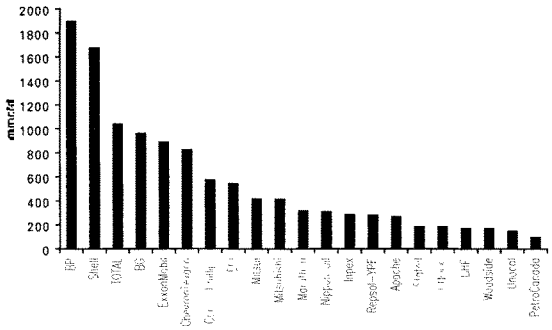
Figure 44: Growth in gas into LNG 2003-07E



Source: Deutsche Bank

Longer-term growth stories present some interesting additional companies. There is clearly a higher degree of uncertainty surrounding project deliveries in these numbers, but they provide our best-informed view of longer-term growth. BP is a winner through additional gas into Egypt's SEGAS project, which is by no means a certainty. Equally, BP will need to convert Trinidad 5 into a producing project before 2010 (not to mention Tangguh), for these numbers to be proved representative.

Figure 45: Growth 2003-2010E in gas into LNG production



Source: Deutsche Bank

Certain companies simply do not appear in the top 20 names in LNG. Occidental has no position before 2010, while Amerada Hess has such a small stake in Snoevhit that it does not register on the leader board. Marathon is very clearly the mid-cap US play on LNG. The US large caps accelerate their performance, but remain well behind their European counterparts in terms of LNG.

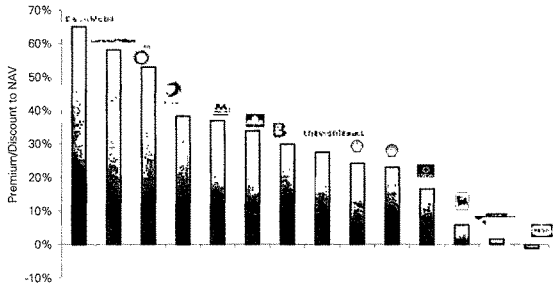
If the US gas market develops as expected over the period 2010-2020, then it may well be the US names, not least the US independents such as Apache from Egypt, EOG and PetroCanada from Trinidad, and possibly Oxy, Hess and ConocoPhillips from Libya, that will rise through the top names. However, these companies themselves would admit that they are playing catch up to such first movers as BG and the super-cap Europeans.

Risks: project development and management

Mismanagement could lead to enormous value destruction

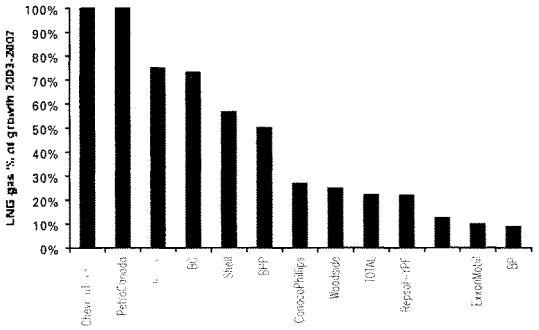
Companies need to invest billions and must successfully manage the process, otherwise value destruction will be enormous. Projects are in risky places, either technically – such as the extreme Northerly Barents Sea for Statoil's Snoevhit, politically – such as Angola, the Middle East (Qatar), or from a labour dispute point of view – such as Trinidad. Companies that mismanage projects in development and operation are likely to cost shareholders literally billions. Investors must be convinced that they are entrusting their money to top quality managements, or be rewarded with an appropriately risked entry price. Unable, as we are, to judge managements objectively (at least in print), we point to NAV premium discount as the market's valuation of management quality.

Figure 46: NAV premium/discount – market's view of management quality



Source: Deutsche Bank, companies shown only integrated majors with LNG project exposure

Figure 47: Who needs LNG? Relative exposure to growth from LNG

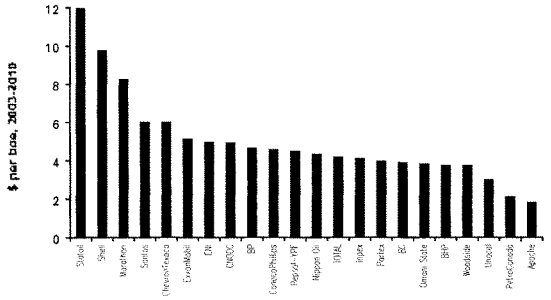


Source: Deutsche Bank

Who *needs* the LNG? As above, companies reliant on LNG growth and have few alternative volume growth drivers are most leveraged to LNG – ChevronTexaco and PetroCanada reveal themselves to be dependent on LNG for providing any kind of growth.

An alternative risk calculation is capex per boe of production. Of course, this is problematic because pure boe production numbers do not capture returns on capital expenditure, nor investment this decade for growth next. Nevertheless, a first glance of approximate capex dollars per boe of additional production 2003-2010 throws up some interesting exposure to relatively high levels of capex for relatively little production over the next 10 years, particularly for Statoil and Shell. However, we stress that current pressure on book returns is likely to lead to longer-term high free cashflow as LNG drives gas delivery in the 21st Century. In other words, high capex for the next decade is not *necessarily* a bad thing, assuming projects are on time, on budget, and perform with long lives. However, history says the market will pay for growth now, not capex now.

Figure 48: LNG capex per boe of LNG gas production 2003-2010



Source: Deutsche Bank

Appendix 1

Important Disclosures

Additional information available upon request

For disclosures pertaining to recommendations or estimates made on a security mentioned in this report, please see the most recently published company report or visit our global disclosure look-up page on our website at http://equities.research.db.com.

Analyst Certifications

The views expressed in this report accurately reflect the personal views of the undersigned lead analyst about the subject issuers and the securities of those issuers. In addition, the undersigned lead analyst has not and will not receive any compensation for providing a specific recommendation or view in this report.

Paul Sankey

Rating key

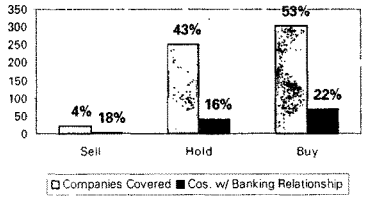
Buy: Total return expected to appreciate 10% or more over a 12-month period

Hold: Total return expected to be between 10% to -10% over a 12-month period

Sell: Total return expected to depreciate 10% or more over a 12-month period

The target prices of shares mentioned in the accompanying text are based on the assumed investment horizon of 12 months. If company notes are published on these shares in the future, the target prices mentioned in the subsequent notes will have priority.

Rating dispersion and banking relationships



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Testimony of Logan Magruder

on behalf of the

Independent Petroleum Association of Mountain States (IPAMS)

before the

Joint Economic Committee

October 7, 2004

Good morning, Mr. Chairman and members of the Committee. I am Logan Magruder, Senior Vice President of Berry Petroleum Company's Rocky Mountain and Mid-continent Regions. Today I am testifying on behalf of the Independent Petroleum Association of Mountain States (IPAMS). IPAMS thanks this committee for holding a hearing on natural gas and including testimony that is focused on domestic sources of natural gas.

In my testimony today, I would like to make three points. First, consumers are paying unnaturally high prices for natural gas because there are many obstacles limiting the development of federally owned natural gas in our own country - including abundant supplies of federally owned natural gas in the Intermountain West. Second, the federal government's action and inaction will continue to affect the nation's natural gas supply by virtue of the fact that the federal government is the dominant owner of the nation's natural gas resources. Third, increasing supplies of natural gas will require continued improvements to the process that governs development of federal energy resources.

Our nation's natural gas supplies are a true domestic product; produced in America, owned by America, and consumed by Americans. Almost ninety-nine (99%) percent of the natural gas consumed in the United States comes from North America, eighty-three (83%) percent of which is produced in the U.S. and sixteen (16%) percent that is imported from Canada. A quick review of some energy statistics helps to underscore the importance of this fuel source to our economy:

- Natural gas provides nineteen (19%) percent of the electric power we use in the U.S.
- Industries get over forty (40%) percent of their primary energy from natural gas
- More than sixty (60) million households nationwide use natural gas for everyday luxuries like heating their homes, taking hot showers, or preparing home-cooked meals

Source: National Petroleum Council

Natural gas is a clean, reliable and affordable fuel for the way we live today, and for future generations. However, production is lagging behind demand causing prices to escalate to unhealthy levels which impacts consumers, businesses and the economy. High natural gas prices impose a hidden tax on consumers, depressing disposable personal

income and savings, and ultimately consumer spending, which accounts for two-thirds of the economy.

In response to the growing need for affordable natural gas, independent producers across the U.S. are employing cutting-edge technologies and best practices to explore for and produce natural gas in an environmentally responsible way on non-park, non-wilderness lands. Pipeline companies are making investments into new infrastructure, and the service sector is expanding.

For many obvious reasons, producers are excited about the natural gas potential in the Intermountain West. It is the only region that has materially increased production over the last twenty years and it currently contributes more than twenty (20%) percent of the nation's total natural gas supply. Producers know that the Intermountain West is a frontier region that has the potential to contribute a great deal to the nation's energy supply. More than twenty-five (25%) percent of the nation's natural gas resources exist in the Intermountain West. However, natural gas development in this region is unique from other areas in that more than half of the mineral estate in the Intermountain West is owned by the federal government. The success of this region in becoming a larger exporter of natural gas is inextricably linked to quality and timely access to public lands and an effective regulatory environment.

Many companies would willingly increase their drilling programs on federal lands within the region, but capital expenditures are limited by the delays associated with federal permitting and other regulatory uncertainties associated with federal leases .

Since the federal government owns more than half of the mineral estate in the Intermountain West, Congress must recognize that federal land managers, principally within the Bureau of Land Management (BLM), are also managing America's energy supplies. In the top four producing states in the Intermountain West (Colorado, New Mexico, Utah and Wyoming), fifty-five (55%) percent of the natural gas is extracted from public lands managed by the BLM. (See Chart 1). This is significant: it means that production from federal lands in just four states in the region makes up nearly ten (10%) percent of the nation's natural gas supply. This underscores the significance of the influence that federal regulations and management of the public lands have on natural gas supply.

Unfortunately, today's federal regulatory environment, particularly the permitting and appeals processes, discourages natural gas production on public lands by injecting uncertainty, additional costs, and delays into the process. Take for example the groups and individuals who

make a regular practice of protesting and litigating to stop energy development. At a recent lease sale in Utah, producers paid nearly $22,000,000 for the right to lease certain tracts of public land. This money was paid upfront without any guarantee from the federal agency that natural gas development will even be allowed. Almost all of the parcels were protested. These protests are commonplace throughout the West, especially in Utah where a staggering fifty-seven (57%) percent of all lease parcels offered by the BLM between 2001 and 2003 were protested by groups opposed to development. Notwithstanding the protests and the potential that you may never be allowed to develop the lease, full payment of bonus bids and rentals are required within 10 days of the sale. Despite the fact that the Mineral Leasing Act specifically requires the BLM to process and issue leases within sixty (60) days after the lease sale, it often takes the BLM eight months or more to issue leases. Thus, capital is being locked-up and not being used to develop natural gas supply.

Legal challenges are another factor limiting oil and natural gas development on public lands. At every stage of development, government agencies are challenged by groups seeking to stop natural gas exploration and production. Many of these challenges are frivolous and do nothing more than increase an agency's work load. Land managers will tell you they are constantly forced to second-guess their work and over-engineer their analysis, adding delays and unnecessary costs to already strapped budgets. As legal challenges increase, so too will the delays and uncertainty associated with production of the nation's resources. In the end, there are no winners: consumers and the nation's economy are being hurt. Fortunately, the House recently passed H.R. 4571, the Lawsuit Abuse Reduction Act. It's a good first step to deter the type of frivolous litigation that is artificially constraining domestic energy production.

Leasing public lands for natural gas development is merely the first step in the uncertain journey through the federal regulatory process. Other federal requirements for approving seismic surveys, drilling permits, and rights of way are equally perilous. Although these procedures were intended to be relatively straightforward, implementation and interpretation varies from state-to-state, between field offices, and even among personnel within an office.

There are no simple fixes to this process. It's not one particular law or regulation, but the cumulative impacts of frivolous appeals and litigation, insufficient funding and staffing for federal land managers and an inefficient system needing more meaningful direction and accountability. Recent policy directives being implemented by the Bureau of Land Management

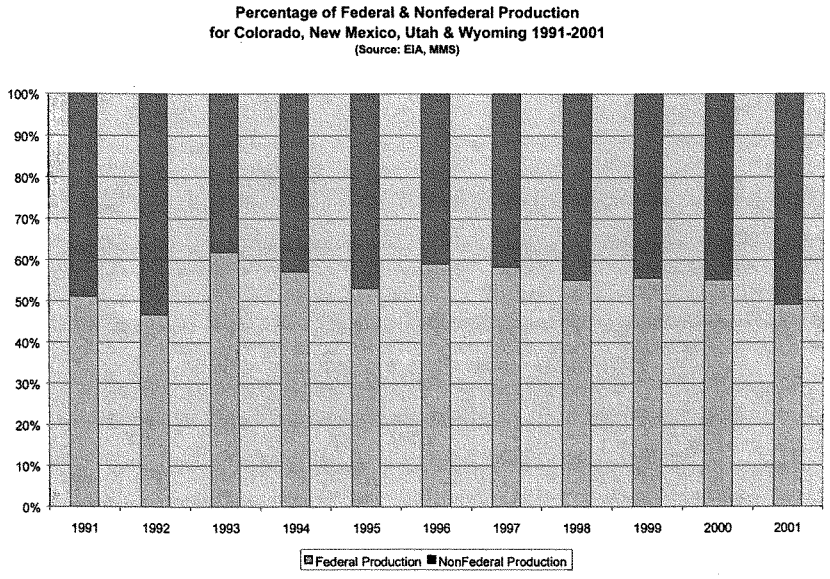
are good attempts to improve natural gas development on federal land, but there is still room to improve the efficiencies of permitting and interagency cooperation.

IPAMS believes that a fundamental change in approach may be required to ensure the timely development of federally-owned natural gas. The shift would move away from an "outcome neutral" approach to energy development, to one that is more "outcome specific" – meeting America's energy needs. This approach would incorporate business principles in the management of federally owned minerals. And like a business, the BLM would be required to develop a plan with specific goals and objectives and strategies for meeting them. Working with industry and other governmental agencies, the BLM could reverse engineer an efficient organization and workflow process that is capable of meeting the current and predicted demand. This process would recognize the importance of thorough yet timely environmental analysis and protection of other valuable resources on public land. But, it would also respond quickly and efficiently to market signals, constantly adapting, as a business must.

In conclusion, we believe it critical for Congress to address the current impediments to developing natural gas on federal land. Independent natural gas producers are committed to helping provide solutions to the nation's growing energy needs. But it is a shared responsibility of government and industry to work in partnership to improve the processes that will allow more energy to be produced for the benefit of consumers, businesses and the economy.

Mr. Chairman and members of the Committee, thank you for allowing me to testify before you today. I am happy to answer any questions you may have.

Chart 1.


Percentage of Federal & Nonfederal Production
for Colorado, New Mexico, Utah & Wyoming 1991-2001
(Source: EIA, MMS)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
Federal Production
NonFederal Production

TESTIMONY OF WILLIAM R. PRINDLE
Deputy Director
American Council for an Energy-Efficient Economy (ACEEE)
before the
JOINT ECONOMIC COMMITTEE
October 7, 2004

Summary

ACEEE research shows that energy efficiency is the most viable near-term strategy for moderating natural gas prices, and is also vital to stabilizing longer-term gas markets. Our testimony first discusses the roots of the current situation, assesses the potential impact of energy efficiency on wholesale natural gas prices, and points out the limits of supply-side solutions. It then focuses on ACEEE's recent analysis, which shows that if we can reduce gas demand by as little as 4% over the next five years, we can reduce wholesale natural gas prices more than 20%. These savings would put over $100 billion back into the U.S. economy, at a cost of $30 billion in new investment, of which $7 billion would be public funds.

Moreover, this investment would help bring back U.S. manufacturing jobs that have been lost to high gas prices, and would help relieve the crushing burden of natural gas costs experienced by many lower-income households. In addition, the efficiency investments generated by this policy scenario would create two to five times as many jobs as a comparable level of investment in energy supply options. Interestingly, most of the gas savings in our analysis come from electricity efficiency measures, because so much electricity is generated by natural gas, often inefficiently.

Federal and state governments current spend over $2.5 billion annually on energy efficiency, in research, development, deployment, and other programs. The 5-year, $7 billion public investment we recommend would average $1.4 billion annually, and would represent a 56% increase in public commitment to efficiency. Given the benefits—a 20%-plus drop in natural gas prices, more than $100 billion in direct economic benefits, and thousands of new jobs, an aggressive federal and state energy efficiency and conservation effort over the next five years is perhaps the best investment we could make in the American economy.

ACEEE's recommendations for near term action include:

1. **Increase funding for efficiency deployment programs.** We recommend Congress increase FY 2005 appropriations for federal programs that deliver energy savings to consumers, including the Energy Star programs, the Weatherization program, and DOE's suite of other deployment programs, and that the Administration follow suit in its FY 2006 budget request.
2. **Expand public benefits funds for efficiency.** 18 states collectively spend over $1 Billion on public benefits efficiency programs funded through utility bill fees. Other

states, and Congress, should follow this example, and states with current programs should increase funding levels.

3. **Create tax incentives for high-efficiency technologies.** Congress should pass incentives for energy efficiency technologies immediately, using the FSC-ETI tax bill or other mechanisms.
4. **Conduct a national efficiency and conservation campaign.** DOE should lead a partnership effort among efficiency manufacturers, farm organizations, utilities, states, and others to accelerate efficiency practices and investments and encourage short-term behavior modifications.

Recommendations for longer-term action include:

1. **Accelerate federal efficiency standards.** DOE should accelerate its standards rulemakings for residential heating equipment and commercial air conditioning equipment, and should take current gas price trends and supply issues into account in setting these standards.
2. **Support Advanced Building Codes.** States should act aggressively to adopt and upgrade building energy codes, and DOE should both push for more aggressive codes at the national level and should provide more assistance to states for code implementation.
3. **Expand research and development.** DOE budgets for advanced technologies that save electricity and gas in the residential, commercial, industrial, agricultural and power sectors should be increased.
4. **Create efficiency performance standards for utilities.** Congress and the states should follow Texas' example and require utilities to offset a portion of demand growth through energy efficiency.
5. **Expand support for Combined Heat and Power (CHP).** Congress should expand support for CHP (also know as cogeneration) by improving proposed CHP tax credits, and by encouraging states and utilities to provide fair and reasonable interconnection and tariff treatment for new CHP systems.

Introduction

ACEEE appreciates the opportunity to provide our comments to the Committee on the important subject of energy efficiency as a response to the severe problems in U.S. natural gas markets. Our analysis shows that energy efficiency and conservation efforts are the most effective response to these challenges over the next few years, and also offer longer-term insurance against future gas price spikes and shortages.

ACEEE is a non-profit organization dedicated to increasing energy efficiency as a means for both promoting economic prosperity and environmental protection. We were founded in 1980 and have developed a national reputation for leadership in energy efficiency policy analysis, research and education. We have contributed in many ways to congressional energy legislation adopted during the past 20 years, including the current energy bills, the Energy Policy Act of 1992, the National Appliance Energy Conservation Act of 1987, and the Energy Title of the 2002 Farm Bill. We are also an important source

of information for the press and the public on energy efficient technology, policies, and programs.

The Current Natural Gas Problem

Senior officials, including Chairman Greenspan and Secretary Abraham, have repeatedly stated that natural gas price and supply problems are significant enough to warrant serious federal response in the near term. As Chairman Greenspan said in Energy and Commerce Committee testimony last year, gas prices have shut down some industrial production, costing many thousands of U.S. jobs and threatening the economic recovery, particularly among gas-intensive industries such as metals, glass and chemicals. The fertilizer industry has been hit particularly hard, with more than 20% of U.S. fertilizer manufacturing capacity shut down by high gas prices. Fertilizer prices have risen sharply, hurting the farm economy. While these sectors have felt the wrath of runaway gas markets most acutely, economists agree that the overall economy needs lower energy prices to get fully on track. The Wall Street Journal's August 2004 survey of economists indicated that the best way to restore economic growth to desired levels is to reduce energy prices.

Gas prices are not only historically high, they have been quite volatile, meaning that the rapid swings in prices we have seen since 2000 are likely to continue. Volatility is almost as much a threat to economic growth as high prices, because it makes it difficult for investors to plan rationally, either for exploration and development of new supplies, or for energy efficiency investments. It was expected that the sophisticated risk-management and trading techniques pioneered by companies like Enron would provide a price-stabilizing effect in energy markets. However, the demise of Enron and other traders has left gas markets without many of the hedging options that might moderate price swings.

Natural gas is proving to be a prisoner of its own success: increasing demands for this relatively low-emission, low-cost fuel over the past 15 years has outrun the North American supply system. As a result of these tight markets, we are experiencing prices that are both high and volatile. Indications are that new resources in North America will have a limited impact on this situation, especially in the near term, and that policy actions on the demand side are the most effective near-term measures to bring gas markets back into balance.

Natural gas markets have been largely deregulated since the 1970s, when federal price regulation limited supply investments, shortages appeared in many markets, and new gas connections were embargoed by many gas utilities. Since the late 1980s, natural gas has become more widely available, and more popular as an environmentally-preferred, relatively inexpensive fuel.

Electric power generation continues to be the fastest-growing demand sector for gas. (See Figure 1.) While industrial demand remains the largest consuming sector, its gas use has

declined somewhat from peak levels in the late 1990s. Commercial and residential natural gas demand continues to be strong. However, the power sector has been the dominant factor in driving gas demand recently, as gas is increasingly preferred for environmental and other reasons. (See Figure 2.) Gas is increasingly the dominant fuel used in peak-period generation: gas combustion turbines are relatively inexpensive to install and can be brought on line quickly.

However, these "peaker" turbines are also among the least efficient generation technologies, with thermal efficiencies between 12% and 20%. Today's combined-cycle gas power plants can perform at close to 50% efficiency, and combined heat and power (CHP) technology provides efficiencies approaching 80%. The overall U.S. electric generation has an average thermal efficiency of about 33%; so gas peaking generation is about half as efficient as average generators, and wastes more than three times the energy as today's best generation technologies.

The disproportionate use of natural gas for peak generation, combined with the low efficiency of peaking units, shows that saving electricity, especially at peak times, is a key to freeing up natural gas for other uses. In this way, pursuing electric energy efficiency in peak demand periods is a powerful tool for saving natural gas.

The long-term prospects for significant expansions in U.S. gas production are limited. The exploration and production of natural gas and petroleum are historically linked. U.S. oil production peaked in 1970, and has declined since. Oil imports have steadily grown to make up the difference. U.S. natural gas dry production peaked in 1973, and in 2002 was 13% below that peak. Most low-cost fields have been drilled; recovery of additional gas from existing and new fields will come at a premium price. The average depletion rate for newly-opened natural gas fields in the continental U.S. is approaching 30%[1]. This means that the gas industry must work harder each year just to offset depletion, let alone increase net production.

Imports, mostly from Canada, have helped fill the supply gap in the past years, but Canada's growing domestic consumption and declines in production have resulted in a significant reduction exports. Liquefied natural gas (LNG) imports have dramatically in the last few years as the gas industry reactivated the full capacity of our four existing LNG terminals. LNG bears a premium price, and our ability to increase imports will be dependent upon building new terminals or expanding capacity at existing facilities – a costly and time consuming endeavor. If we rely on LNG as the marginal source for gas, it will also tie U.S. gas markets to a permanent higher cost baseline.

U.S. gas production and delivery can be increased on the margin in the medium term through industry investments and policy measures. However, these efforts will not ultimately reverse the long-term decline in U.S. gas production. Imports may provide limited additional supply, but as LNG they will come at a price premium and also bear safety and homeland security risks. Most of these new supply initiatives are likely to

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1 National Petroleum Council. 2003. *Balancing Natural Gas Policy: Fueling the Demands of a Growing Economy.* Washington, DC. Volume 1, page 30.

come at a price premium, so most industry forecasts are for higher prices into the foreseeable future.

Given the limitations and cost premiums associated with natural gas supply options, Congress must consider options to manage demand as part of a balanced energy policy. Energy efficiency and conservation are proven resources for moderating energy demand, and are also the most effective tools to apply in the near term to bring balance to gas markets. By combining aggressive demand management with prudent supply development, we can stabilize natural gas markets and husband this strategic fuel to support America's economic growth and environmental protection.

Energy Efficiency as a Vital National Resource

Energy efficiency is a quiet but effective energy resource, contributing substantially to our nation's economic growth and increased standard of living over the past 30 years. Energy efficiency improvements since 1973 accounted for approximately 25 quadrillion Btu's in 2002, which is about 26% of U.S. energy use and more energy than we now get annually from coal, natural gas, or domestic oil sources. Consider these facts which are based primarily on data published by the federal Energy Information Administration (EIA):

- Total primary energy use per capita in the United States in 2002 was almost identical to that in 1973. Over the same 29-year period, economic output (GDP) per capita increased 74 percent.

- National energy intensity (energy use per unit of GDP) fell 43 percent between 1973 and 2001. About 60% of this decline is attributable to real energy efficiency improvements and about 40% is due to structural changes in the economy and fuel switching.[2]

- If the United States had not dramatically reduced its energy intensity over the past 29 years, consumers and businesses would have spent at least $430 billion more on energy purchases in 2002.

- Between 1996 and 2002, GDP increased 21 percent while primary energy use increased just 2 percent. Imagine how much worse our energy problems would be today if energy use had increased 10 or 20 percent during 1996-2002.

Energy Efficiency's Resource Potential

Even though the United States is much more energy-efficient today than it was 25 years ago, there is still enormous potential for additional cost-effective energy savings. Some

[2] Murtishaw and Schipper, 2001, *Untangling Recent Trends in U.S. Energy Use*. Washington, D.C.: U.S. Environmental Protection Agency.

newer energy efficiency measures have barely begun to be adopted. Other efficiency measures will be developed and commercialized in coming years, with proper support:

- The Department of Energy's national laboratories estimate that increasing energy efficiency throughout the economy could cut national energy use by 10 percent or more in 2010 and about 20 percent in 2020, with net economic benefits for consumers and businesses.[3]

- ACEEE, in our *Smart Energy Policies* report, estimates that adopting a comprehensive set of policies for advancing energy efficiency could lower national energy use from EIA projections by as much as 11 percent in 2010 and 26 percent in 2020.[4]

- The opportunity for saving energy is also illustrated by experience in California in 2001. Prior to 2001 California was already one of the most-efficient states in terms of energy use per unit gross state product (ranking 5th in 1997 out of 50 states[5]). But in response to pressing electricity problems, California homeowners and businesses reduced energy use by 6.7% in summer 2001 relative to the year before (after adjusting for economic growth and weather)[6], with savings costing an average of 3 cents per kWh,[7] far less than the typical retail or even wholesale price of electricity.

- A recent ACEEE analysis of efficiency potential studies shows that cost-effective technologies could save a median 24% of electricity use and 9% of gas use nationwide.[8] While the efficiency potential number for gas seems low, there has been relatively little analysis of gas efficiency potential. Moreover, other ACEEE analysis shows that the greatest source of natural gas savings is indirect; it comes through reducing electricity use, which then displaces gas consumed in power generation.

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[3] Interlaboratory Working Group, 2000, *Scenarios for a Clean Energy Future*. Washington, D.C.: Interlaboratory Working Group on Energy-Efficient and Clean-Energy Technologies, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy.

[4] Nadel and Geller, 2001, *Smart Energy Policies: Saving Money and Reducing Pollutant Emissions through Greater Energy Efficiency*, www.aceee.org/energy/reports.htm. Washington, DC: American Council for an Energy-Efficient Economy.

[5] Geller and Kubo, 2000, *National and State Energy Use and Carbon Emissions Trends*. Washington, DC: American Council for an Energy-Efficient Economy.

[6] California Energy Commission, 2001, *Emergency Conservation and Supply Response 2001*. Report P700-01-005F. Sacramento, CA.

[7] Global Energy Partners, 2003, *California Summary Study of 2001 Energy Efficiency Programs, Final Report*. Lafayette, CA.

[8] Nadel, et al. 2004. "The Technical, Economic, and Achievable Potential for Energy Efficiency in the United States: A Meta-Analysis of Recent Studies". In *Proceedings of the ACEEE Summer Study on Energy Efficiency in Buildings*. American Council for an Energy-Efficient Economy, Washington, DC.

Energy Efficiency Potential for Natural Gas

ACEEE has conducted years of research on the energy efficiency potential in a wide range of technologies and end-use sectors. We have a research effort underway to refine energy efficiency potential estimates specifically for natural gas. On a preliminary basis, we identified a number of cost-effective efficiency measures that would collectively save more than 10% of U.S. gas usage by 2020. A sample of these measures is shown in Table 1. It is important to note that these savings are only direct gas end-use savings; indirect savings, which reduce gas used in power generation by saving end-use electricity, greatly expand the potential for gas energy efficiency.

Table 1
A Sample of Natural Gas Energy Efficiency Measures

Measure	Current Efficiency	Efficiency Target	Units for Efficiency Target	Potential Gas Savings In 2020 (TBtu)	Average Cost of Saved Energy ($/therm)*
1 Ind'l management practices	Typ. plant	8%	savings	402	0.351
2 Comm'l building retrocommissioning	149	134	kBtu/sf	362	0.229
3 Res duct sealing & infiltration reduction	Avg. home	20%	H&C svgs	310	0.450
4 Residential windows	.64/.65	.33/.44	U-Factor/ SHGC	233	0.154
5 Commercial furnaces and boilers	standard units	Power burner	savings	181	0.082
6 New homes	Avg. home	30%	H&C svgs	178	0.401
7 Res. furnaces/boilers (equip. & install.)	82%	90%+	AFUE+	162	0.479
8 Sector-based comm retrofit (e.g. offices)	0.5	0.4	therms/sf	162	0.361
9 Advanced commercial glazing	1.3/.69	.45/.45	U/SHGC	145	0.301
10 Comm'l new construction	90.1-1999	30%	savings	140	0.322
11 Res. combo gas space & water htg unit	82/59	90/90	AFUE/EF	85	0.543
12 Comm'l cooking and ventilation	typ equip	improved		76	0.300
13 Major residential appliances	Federal Standards	21%	savings	53	-0.859
14 Res. gas water htg (stand-alone units)	0.59	0.62	Energy Factor	52	0.370
15 Bldg. operator training & certification	Typ O&M	Better		51	0.063
			TOTAL	2,590	

* Note: Cost of Saved Energy is the cost of a measure per unit of unit of fuel saved. Measures costing less than retail gas prices (currently averaging $0.83/therm for residential customers) are cost-effective. A negative cost of saved energy means that savings in non-energy costs can fully pay for the measure.

Source: Nadel, Steven, 2002, *Screening Market Transformation Opportunities: Lessons from the Last Decade, Promising Targets for the Next Decade*, Washington, DC: American Council for an Energy-Efficient Economy available online at http://aceee.org/pubs/u022full.pdf.

Energy Efficiency's Effect on Wholesale Natural Gas Prices

In 2003, we conducted an analysis of the effect energy efficiency and renewable energy could have on natural gas wholesale prices. In the tight markets we are experiencing, small changes in demand or supply have large impacts on price. To test this market

principle, we used one of the best available computer model of U.S. gas markets, designed and operated by Energy and Environmental Analysis, the consulting firm who used the same model to support the National Petroleum Council (NPC)'s 2003 natural gas study. We tested the wholesale prices impact of small (2-4%) changes in natural gas demand over the next 1-5 years. The next five years contain large risks for the American economy if gas prices do not stabilize (see Figure 3), and energy efficiency is the most widely available resource in that timeframe, as most new gas supply options will take six or more years to bring on line.

What we found was that moderate gains in end-use efficiency over the next five years can reduce wholesale gas prices by about 20%, or about $1 per thousand cubic feet (see Figure 4). This would bring substantial price relief to all gas consumers, particularly farmers and manufacturers. Achieving these results would cost about $30 billion in new investment, including about $7 billion in public expenditures, but would generate over $100 billion in direct economic benefits, including direct energy savings to customers who invest in efficiency and lower gas prices to all energy users. The ratio of benefits to costs would be more than three to one.[9]

Our findings are quite consistent with those of the National Petroleum Council study. The NPC report calls for energy efficiency to offset about 4% of demand growth by 2010, and about 19% by 2025. [10] It also estimates that 2010 wholesale prices would fall by about 20% under its Balanced Future policy scenario. [11] Our analysis simply took a more detailed look at a specific efficiency investment scenario, using the same analytical approach and tools.

A major finding of our study, which is not apparent in the NPC report, was that the majority of the natural gas savings came indirectly, through investments in electricity efficiency. This effect stems from the fact that natural gas has become the marginal generating fuel in many power markets, so that electricity savings tend to displace gas used for generation more than any other fuel. Also, because the average efficiency of natural gas generation remains low, especially at peak times, saving one unit of electricity backs out several units of gas at the generator. Thus saving electricity is the key to saving natural gas, and adding electricity-saving measures to the list in Table 1 would greatly expand the potential for gas demand reduction.

Efficiency and Gas Prices: A 2004 Update

We are currently updating our 2003 analysis in light of the even-tighter markets we are now experiencing, anticipating that the price effects of reduced demand from efficiency and renewable energy may be even greater. As we anticipated, our initial results show that expanded energy efficiency and renewable energy implemented nationally will reduce wholesale natural gas prices at the benchmark Henry Hub by 26% in 2010.

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[9] Elliott et al. 2003. *Natural Gas Price Effects of Energy Efficiency and Renewable Energy Practices and Policies.* American Council for an Energy-Efficient Economy, Washington, DC.
[10] National Petroleum Council. 2003. Op. cit., Vo. 1, page 8, Figure 3.
[11] Ibid., page 11, Figure 6.

We also analyzed a scenario based on natural gas and electric end-use efficiency investment in eight Midwestern states (IA, IL, IN, MI, MN, MO, OH, and WI). Gas prices for power generators in the region have tripled since 1999, while industrial rates jumped 64% and residential/commercial rates increased by 44%. These price increases translate into an increase in natural gas expenditures of almost $350 per household in the Midwest.

Realizing these efficiency gains in the Midwest would benefit both the region and the nation as a whole. Our analysis shows a national reduction in natural gas prices of 2% in the first year and 6 % in 2010; this would benefit all U.S. gas users. Within the Midwest region, natural gas bill savings to residential, commercial, and industrial consumers would exceed $4.14 Billion from an investment of about $1.12 Billion over five years. Energy efficiency investments could reduce residential gas bills by over 3% in the first year alone, savings the average Midwest household $36 in the first year. These savings will continue into the future, averaging $86 per year per residential natural gas customer.

The bottom line of our 2004 update is that with gas markets becoming tighter this year, as the economy grows and as high oil prices induce some industrial users to switch back to gas, a near-term strategy to invest in energy efficiency holds even greater potential to benefit the economy

Economic Impacts of Investments in Natural Gas Savings

Our analysis shows that a new public commitment to energy efficiency investment, on the order of $7 billion over 5 years, would generate $23 billion in private investment and create over $100 billion in economic benefits. These benefits would appear in the form of natural gas and electric bill reductions to consumers who invest in efficiency, price reductions to all natural gas users, and price reductions to electric utilities. We have not accounted for the non-energy benefits of energy-efficient technology, which can include increased productivity and improved quality. Moreover, we have not modeled the indirect economic impacts of increased sales and services related to energy efficiency investments, nor the induced effects of consumer spending of reduced energy bills on other goods and services. These effects would substantially increase the economic benefits of energy efficiency investment.

The combined benefits of energy efficiency and lower natural gas prices would be especially helpful to two consumer groups: lower-income households and gas-intensive industries. High energy prices are generally very regressive, as lower-income households spend a much higher percentage of total income, and of housing costs, on energy. Households that are able to obtain below-market housing may initially believe that they have found affordable housing, but a series of high gas heating bills can change that perception. Non-payment can lead to gas service disconnection, which can lead to health problems from under-heated homes, safety problems from improvised heating devices, and homelessness. Federal programs, such as the Low Income Home Energy Assistance Program (LIHEAP) and Weatherization Assistance Program (WAP), can help offset the

impacts of high energy prices, but these programs are under-funded, particularly in this current high energy price environment. Indications are that last winter's LIHEAP allocations were used up well before the winter was over. An energy efficiency scenario that emphasized low-income programs would make LIHEAP dollars go much further.

Gas-intensive industries have a very different but nonetheless vital set of concerns regarding natural gas prices. Leaders of the chemical industry wrote to the President and leaders of Congress at the beginning of 2004, urging major new policy action to balance natural gas markets.[12] This letter pointed out that natural gas has imposed more than $100 billion in an effective "tax" on the economy since 2000, and that many thousands of industry jobs have been lost as a result. Since many of these companies, being unusually attuned to gas prices, have already implemented many energy efficiency and other measures, their ability to control gas costs internally is very limited. They depend on the broader efficiency policy scenario we describe to bring relief to their businesses. If we can achieve the price reductions our analysis shows is possible, we can reduce costs in these vital industries, bring back some good manufacturing jobs to the U.S., and support the overall economic recovery.

In this context, we suggest that the energy efficiency policy scenario we describe should be viewed as an economic stimulus, analogous to a tax cut. Our analysis shows that an efficiency policy commitment could generate a "tax cut" of similar magnitude. Moreover, the efficiency scenario provides economic benefits at a very low public cost. Our analysis shows that the $100 billion-plus in benefits from efficiency requires a public outlay on the order of $7 billion, achieving very high leverage ratio.

Energy efficiency investments not only provide substantial economic benefits at low levels of public expenditure, they also compete very effectively in terms of net employment and GDP impacts in comparison to other energy resource investments. A key fundamental economic reality in this regard is that energy efficiency investments create more jobs per dollar invested than do energy supply investments. For example, sectoral employment multipliers differ greatly between sectors. Energy supply sectors, including mining, refining, and utilities, create 5 to 10 jobs per million dollars of expenditure. Sectors affected by efficiency investments, including services, construction, and retail trade, create 19 to 25 jobs per million dollars of expenditure.[13] This means that energy efficiency investments can create two to five times as many jobs as supply-side investments. While both supply and demand-side investments will be needed to achieve and sustain balanced natural gas markets, we submit that energy efficiency investments provide a stronger job-creation stimulus.

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[12] Letter from 11 chemical industry CEOs to President Bush and leaders of Congress, January 20, 2004
[13] 2001 IMPLAN database for the United States, per MRG Associates 2004.

Barriers to Free-Market Solutions to the Natural Gas Problem

A free-market advocate might argue that high natural gas prices contain their own remedy, since by economic theory price elasticity would cause demand to fall when prices rise. This argument contains a fundamental element of truth, and ACEEE believes in markets as a key focus for energy efficiency solutions. However, several factors in today's U.S. markets keep the laws of economics from being applied in their purest form:

- **Falling energy intensity.** Over the last 30 years, U.S. energy intensity (measured in BTU per dollar of GDP) has fallen by more than 40%. While this is generally good news for the economy, it also has the effect of blunting the market-based response to high energy prices. When energy costs less as a percentage of the total cost of running a business, owning a home, or driving a car, consumers typically are less sensitive to price increases. This means it takes larger and larger price increases to induce a given level of change in energy demand. The implication is that relying solely on market response to price signals would require energy prices to rise to economically damaging levels before the market corrects itself. We should not, and need not have to incur such economic damage—judicious energy policy action can forestall needlessly high natural gas prices.
- **Income elasticity of demand.** Indications are that rising incomes in many demographic segments tends to increase demand for energy services. Households that can afford half-million dollar homes and $50,000 vehicles are relatively insensitive to energy costs. The falling-intensity effect compounds this phenomenon; more-efficient homes and vehicles shrink the cost of energy as a percentage of income, as well as a percentage of the cost of driving or homeownership
- **Current policies promote increased use of natural gas.** Environmental policies aimed at reducing air pollutant and greenhouse gas emissions have made natural the fuel of choice for power generation and industrial use in many areas. This tends to override fuel price considerations.
- **Lack of Price Transparency.** Price signals work only when customers receive clear, consistent, and timely price information. In today's gas markets, it is very difficult to understand prices in ways that encourage efficiency investments. Several issues stem from this point:
  - Contract structures, in which many utilities and customers purchase gas in annual or multi-year contracts, can delay the "bad news" of price increases, such that motivations for efficiency investment are delayed.
  - Price volatility not only confuses customers on predicting future prices, it also reduces investors' willingness to take risks on efficiency or on supply investments.
  - Most customers see prices only retrospectively, after they receive bills for past consumption. And with today's complex bills, calculating the full price per unit of energy and normalizing it for weather or other factors, takes a level of analytical ability beyond most customers.

These factors are currently insulating many consumers from the pending gas crisis. But they must not mislead Congress into waiting to take action on this problem. If we wait until most customers feel the full effect of today's gas prices, the ensuing crisis could be much worse than if we act now to take prudent steps that will help keep markets in balance. Market forces will ultimately drive gas demand down, but the question is how soon and at what cost to our economy.

In addition to these broad barriers to efficiency investment, a variety of more specific market barriers to energy efficiency keep worthwhile investments and behavior changes from being made, even when prices rise. These barriers are many-fold and include: "split incentives" (landlords and builders often don't make efficiency investments because the benefits of lower energy bills are received by tenants and homebuyers); panic purchases (when a product such as a water heater needs replacement, there often isn't time to research energy-saving options); and bundling of energy-saving features with high-cost extra "bells and whistles."

Energy efficiency is also hobbled by being a "distributed resource". It is found in more than 100 million homes, over 5 million commercial buildings, and hundreds of thousands of factories. In most homes and smaller businesses, the information and technical skills needed to understand and pursue energy efficiency projects are not available. Moreover, the transaction costs of developing, financing and implementing a multitude of small projects are much higher than for a relatively few, large energy supply projects. This tends to shift investment capital toward the larger projects, even when studies show that the efficiency resource is more cost-effective.

For these reasons, policy and program initiatives are needed to realize the benefits of energy efficiency for the economy and the environment as a whole.

Recommended Near-Term Steps

ACEEE recommends the following near-term actions for Congress and the Administration to respond to the looming threat of natural gas prices.

1. **Increase funding for efficiency deployment programs.** We recommend Congress increase FY 2005 appropriations for federal programs that deliver energy savings to consumers, including the Energy Star programs, the Weatherization program, and DOE's suite of other deployment programs, and that the Administration follow suit in its FY 2006 budget request. These programs have been shown to be effective in the limited geographic areas, and at the limited funding levels in which they have operated. With added funding, they can quickly ramp up energy savings in the next few years.

2. **Expand public benefits funds for efficiency.** 18 states collectively spend over $1 Billion on public benefits efficiency programs funded through utility bill fees. Other states, and Congress, should follow this example, and states with current programs should increase funding levels. Most states operating such programs coordinate their

efforts with federal programs like Energy Star; this partnership should be continued and expanded, so that the benefits can be felt in more states.

3. **Create tax incentives for high-efficiency technologies.** Congress should pass incentives for energy efficiency technologies immediately, using the FSC-ETI tax bill or other mechanisms. A suite of efficiency incentives have been part of the energy bill for the last few years; since the overall bill is stalled, however, it is important to pass these key provisions separately, because they can create an economic stimulus beginning next year.

4. **Conduct a national efficiency and conservation campaign.** DOE should lead a partnership effort among efficiency manufacturers, farm organizations, utilities, states, and others to accelerate efficiency investments and encourage short-term behavior modifications. California spent about $30 million in 2001 on a concerted public awareness campaign; evaluations indicate that this campaign was responsible for about one-third of the energy savings realized in that year.

These initiatives can make a difference in the next five years, which will be critical in avoiding crippling gas market problems. Otherwise, U.S. economic growth will remain at risk.

Recommended Longer-Term Steps

Looking three years and beyond, ACEEE recommends the following actions:

1. **Accelerate federal efficiency standards.** The Department of Energy's appliance efficiency standards program currently has a rulemaking underway for residential heating equipment. DOE should accelerate this rule, allowing cold-weather states to elect a higher standard level, and including furnace fan efficiency in the standard. DOE should take higher gas prices into account in setting the final rule. DOE should also accelerate its commercial air conditioning standard rulemaking, as commercial cooling is served mainly by inefficient gas-fired peaking turbines.

2. **Support Advanced Building Codes.** Building codes are an important element in the efficient policy portfolio, insuring that buildings built today place minimum strain on tomorrow's energy supplies and put minimum pressure on market prices. The International Energy Conservation Code (IECC) is widely adopted in states, but many states need to update their codes. DOE should both push for more aggressive model codes like the IECC, and provide more support to states and local governments in implementing better codes.

3. **Expand research and development.** Congress should increase funding for advanced technologies that save natural gas in: buildings through advanced heating, cooling, and hot water systems, advanced envelope designs, and control systems; in industry through CHP, advanced manufacturing processes, motors and other

components; and in power generation through CHP and other advanced generation technologies, plus efficient transmission and distribution technologies.

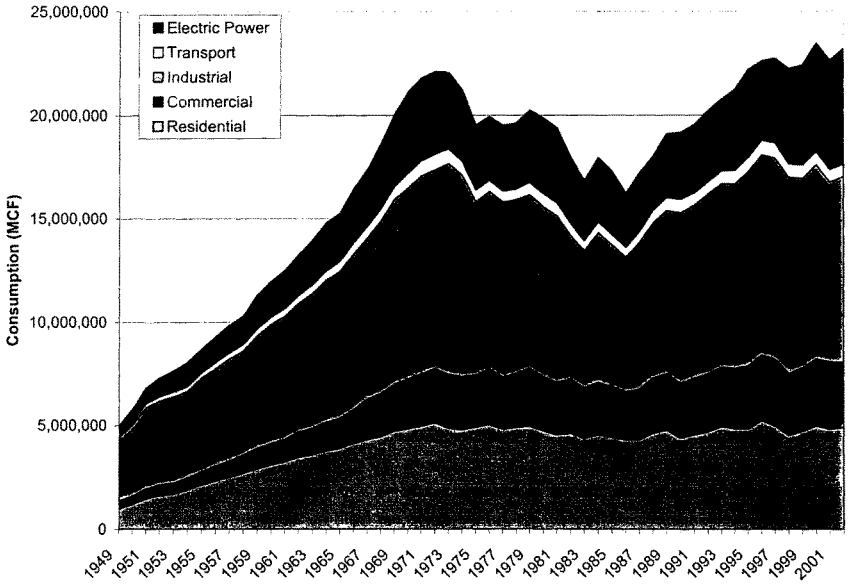
4. **Create efficiency performance standards for utilities.** Texas' electricity restructuring law created a requirement for electric utilities to offset 10% of their demand growth through energy efficiency, and enabled them to use public benefits funds for this purpose. Bills along these same lines have been introduced in Colorado and Washington, and have been discussed in Congress. This kind of performance standard also can be applied to natural gas utilities.

5. **Expand support for Combined Heat and Power (CHP).** CHP generates electricity far more efficiently than the majority of the conventional natural gas generation. Congress should expand its support for CHP by passing the proposed CHP tax credit now under consideration as part of the package of energy efficiency and renewable tax credits. The Congress should also include language in the energy bill that encourages states and utilities to provide fair and reasonable interconnection and tariff treatment for new CHP systems.

ACEEE's experience with these programs and policies gives us confidence that they can make a critical difference in bringing balance to natural price prices and supplies in the coming years. We look forward to working with the Committee on these important issues.

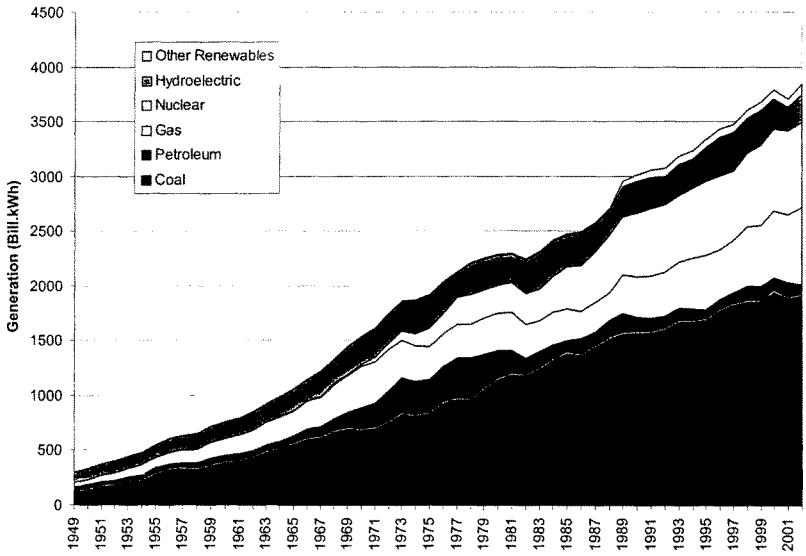
Thank you for the opportunity to share our views with the Subcommittee.

Figure 1
Natural Gas Demand By End-Use Sector



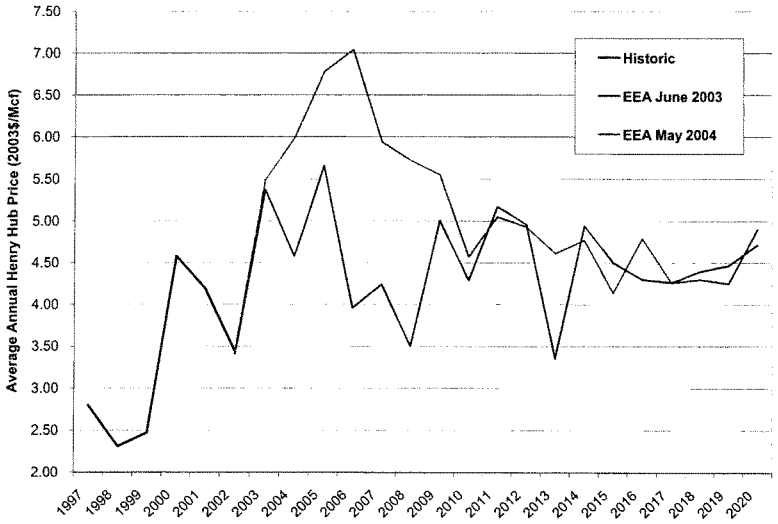
Source: ACEEE staff analysis based on Energy Information Administration data

Figure 2
Fuel Sources for Electricity Generation



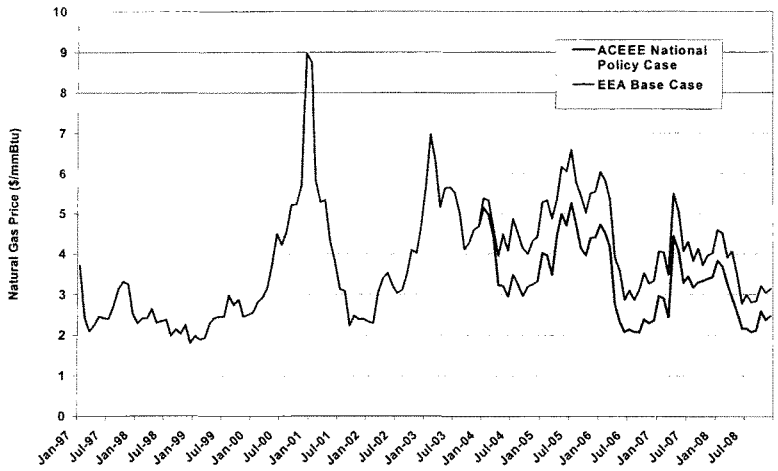
Source: ACEEE staff analysis based on Energy Information Administration data

Figure 3. Natural Gas Price Forecast (Henry Hub)



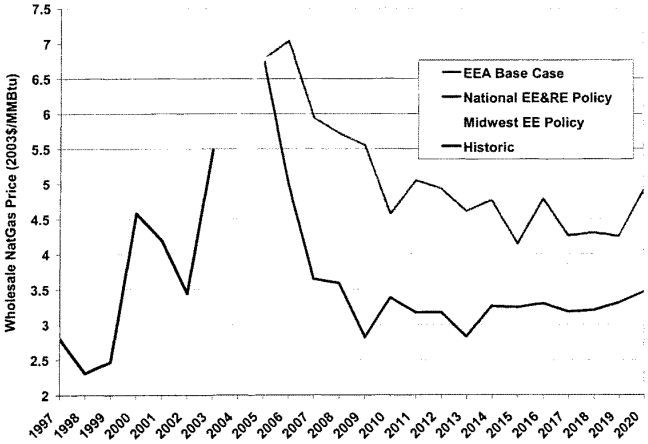
Source: ACEEE Staff analysis based on EEA gas price forecasts

Figure 4. Impacts of Efficiency and Renewables Investments on Wholesale Natural Gas Price (Henry Hub) Relative to the EEA 2003 Forecast



Source: Elliot, et al. 2003. *Natural Gas Price Effects of Energy Efficiency and Renewable Energy Practices and Policies.* American Council for an Energy-Efficient Economy, Washington, DC.

Figure 5. Impact of Midwest and National Scenarios on Wholesale Natural Gas Prices (Henry Hub) Relative to 2004 EEA Forecast



Source: Forthcoming ACEEE Analysis, 2004.