THE BROOKINGS INSTITUTION

# EVALUATING THE PROSPECTS FOR NATURAL GAS EXPORTS FROM THE UNITED STATES

Washington, D.C.

Tuesday, January 24, 2012

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P R O C E E D I N G S

MR. EBINGER: If we could get everyone seated we'll try to get underway, please. Good morning, ladies and gentlemen. Thank you for coming today.

I'm Charlie Ebinger, the director of the Energy Security Initiative here at Brookings, and since this past May of 2011 my team at ESI has been working on a yearlong study examining the feasibility and implications of increased exports of liquefied natural gas from the United States.

Today we launch our interim report which looks at the feasibility of natural gas exports. In other words, can we export natural gas physically and, as I'll mention shortly in the report, we will go into much greater detail of what the implications of that are.

The second half of the study, indeed, will look at the implications of exporting natural gas and together, the Brookings team hopes to answer the question, should we export increasing quantities of natural gas? And if we do, how best should we do it and in what volumes?

Today I will present to you the findings of the first half of our research. The full report can be found online on the Brookings website. Some of you may have already seen it. Also, we have hard copies of the presentation out front if for some reason, given this room's inability to see

from long distances, you can't see some of the slides on the monitors.

After a brief presentation, I will sit down with our three distinguished panelists. Jim Jensen -- and I will introduce them at that time -- president of Jensen Associates; Ken Medlock, a fellow in energy studies at the Baker Institute of Public Affairs in Houston; and Michael Ratner, the lead and natural gas analyst at the Congressional Research Service. After brief discussion we will open up to questions from the floor, and we welcome your participation.

I won't spend too much time delving into the past seven years of U.S. energy history and how we have arrived at the point where we are today. Needless to say it was unthinkable less than a decade ago that there would be a legitimate debate in Washington over the merits of exporting LNG in large quantities. Indeed, we thought we would be importing LNG in large quantities. The shale gas revolution has helped shape a new energy landscape both domestically and internationally that I think few people would have bet on not long ago when the United States was planning to import, as I mentioned, large volumes of LNG.

Today there are discussions about turning many of these proposed import facilities into export ones. This has drawn the ire of some consumers of natural gas, as well as some politicians who object both to exporting what they see as a valuable domestic resource and in the

manufacturing community concerns about the implications of exports on domestic natural gas and the cost of that gas for key feedstocks into manufacturing products.

Let me give you an overview of what we have tried to do during our study sessions. First, I will go briefly over our research methodology, or how we went about the research that went into this report. Then, I will go over the essentials covered in the interim report, looking at the various factors that have a bearing on the feasibility of exporting LNG.

These are separated into domestic supply, where do we get the gas from; domestic demand, who else wants the gas; international gas markets, where would we ship the gas; and, who would be other suppliers in the international market against whom we would have to compete? And finally, we look at economic and financial considerations on the U.S. economy and on select industries.

Central to our research was the assembly of a natural gas task force, 17 independent natural gas experts. This task force met on a regular basis to discuss major issues relating to natural gas supply, demand, the international gas market, all critical points in determining the feasibility of exports. The task force's insights and opinions were considered by the Brookings research team but were not the only factors

in our conclusions.

Along those lines, the task force itself did not nor was it required to -- this was an important point -- reach a consensus verdict on any issue. We also invited individual subject area experts to our sessions to present to the task force on specific topics where they had unusual expertise. For instance, we had electricity modelers present their views on the impact of EPA regulations on the coal sector and the coal sector's competition with natural gas. Finally, the report's authors conducted additional research and interviews in the policy community to arrive at our conclusions.

This study is divided into two parts. The first part looked exclusively at the feasibility of increasing LNG exports from the U.S. Can we export more LNG, and potentially in what volumes? The research in Part 1 is reflected in this interim report, and I want to reiterate this is an interim report that can be found, as I mentioned, on the Brookings website. The second part, in the early spring, will look at the implications of increased LNG exports and what policy approach the government should have regarding gas exports.

We broke down the feasibility of supply into three categories: domestic supply, domestic demand, and the international gas market. In other words, do we have enough gas to export? Who else would or could

otherwise consume the gas at home? And, are there markets for the gas abroad? Sufficient domestic supply for exports is dependent on a handful of major factors. The first of these is the availability of the physical resource.

As you can see from the map, the United States has an array of large shale gas deposits no news to this audience -- some of which remains un- or sparsely developed. The most important of these shale gas plains is the Marcellus Shale in the Northeastern part of the country. The EIA's estimate for Marcellus Shale gas is roughly half of the total technically-recoverable resources available in the entire country. Although a recent survey of the Marcellus by the U.S. Geological Survey has raised doubts over the extent of gas reserves, the issue will not be resolved until more details on the survey methodology are released and published.

Nevertheless, the estimates for shale gas in the United States are large and very wide, as you can see from the chart above you. It is safe to say that under the current policy and regulatory framework the U.S. has significant reserves of natural gas, perhaps 100 years, perhaps even more.

The second supply consideration of note is the sustainability of production. Regarding production sustainability, we found that there

are two primary points of potential concern. The first has to do with the availability of a skilled workforce. The National Petroleum Council has highlighted in a number of reports in recent years the aging of the existing stock of qualified, capable petroleum engineers. This is made clear in this chart, where the largest age demographic of petroleum engineers from 1997 to 2010 has aged by 10 years with fewer younger engineers today than previously. A rapid build-out of production will require a qualified workforce to oversee that production. It is possible that the employment trend could be reversing, however. Since 2005, for example, the number of enrolled petroleum engineering students has roughly tripled, a good sign for the future of the industry.

The second issue is the availability of drilling infrastructure. Since the collapse in natural gas prices in late 2008, the number of rigs allocated to gas production plummeted. However, while the oil rig count has rebounded in recent years in concert with the rising price of oil, natural gas prices and, therefore, rig counts have remained low, seeing only modest growth from their trough in 2009.

Some analysts have expressed concern that sustained low natural gas prices and high oil prices will yield a mass diversion of rigs away from gas production and, therefore, have a negative impact on supply. We found this concern -- and I want to emphasize this -- to be

vastly overblown, as technological developments have prevented the sudden drop in supply. We will discuss these improvements in drilling technologies in a moment.

Domestic supply will also depend heavily, obviously, on the environmental and regulatory landscape for shale gas production. The first and most prevalent issue surrounding the environmental impact of shale gas production has to do with water usage. Not only is water a key ingredient in shale gas production, where large volumes of water are required, but the fear of water contamination, whether legitimate or not, is an inescapable reality of hydraulic fracturing, or fracking. For starters, there is the fear that fracking can result in methane leakages that contaminate underground aquifers. Energy companies contend that because the fracking operations occur thousands of feet below aquifers, that the process is safe. The main concern has to do with the treatment of waste water that emerges as a byproduct of the fracking process.

While in some regions, such as Texas, geological structures allow waste water to be injected into underground caverns without fear of contamination, in other areas such as Pennsylvania the geology is less forgiving. In these areas, the rapid increase in shale gas production has yielded a significant increase in waste water requiring treatment. In some cases, regulators and water treatment facilities found it difficult to keep up

with production and water was disposed of improperly. Although, after examining the evidence we think usually by fly-by-night operators, not by the more established companies. Maintaining high standards for water treatment, recycling, and/or disposal will allow for shale gas to continue without bans or moratoria.

There have been other environmental concerns regarding shale development, this time in the realm of shale oil. In shale oil-rich places -- this is the Bakken in North Dakota or the Niobrara in Colorado and Wyoming -- natural gas pipeline infrastructure has not been developed as quickly as oil production has grown. Therefore, large volumes of natural gas have been flared from these fields. Conserving this gas and shipping it to market would add roughly another 3 billion cubic feet a month of gas supplies.

Lastly, while the issue is relatively new in the United States, it is worth mentioning that there are concerns that the injection of post-frack waste water has resulted in minor seismic activity. The state of Ohio partially banned fracking this month out of concerns over earthquakes close to the sites of fracking activity. There has not, however, been enough research conducted to support conclusively a link between fracking and earthquakes, but it is certainly an area worthy of more study and in areas where it has happened, of deep public concerns.

As mentioned, regulators federal, state, and local will have a bearing on the speed of development of shale gas resources. Currently most of the existing regulations of fracking are at the state and local level. The EPA has little jurisdiction over this process. However, as mandated by Congress the EPA is looking into the consumption of water by the fracking process and has recently announced that it will use the Clean Water Act to regulate the disposal of waste water produced by fracking, and it has said it will issue a proposed rule by 2014.

While the EPA is looking into various manners in which it can regulate fracking and ensure that it is done safely, most of the existing regulations have been promulgated at the state and regional levels around the country. Texas, Pennsylvania, West Virginia, Colorado, and Wyoming are just some examples of states that have introduced additional regulations on shale gas production.

The engagement and education of the public is a critical component of the continued growth in shale gas production. The extent to which industry can act as a responsible stakeholder and a standard-setter, and the extent to which public confidence in fracking can be retained will have a large bearing on the feasibility of continued shale gas development and, therefore, the feasibility of U.S. LNG exports.

The final component that has a bearing on domestic supply

is the availability of adequate infrastructure to produce, transport, store, and ship natural gas. The development of shale gas will likely have a large impact on regional natural gas markets. For instance, the growth and production at the Marcellus Shale will displace imports to the Northeast of gas from the Gulf Coast. Moreover, additional pipelines will be required to evacuate natural gas from the Marcellus as the existing pipelines are near capacity.

In 2010, Marcellus producers predicted that fewer than half of the 11,000 wells drilled had pipeline access. ICF International, a leading consultancy, estimates that 33,000 additional miles of pipeline will be built in the Northeast between 2009 and 2035, and I hope they build an undersea pipeline to my home in Nantucket so I don't get ripped off by high electricity prices.

There are similar concerns about the potential lack of pipeline networks at the rapidly-growing Eagle Ford play in Texas. However, these concerns such as the concern about the lack of available storage capacity in the Northeast are expected to be placated in the coming years as additional investments are made, providing a tremendous potential growth in jobs in an area of the country in deep need of those jobs.

As previously mentioned, the new technological

developments and improvements in the fracking process have allowed for continued growth in natural gas production, despite the large drop in natural gas rigs experienced since 2009. Producers are experimenting with longer and longer laterals and more wells per pad to improve production. Other areas to watch are the availability -- and you'll see that on the graph there -- that production even though the rig count has gone down quite substantially, production has continued.

Other areas to watch are the availability of human capacity, which we addressed earlier, and the availability of shipping infrastructure and capacity to deal with the tankers required to ship LNG around the world. Not only will some ports have to undergo additional dredging to allow for large LNG tankers but the Coast Guard must also be given the capacity to monitor and ensure the security of such vessels.

The demand side will also have an impact on the feasibility of exports. Exports will likely compete with two major consumers of natural gas; the electricity sector and the industrial and manufacturing sectors. Increased natural gas consumption will most likely come from the power sector. The Energy Information Administration, for example, estimates that natural gas power plants will account for 60 percent of new electricity capacity additions between 2010 and 2035. Much of this additional natural gas demand will be the result of replacing coal-fired

generation, as the chart on the right illustrates.

In addition, while many old coal power plants were expected to be retired, the promulgation of new EPA regulations will likely accelerate the phase out of other inefficient coal-fired plants over this period. As the map on the left indicates, many of these will be phased out in the Southeast and Northeast, where natural gas reserves are found in abundance.

The industrial sector will likely be a significant beneficiary of the newfound natural gas reserves. Natural gas is the primary feedstock for industrial producers, particularly for manufacturers. Ethylene, a petrol chemical product that is critical to many manufactured goods, is produced in the U.S. from ethane, a byproduct of natural gas. The precipitous decline in natural gas prices has made U.S. industrial manufacturers have among the lowest feedstocks cost, making them currently some of the lowest cost producers in the world.

As the chart on the right -- I think I'm missing this slide here. As the chart on the right illustrates, since 2008 the number of manufacturers that have disclosed the impacts of shale gas has risen substantially as they continually argue in surveys done by PricewaterhouseCoopers. That the prospect of cheap natural gas or the price of natural gas is one of their major concerns, and as a result they are

deeply worried about the impact that large-scale exports could have on raising that feedstock cost and making them less competitive in the global environment.

In our research we found that due to various constraints the transportation, commercial, and residential sectors will probably not experience dramatic increases in natural gas demand, and we looked at these sectors very systematically because of course particularly in transportation, led by Boone Pickens and others, there's been deep interest in converting a large portion of the transportation and trucking fleet to natural gas.

The most notable issue we found is that natural gas penetration into the vehicle fleet faces a number of technical, financial, and infrastructure limitations. This is not to say it may not increase, but it will not be a significant determinant on whether or not we have enough natural gas for export.

U.S. LNG exports will not only be competing against domestic consumers of natural gas, but also against international LNG producers such as Qatar, Indonesia, Australia, Malaysia, and Nigeria, and perhaps others. Much of this is based upon the arbitrage opportunity that the U.S. has in selling its gas, which is produced and sold at floating market rates to the Atlantic and Pacific markets, which purchase LNG at

more expensive oil index rates in those two regions of the world.

I will not delve too deeply into the global LNG markets, since we have Jim Jensen speaking in a moment, and I don't think there's anybody who's more of an authority on this topic than Jim is. However, I will mention three major factors that have a significant bearing on the United States' ability to export LNG.

The first is the widening of the Panama Canal expected to be completed in 2014. Currently, very few LNG tankers can traverse the isthmus, but after the widening it is estimated that at least 80 percent of the world's LNG tankers will be able to pass through. This makes the Gulf Coast LNG exports to Asia instantly economic.

The second is the impact of various national nuclear energy supplies on gas demand. Germany's decision to accelerate the phase-out of nuclear power plants will significantly increase the demand for natural gas. A similar decision by Japan where the public is wary of nuclear energy in the wake of the Fukushima accident will provide a significant boost to the country's natural gas demand. Already the temporary shutdown on nearly all of Japan's nuclear reactors has tightened the global LNG market.

Finally, the spread of the unconventional production to new markets, such as China, India, Ukraine, and Poland will change the

fortunes of the LNG market. While technical and regulatory obstacles may delay the prospect for rapid shale developments in the near term, it may displace demand for LNG in the decades to come.

There will likely be domestic price implications to exports, and of course this is an issue of deep concern to many in the manufacturing sector. A number of studies have been released analyzing the potential price impacts of various levels of exports. Part of the second half of the Brookings study to be released later in the spring will analyze and assess the various pricing reports and try to come up with our own recommendations.

It is important to note that in addition to the wellhead cost of natural gas, there are additional costs of liquefaction, shipping, and re-gasification. This partially erodes the opportunity for price arbitrage, but it does not eliminate it. Therefore, sellers of LNG will need to make sure that the LNG price spread will exist for a number of years, not just when they make the decision to apply for an LNG export license in order to budget for facility preplanning and construction.

When taking into account the various factors that will have an impact on supply, demand, and the global gas markets, the Brookings team has concluded that it is technically feasible to export LNG. The supply picture as it stands now is well-established to supply enough gas

for export without any technical challenges. Similarly, the demand sector is poised for some increased demand for natural gas, but we do not believe in an amount that poses technical challenges for exports. In the global LNG market, it remains relatively tight, particularly in East Asia. Therefore, there are demand centers for low-cost LNG exports.

But the ultimate question that this study will hope to answer is, should we export the gas? And if so, how should we do it and what would be the implications, and in what volumes should we export? Moreover, we looked to explore how the government should position itself on the issue. We hope to have the study done by the spring of 2012, at which point we will have a full report ready for release.

I thank you for your time and attention, and I now invite our three panelists to come for further discussion. Thank you. (Applause)

While we're getting mic'ed up here, let me introduce our three panelists in greater detail, and we are delighted to have them here. Two of them, Mr. Jensen and Mr. Medlock, are members of the study team, so we should note that. But as I mentioned, the study team itself has not reached a consensus view on many of the issues I raised in my remarks.

Jim Jensen is president of Jensen and Associates, a consulting firm that specializes in natural gas economics. He received a

degree in chemical engineering from MIT, and an MBA from Harvard Business School. He has testified on numerous occasions between the U.S. Senate and House congressional committees on a host of LNG and other natural gas issues. He was the recipient in 2001 for outstanding contributions to the profession of energy economics, and to its literature from the International Association for Energy Economics. He has been a visiting faculty member of the Oxford Energy Seminar at St. Catherine's College at Oxford, as well as programs at Harvard, John's Hopkins, MIT, Northwestern, NYU, Oxford, and Stanford. Truly, a prodigious list.

Ken Medlock is currently a fellow in energy studies at the James Baker Institute for Public Policy, and an adjunct assistant professor in the department of economics at Rice University. He is the leader of the Energy Forum's natural gas program, and a principal in the development of Rice's world natural gas trade model, which is aimed at assessing the future of LNG trade and is regarded within the industry as one of the primary economic models. He won the International Association of Energy Economists award for best paper of the year in the *Energy Journal* in 2001. Prior to returning to Rice, Mr. Medlock held the position of corporate consultation at El Paso Energy Corporation, where he was responsible for the fundamental analysis of North American natural gas, petroleum, and markets, and Dr. Medlock received a Ph.D. in economics

from Rice University.

Our third speaker is Michael Ratner, who is an analyst in energy policy at the Congressional Research Service specializing in oil and natural gas markets and energy security. Prior to joining CRS, Mr. Ratner was a senior energy analyst at the Central Intelligence Agency, specializing in international energy security issues related to global natural gas. Mr. Ratner has worked as an investment banker in the Houston office of West LDAG, and he was the lead negotiator for the sale of the development rights to a Canadian liquefied natural gas import terminal. Mr. Ratner worked for four years in Enron's domestic natural gas pipeline division, focusing on mergers, acquisitions, and divestitures. Mr. Ratner has an M.S. in mineral economics from the Colorado School of Mines, an M.A. in international economics and U.S. foreign policy from John's Hopkins School of Advanced International Studies, SAIS, and a B.A. in international relations from Columbia University.

Gentlemen, welcome. I thought the format we would pursue is that I will begin a conversation with two questions for each of the panelists, and then after we do that to kind of get the discussion going we will turn to the floor, allowing a good deal of time for questions you may have, but I also want to give the panelists any opportunity they might want to remark on what they themselves say here.

Let me begin with you, Ken. I mentioned production sustainability in my presentation as a major point of concern. There's been a lot of speculation around the reserve numbers and the produce-ability of shale gas in the United States. Without putting an exact figure on reserves or resources, what is your general sense about the size of the resource base to support both increased domestic demand and exports?

MR. MEDLOCK: Thanks, Charlie. Well, the size of the resource-base is sort of best characterized as how much gas is in place in the formations that we typically think of as being shale formations or type formations. We've known for a long time that these resources exist. It really has been an issue of technological recoverability, and one of the things that's happened in the last decade is we've seen tremendous leaps and bounds with regard to making not only these resources technically feasible but also commercially feasible.

You know, you said it in your talk. Ten years ago, who would imagine that we'd be sitting her today talking about LNG exports due to a massive amount of natural gas domestically? The industry was positioning itself to import, and everything's been turned on its head and it's largely due to a technical revolution.

Again, we've known about the size of the resource base, we continue to make strides to make it more technically and commercially

feasible, and I don't think there's any looking back now. There's certainly enough resource to do a lot.

MR. EBINGER: Okay, thank you. Michael, the discussion about gas exports is getting lots of attention on Capitol Hill these days, as evidenced by Mr. Markey's letter to Secretary Chu, the recent EIA report out last week, and so forth. What is the sense you're getting on how the politics of this is shaping up? From what you're seeing, is there a predominant view among lawmakers on the desirability of exports?

MR. RATNER: Thank you, Charlie. First I'd like to preface any comments that these are my views and not CRS, Library of Congress, or the United States Congress. So with the disclaimer, there seems to be a growing interest since Senator Bingham held hearings in early November. There has been a lot of activity, or some public comments. I haven't seen anything scheduled for additional hearings coming up, but there definitely seems to be growing interest and I suspect it's going to -- particularly given the number of people in this room -- that it's going to continue to grow. There seems to be a lot of interest in it, and particularly with the EIA report coming out, setting certain parameters on pricing or the price effect, what it may mean to consumers of natural gas. I think that it will continue to grow.

MR. EBINGER: Okay, Jim. With U.S. gas prices well below

$3 a million BTU and prices in Asia at $15 per million BTU and higher, the economic rationale for exports looks extremely compelling. But as we all know, things in the global energy sector can change rapidly. How likely is it that this opportunity is going to endure? What is the likelihood, for example, that increased LNG exports both from the U.S. and elsewhere will start to erode the traditional contract and pricing structure for natural gas in Asia and Europe, making exports perhaps look less attractive?

MR. JENSEN: First of all, I think looking at current prices is a trenchant effect. Nobody expects prices below $3. In fact, looking out to 2020, you're talking probably $6 or something like that. And essentially, in part the Asian prices are inflated because there's been a panic in Japan, which shut down the nuclear plants. So you really have to look out and see what the trends look like to try to put them together.

When you look at prices, there are probably four pricing systems that are influencing international trade. One is North American commodity gas pricing, gas-to-gas competition set by, you know, supply and demand, purely competitive. Second one is essentially contract supply, which applies to much of the continent in Europe and in Asia, and essentially that is dependent upon the way the contracts are structured. And they've been under stress and their changes take place in that.

Interestingly enough, UK is a special case. It is

schizophrenic. It is essentially a commodity supply gas-to-gas competitive market that is short of gas, sits next to the continent. When it's short of gas, the MBP price goes up to continental levels. When there's a surplus, it drops to North American arbitrage, and that infection of the North American pricing structure has moved into North Central Europe, so that essentially it has caused problems in Germany, the Low Countries, et cetera.

In much of the rest of Europe, it's still contracted. Interestingly enough, if you look at Spain -- and Spain has just done a deal with Cheniere. Spain claims it has a totally free market. I worked for Gas Natural last year and they were talking about, gee, we have gas-to-gas competition, totally free, liberalized market. If you look at it, it's not a liberalized market like we have, because all supply coming in to the country is under contract, and so that's what we came to describe as contract-to-contract competition, not commodity gas-to-gas competition.

And so then the question is, what makes those contracts move? Of course, the other pricing system is that by the former command and control economies, Russia, the Caspian, and China, and they are very important to what happens to world gas trade and they operate on a logic that doesn't lend itself to computer models. So in a sense, you're trying to figure out how all of this will go.

And as I look at it, I mean, I look at Europe as a sort of risky market. At the moment, the prices in Asia are by oil terms much higher than they are in Europe, and that's traditional. If they stay that way, Asia looks like a very good market. If they erode, then you begin to have problems.

MR. EBINGER: Okay, thank you. Ken, this is really an implications question rather than a feasibility one, but I think it's pretty relevant. There has been some speculation that opening up an interface between the U.S. market and the global market will increase the volatility of U.S. natural gas prices. In your view, how much validity is there to this concern?

MR. MEDLOCK: Well, in my view very little. One of the principle results of increasing arbitrage capability is, in fact, to increase arbitrage opportunity, and that by its very nature will reduce the amount that price will fluctuate.

So, I actually did some work about a year and a half ago looking at this from an import point of view, because there was a similar sort of question raised with regard to the construction, the big build-out that we saw in the early part of the century of re-gasification terminals, and what imports might do if we were to start to increase imports of LNG, particularly if they were tied to oil markets rather than traditional natural

gas markets, as we've seen historically in North America.

One of the things that you're able to demonstrate is, you can notice -- and you can use microcosms to do this. You can pick places where new infrastructures have been built into to deliver or take away natural gas to particular regional markets. So, you can look at the Chicago market with regard to the Alliance Pipeline and the Northern Border Pipeline, you can look at the recommissioning of the Cove Point Terminal in Maryland, and what you saw in every case was actually a reduction in the annualized volatility at those local pricing points as a result of increased takeaway and input capacity.

So in effect, what happened is you provided a mechanism to expand liquidity at the point of interest, and what that did is it actually reduced volatility. Typically, you see volatility in places where you have capacity constraints, and what we're talking about here is removing a capacity constraint, effectively.

Now real quickly, when we talk about volatility you have to be careful that we understand what we're actually talking about because there's -- in the trade literature, if you will, there are different sort of definitions of volatility. Historically or typically, we think of volatility as sort of, you know, the up and down movement in price, if you will, or the -- to use a technical term, the standard deviation of the log returns in price. So,

you just look at what's happening on a daily basis and you can evaluate that statistically. But every now and again you run into somebody who is really thinking about when they talk about volatility uncertainty and expectations. Where will price be tomorrow relative to where it is today?

If I look back and realize that I was always wrong, then I think prices historically have been very volatile, and that might not necessarily be the case. It's just that your expectations have been erroneous. So, those are two different things and it's important that we be able to grapple with both because for an investment planning-type of model -- like if I'm a utility or I'm investing in power plant capacity, I'm really not that worried about the more financial definition of volatility. I'm really worried about how accurate are my expectations?

MR. EBINGER: If I may follow up on that how valid, then, do you think the concern of manufacturers and industrial users who are benefiting from cheap feedstock prices are if they're looking out, you know, a number of years?

MR. MEDLOCK: Well, I mean, again you're talking about the investment model there, right? Because what they're talking about is massive investments in capacity, and contingent on those -- one of the biggest contingencies in those investment planning models is, what is the price of natural gas? Because you've got options to move capital, but

once you've actually installed it you're stuck. And so, what you want to be able to do is earn a return on that capital and you want to be sure that all your input parameters are what you thought they'd be.

And so one of the things I think that we're seeing happen here in this country is really, you know, for lack of a better way to put it a battle over rents, if you will, in the natural gas industry. It's really about, am I going to get the rents if I'm a producer? Because there's an export vein that I can actually use to give me a better price to market. Or, if I'm in the petrol chemical industry, am I going to get the rents because I'm actually using the low cost of natural gas as a feedstock to develop something that I can provide to an international marketplace that is typically going to be at a higher price?

It's kind of interesting when you think about it in those terms, because really what you have, again, is a battle over rents and it will be cast -- there will be many different lights, I think, cast on this debate before all is said and done. But what it really boils down to is, what is the elasticity of supply domestically? How responsive will consumers and producers be to movements in expectations, in actual spot prices, so on and so forth. And if anything, what we've seen over the last couple of years is that domestic supply picture looks very robust. It looks like we have a very elastic supply curve, which means we can see increases in

demand without much change in price, at least for a reasonable amount of demand.

Now with regard to the EIA study -- because I have a feeling this is where this is all going. They certainly showed if you have a very rapid increase in exports you might actually see a short-term lift in price that's, you know, reasonably high and then it would fade as producers began to respond, I think is basically how the model works.

One of the things I think is very critical and I hope all of you take this away from this. It's a technical issue, but when you look at price responsiveness in different models not only does it matter how elastic you model supply, it matters what kind of model you're using, too. Some of the models that give you the more robust sort of price impacts associated with an increase in exports don't necessarily model producer response in a dynamic way, and that is a very, very important thing to consider because the models that do try to pick up that dynamic producer responses effectively assume that you have a well-functioning set of forward markings. So that, activities today that might influence future prices are actually internalized and they result in a different outcome.

MR. EBINGER: You want to add anything to that? All right. Michael, in your recent report done for the Congressional Research Service, you did an excellent job of outlining the many regulatory and

licensing approvals required for the construction and operation of liquefaction facilities in the United States. The EIA talks about 12 billion cubic feet a day of exports as its high estimate in its report. That's an awful lot of permits. What is the current situation with regard to approved export terminals, and can you give us some insight in the decision-making process around approving new ones?

MR. RATNER: Well, it's interesting you picked the one part of the report that I had the least part in writing. One of my colleagues, co-authors of the report focused much more on regulation. But that said, yeah, 12 BCF a day is going to require -- I mean, we've already seen since my report came out and your report came out that more people are applying for permits.

You know, reconfiguring an import terminal, I think is probably the easiest way to go and I suspect in the chart that outside of DoE and FERC, that the rest of the permits should be fairly easy to get for reconfiguring an import terminal.

DoE does have the capacity, though, to evaluate projects based on the projects before it, and so given their model and depending upon how they see things getting built, they may look to slow down the progress. As Ken pointed out, in certain of their scenarios that EIA looked at, if you're looking at 12 BCF coming on very fast that's going to have the

biggest price impact and so DoE may look to temper that and slow the process down.

I can't really speak for DoE, you know, given my vantage point, but it seems like the process is moving forward. I mean, they've only approved one permit to a non-FTA country and then they did their price report. So, I think they may have been taken a little bit by surprise over the interest of people in this, but I think it's good that they've done their price report and set certain parameters.

I think going forward as Congress gets more and more interested in this, that the permitting process will reflect that somewhat, and probably slow down. Do you want to add anything?

MR. JENSEN: Yeah, I think it's worthwhile making a comment right here. When I look at the DoE report, the scenarios are extremely aggressive. If you look at the average increase in LNG trade over the last decade, it is slightly less than 2 billion feet a day. The slow scenario essentially assumes you're going to take half of the world market, assuming that that's the level of activity. The aggressive scenario says you're going to take 150 percent of the market.

Now, to me that's totally unrealistic. Fine to look at the envelopes, but it sort of puts the debate about pricing out there in an unrealistic place and that's unfortunate, I think, so.

MR. MEDLOCK: Just to add on to that. In 2010, total liquefied natural gas trade globally was about 30 billion cubic feet a day and we're talking about adding 12 BCFD. This is an interesting point in and of itself because you're talking about flooding a market with a new source of supply and all the while you're not anticipating any international price impacts, and that would actually change the nature of the trade conversation here as well. So you know, these things are sort of left out of the EIA report, just to be blunt, so.

MR. EBINGER: Jim, one final question for you. What physical constraints do you foresee in the international LNG market over the next few years that might have a bearing on U.S. LNG exports? For example, shipping, port capacities, high capital cost for liquefaction facilities, limited storage in Asia, whatever?

MR. JENSEN: Well, one of the things that is difficult to understand is, you know, what essentially makes the big arbitrage between -- for example, I think Asia is a better market than Europe -- between Asia and the United States?

First of all, our gas is cheap. The interesting thing is looking at expanding a current or, let's say, changing a current import terminal into an export terminal really is a matter of adding trains. It's not a green field expansion.

Charif Souki of Cheniere was on CNBC at one point and said he could get plants built for $400 a ton. The Bechtel bid that came in is $556. The Australian projects that have gone in recently are somewhere between $1,600 and $1,800 a ton. Now, that's a combination of things in Asia and Australia -- I mean, it's a tremendously overheated construction economy. If that inflation demand pull for inflation comes down, the Australians who have got an awful lot of gas are in a position to be much more competitive. So, that's a factor.

You're looking at -- if you are in Asia, you're looking at expansion of the Panama Canal. This 80 percent of the tankers being able to go through the lochs came out of the IEA and they quoted somebody else -- I've not been able to track that down. I look at the dimensions of the lochs proposed, I don't see why you can't take any tanker through. But at any rate, clearly what you can do is -- I mean, you're going to have to build new tankers for that trade, and you can design tankers that would be Panamax tankers that would go that.

Now, the Qataris, who are essentially a long way from market revolutionaries, the tanker design, they went for size. Typical tanker today is 150,000 cubic meters, they're Q-Flex tankers of 216s, 2 max at 216s. But also, an interesting thing is that they put re-liquefaction onboard. Now, on a traditional tanker you lose -- every 7 days you lose 1

percent of the cargo through boil-off. If you can re-liquefy it -- and it's expensive cargo -- the economics improve a lot. When I run the economics of running a conventional tanker from the Gulf to Japan through Suez, I get a cost in excess of $3. I can cut that to less than half by going with Q-Max-designed Panama tankers. So in other words, you've got to build those things, design them, and I'm not sure what that means for world shipyards because that's a very long haul and that means an awful lot of tankers. So, that's going to enter into the equation.

MR. EBINGER: Okay, thank you all very much. We'll open it up to the floor. We please ask that you identify yourself. There are, I think, some mics coming around. Identify yourself and if you want to direct a question to a particular panelist, please do so, or to the entire panel if that's more fitting with your question.

Any hands?

MR. GIVENS: Mr. Medlock. David Givens, Argus Media. You just mentioned a $3 figure in your last statement. Would you repeat that and clarify, please, the figure?

MR. EBINGER: The $3 figure that you talked about, getting gas from the Gulf through Suez.

MR. MEDLOCK: Right.

MR. EBINGER: And cutting that in half by going Panama.

MR. MEDLOCK: That was actually Jim that said that.

MR. JENSEN: What do you want to know about it?

MR. MEDLOCK: He wants to know, I think, more about that $3 figure.

MR. JENSEN: Okay. I mean, I built over the years a number of I call them cookbook models. They're essentially general models and you can change all the dimensions you want to play with, tankers, et cetera. And one of the problems is, you have to vintage them because costs have been going crazy. So, my 2011 model is much more expensive than my 2010, my 2009 model.

And essentially when I run a project from the Gulf to Japan through Suez, essentially I have to deal with a number of tankers because it takes a lot more tankers for a long distance. I have to deal with the Suez Canal charges, all of those things operate, and the tanker is losing a certain amount of boil-off each day. So essentially, that's a charge against the cost.

The model states all that, and if I run it the other way for Panamax, I cut down on the boil-off. I have bigger tankers, I get economies of scale. The Panama Canal charges are in place, but I am sure they will go off once the Panamanians figure out there's a deal there, but I'm using the current ones. And you know, essentially you just run the

economics and that's what falls out.

MR. EBINGER: Up front.

MS. RYAN: Thank you, I'm Margaret Ryan with AOL Energy. Yesterday, Howard Gruenspecht of EIA gave the preliminary annual energy outlook, and EIA's analysts have knocked their price trend line down all the way to 2035. So now, the gas prices -- their estimate for the U.S., of course, are not going above $5 until after 2020.

Can you talk a little bit about what the effect a continued price that low in the U.S. would have on the export prospects and the pressure for exports?

MR. RATNER: I'll take the first shot, I guess. Certainly if prices stay below $5 for an extended period you'll see increased pressure to export gas from this country. I guess the saying is, you know, the best cure for low prices is low prices, and I think you're sort of seeing that now because that's why producers are, in fact, looking for new markets and that's what generated this export interest.

In the last week or so, you've seen a couple of announcements by different firms that they're going to suspend some of their drilling activities because prices are so low, and what sort of effect do you think that's going to have on prices? Well, it ought to, you know, provide some lift, which is exactly what you would anticipate when there's,

in fact, an oversupply situation. So until we see some new demands, either domestically or internationally through the export opportunity, you should expect prices to remain fairly low.

MR. JENSEN: I'll look at the other side of the coin. I mean, essentially we have now a pricing system internationally which is based on oil linkage. Oil linkage is very different in Europe from what it is in Japan, and also it's misleading when you look at the price series because the Japanese prices are quoted LNG, X-Ship as liquid. Do not include re-gasification costs. But if you go into Europe, you have to allow for re-gasification. So essentially, the Japanese prices are $0.70 to $1 on the low side for comparable levels.

Now essentially you've got very high Asian prices, quite high European prices, and a very low price in North America. The question is, what is going to happen to undermine -- are those prices subject to being undermined? And you know, that's a big question. What's going to happen internationally to the price structure?

One of the fascinating things is that we had a very severe test in 2009, 2010, almost a perfect storm recession, surplus of LNG, U.S. dropping out of the market. And interestingly enough, very little effect in Asia. The Asian prices have held quite well and surprisingly enough despite the fact that this year European consumption is down about 12

percent the NBP prices are still up and strong, which sort of says that we haven't had that much of an impact, so they may hold.

On the other hand, one interesting telltale historically is if you look at China when it first came into the market. China was viewed by -- at that point you had Australia, you had Indonesia, you had Qatar, and you had Sakhalin all looking at China as a market and they wanted to be first movers. And China got -- the first two deals they got were extremely good. Today, the prices in China from Indonesia -- from Australia are 25 percent of the prices that are from Qatar into China. The Indonesian prices are 30 percent, the Malaysian prices are 60 percent.

Now the question is, is there anyone out there who is going to break that international price as was done with the Chinese at that point in time? Now at the moment, it's very difficult to see because the Australian stuff is high-cost. A lot of the traditional LNG has been liquids-rich, which means that you can make your money on oil. Qatar, Algeria are what I call negative opportunity costs. Essentially, the liquids are so valuable you can develop the field and flare the gas. If you can't flare the gas and have to re-inject it, it's worth a negative value.

Most of the new supply coming on, the Australian Coal Stream stuff is basically lean, no liquids, and a lot of the offshore Australian stuff coming on now is either high CO2, some places we're

getting high sulfur contents, not the liquids contents. So the question is, are there some new old traditional high liquids cheap stuff likely to come on the market?

I'm very curious about Mozambique, but we don't know enough about it yet. But I mean, you've got big discoveries coming on that might have the potential to upset the system, but essentially it seems to me that the question is, is there anything out there to rock a price which is really much higher than ought to be in pure economic terms worldwide.

MR. EBINGER: Could shale gas in some of these countries --

MR. JENSEN: Well I mean, it would be interesting, of course, to China because China has more shale gas resources than we do. Unfortunately, a lot of what's out in the Tarim Basin -- which is a long way away from market -- it's dry, doesn't have water. Some of it is in Sichuan, which is a little closer to market, and they've got some coal seam stuff. So, the Chinese are optimistic about the ability to develop the volumes. Whether it will have a price effect, I don't know, but obviously it's a part of the equation.

MR. MEDLOCK: I just think it will add to the expectations debate here in Washington where producers can now make a strong case to say, well, prices are lower. Therefore, we need to be able to export,

and I think the consuming side of the picture will look to say, well, we want the lower prices so, you know, I don't think they'll back off from the export debate.

MR. EBINGER: I have a question in the middle of the room there.

MR. TUBMAN: Hi, Michael Tubman with the Center for Climate and Energy Solutions. Earlier, Mr. Medlock, you were talking about the elasticity of supply being so great that exports wouldn't be so reflected in the price, and you had talked about there being demand response that isn't reflected in the EIA's report. I wonder if you could elaborate on that a little bit more and clarify your point.

MR. MEDLOCK: Well, yeah. I was actually referring to both responses on both the demand and supply side. There is certainly an elastic demand element in the EIA model. That's all well documented. To sort of diverge into a little bit of a technical conversation here, though, what I was really referring to is the nature of the models themselves. So, when you say a model does not actually dynamically handle producer response effectively, what you're saying is it's at its core linear program. So what that means is, it solves this period's problem and then takes that information and steps forward, okay?

And so that's actually why you begin to see -- you know, you

get that big price upswing and then it begins to taper. Because what you're seeing is that response sort of in a lagged sense, being built into the model. In a model in which all that dynamic producer response is actually internalized, then what you would actually see is -- for example, if you had the expectation of a big chunk of demand coming on in 2015, you would actually see producers begin to plan for that and respond to that ahead of the event. And so what that tends to do is, it mutes the supply response.

This is getting into rational expectations, or sort of perfect foresight world, right? The world is neither of those extremes, right? But one of the things we know we do have in this country is a well-functioning forward market for natural gas. And so, if we are on the cusp of, let's say, seeing an increase in LNG exports from the United States because a few terminals are coming online, where do you think that's going to show up first? It's going to show up in the futures market, and what you're likely to see is steeper contango in the forward curve, which would immediately incentivize producers to begin to produce.

Now, how would they do that? Well, you would see it first in their hedging programs, and by a lot of accounts that's actually what's responsible for the oversupply condition right now is we had contango that has since eroded in the natural gas market. And so the average hedge

position, I saw a report for 2010, it was about $5.30; for 2011, it eroded into the high 4s; and I think going forward it's below that, which is why you're seeing operators begin to back of their drilling programs now.

So, if we begin to see any sort of contango in the market because of expected demand, you'll see that kind of behavior begin to emerge again, and that's where you get the dynamic producer response. There will be actually planning for the event that's on the horizon, okay? And that's something that you don't see in the EIA model at all.

MR. EBINGER: Yes, the back?

MR. JOHNSON: Hi, can you hear me okay? I'm not sure these are working. My name is Jeff Johnson. I work for *Chemical and Engineering News.* I am concerned about -- this is a little off-topic in a sense, but the greenhouse gas implications or global warming implications about using the large amount of natural gas or methane that you guys are talking about. As we all know, methane is a more powerful greenhouse gas than even carbon dioxide, which we focus on.

I'm curious if the large amounts of methane that we're going to start processing and using and possibly shipping around the world in terms of boil-off and loss, what kind of implications -- as well as drilling, too -- the implications that might have on the methane budget that's in the atmosphere?

And secondly -- excuse me, I've got a cold -- the idea was that natural gas would be this bridge to take us away from coal. I wonder with this flood if it's going to be more of a permanent bridge and will that sort of curb our interest in going to renewable energy sources because we'll be satisfied with methane? Make sense?

MR. MEDLOCK: I can come on to that. Actually, at Rice University last week we held a conference called the North American Energy Resources Summit. And the very last panel of the day was an environmental panel, and as you might imagine, you know, we had former head of the Department of Environmental Protection, State of Pennsylvania, which is sort of ground zero for a lot of the anti-fracking movement -- Pennsylvania and New York -- John Hanger. And so he spoke about his experience when he was in office.

We had one of the members of the team that led the Duke study on water issues. We had a member of a team that's involved in a water study at the University of Texas. All of them were invited really because the public perception is that water is the big issue, but to a man everyone of them said air is the thing we ought to be most focused on because everything that they had been involved in -- all the studies they had done -- water was really a very minor -- not a very substantive issue when you think about, you know, what increased development of natural

gas resources means.

Now, on the air issue it, of course, comes back to CO2 is only one component of that because air quality around drill sites and things like that is also a different issue, and that's not a CO2 issue. All of these things are manageable, though, in so much there are technologies to deal with these issues. You just have to have the right regulatory structure in place to make sure that actually is done correctly.

But on the air quality issue, there's an interesting study that was mentioned that the Duke team is actually now involved in with Boston University looking at potential for methane leaks in municipalities. So, places where, you know, you have a lot of people living. And so, they're actually doing air quality sampling in the city of Boston, and so what they're doing is they're going around looking for methane -- they're detecting methane leaks all over the city of Boston and they're isotopically fingerprinting the gas to see whether or not it's sewer gas or if it's actually gas from a pipeline system.

The interesting thing about this is, you might think, oh well if they actually seal out a methane leak and there's a problem with using more natural gas. Well, that's a natural gas issue, that's not a shale gas issue, first thing. The second thing is, you really are talking about leak detection in places that are sort of out of the hands of traditional oil and

gas companies. You're talking about things that are in the hands of public utilities. So, utilities in their backyards, they're typically -- if they're required to renovate systems for delivery where you see a lot of these ageing infrastructure issues around the country. Think Sam Bruno, PG&E. They're typically going to earn a particular rate of return associated with a rate case they file with the state public utility commission.

And so you have to ask yourself, well why do we see these problems in public utility areas but we don't actually see the same kind of problems along interstate systems? And I think if you dive into that question you'll find the answer. It has a lot to do with the fact that those rate cases are political animals, and it is a problem.

So, when we think about methane leaks we have to actually go beyond the standard. You know, is increased natural gas production going to create a problem for methane emissions, which is 100 times more potent than CO2 as a greenhouse gas? We actually have to ask the question, well how do we deal with it? Because there are proven tried and true ways to deal with it, it's just an issue of is policy up to the task?

MR. EBINGER: Yes.

MS. WINSTON: Hi, my name is -- I don't know. My name is Kate Winston. I'm a reporter with *Platz.* Yesterday, EIA dramatically cut

its estimate for the resources in the Marcellus Shale. I was wondering if you can comment on whether or not you agree with that, and whether you think it will impact the LNG debate or not?

MR. RATNER: I saw that. I don't remember the exact numbers and how it lines up with USGS. I don't think it will impact the debate over exports. I think there's a lot -- I mean, in all this conversation, I mean so many of the projects are focused on the Gulf that Marcellus gas, I don't believe, is going to be shipped down to the Gulf for export and so I think more of the gas would be coming, you know, from closer to the Gulf. So, I don't think it would have an impact, really, at all.

MR. EBINGER: I think we have a hand in the back.

SPEAKER: Hi, what kind of price effects and competition would you anticipate from Canadian LNG exports, like from Kitimat on domestic markets?

MR. EBINGER: We can't hear you. Can you speak up?

SPEAKER: Price effects from Canadian LNG exports and just overall competition for U.S. LNG exports?

MR. RATNER: Do you mean would Gulf source LNG exports be competitive with, say, something off the East Coast of, like, British Columbia -- or West Coast? I'm sorry.

SPEAKER: Kitimat, yeah.

MR. RATNER: Is that what you're referring to?

SPEAKER: Yes.

MR. RATNER: Well, certainly the stuff at Kitimat enjoys a transportation advantage, but you're going to see limits with regard to how large those facilities can become because there are rights of way issues. You've got to actually cross over a mountain range to expand that facility. So, you know, even if it is the most competitive sourced North American gas to Asia, say, you run into capacity constraint, in which you start to see spillover effects where you're going to see demand pull from, you know, places like the Gulf Coast. So, I don't really anticipate that being an issue longer term.

MR. EBINGER: I think one other additional thing on that is, I mean, we've been exporting LNG from Alaska since 1969 and even though that facility had been idled at the end of last year, my understanding is it's supposed to be reopened by the end of this year because of new discoveries in the Cook Inlet, and there's also talk of other LNG projects in Alaska to utilize potential gas as well up there. So, you know, if it's a U.S. versus Canada thing, the U.S. may have a bit of an advantage out of Alaska instead of the Gulf.

MR. JENSEN: Anything done out of Alaska is automatically a long timeframe. But interestingly enough, if you look at the -- I mean,

the problem with Alaska has been we've never been able to justify the economics of the pipeline down to the Lower 48, and from time to time the idea of exporting LNG to Asia cropped up. Yukon Pacific at one point was pushing very hard for an LNG project to Japan. The economics of getting the gas down by pipeline to Valdez require economies of scale. You don't want to do it in a small size because you're going to pay very high costs of gas to be liquefied, and essentially you were talking 3 to 4 billion a day to come down to the Lower 48. There was an option for the project, for the bidders to come in and opt for going to Japan, and you can run the billion-a-day economics and they are not too good. But if you sort of go for broke, go 3 billion a day, put it down to Valdez, and then ship it to Japan, the economics look quite good.

And very interestingly enough, the CEOs of the big companies up there brought up to Alaska within the last couple of weeks to have a big discussion, and there seems to be an emerging feeling that maybe the option is to go to Japan, not -- or, let's say go to Asia, not to bring to the Lower 48. Now we'll see how that goes, and if we decide to do it it'll take a long time, but it is a big source of potential North American supplies.

MR. EBINGER: Question in the back?

MR. ANDERSON: Yes. Tobyn Anderson, Lighthouse

Consulting Group. I was just trying to think whether there were any limits on any other energy commodities like coal, oil any of those, and I couldn't think of any. I was just wondering am I missing any of those or I'm really just focused on that?

MR. RATNER: There have been limitations on oil exports. I'm not aware of any that exist today. I think potentially we could be back here in a year or two talking about coal exports. I mean, that seems to be hearing up.

But to answer your question, I'm not aware of any restraints.

MR. EBINGER: I was recently -- not too much in the past few months -- talking to one of the major railroad companies that's heavily in the coal business, and they were pointing out, you know, there are a lot of Americans, particularly in the environmental community, take great solace that they've beaten back new coal-fired generation projects. But the reality is, you know, coal exports are near record levels, and he was making the point that the constraint on further coal exports was now -- well, partially port facilities -- but was really railroad capacity, and that if we were to expand the railroad capacity, then he thought we could export another 20 or 30 million tons. So, you know, the coal is not being burned just because we've stopped coal-fired plants in the United States. It's going to be burned in Asia.

Yes.

SPEAKER: Thank you. My question may go to Mr. Ebinger. I'm from China, Chinese Academy of Social Sciences. I think you know that it's the largest think tank in China.

My question is, it seems to me that shale gas serves as the most potential product in the future energy cooperation between China and the U.S. Now you also focus on the natural gas research, you have a team. Do you consider doing something to promote shale gas cooperation between the two countries? Thank you.

MR. MEDLOCK: Could anybody repeat the question?

MR. EBINGER: We cannot hear you.

SPEAKER: Between China and the U.S.

MR. MEDLOCK: What about it?

SPEAKER: Just importing, exporting --

SPEAKER: No, I just mean now because you have a team on the natural gas research. Do you think to promote shale gas cooperation between China and the U.S.?

MR. JENSEN: Cooperation between China and the U.S. with shale gas?

MR. MEDLOCK: There already is a program actually, right? Yeah.

SPEAKER: Would you promote it, is the question.

MR. MEDLOCK: Oh, will we promote it? Will Brookings promote it?

MR. EBINGER: We haven't talked about that issue, but it is certainly something we could raise in our discussion group.

Interestingly, just to share an anecdote with you, each year our China Center here at Brookings has, for the last several years, a joint discussion with China -- sometimes in Beijing, sometimes here -- on clean energy cooperation. And in our forthcoming meeting scheduled for June, we have suggested the issue of shale gas as one of the topics, and we were told by the Chinese they would not discuss shale gas, and we are wondering what it is going on -- maybe in a debate inside China -- of why that was so categorically rejected as an issue for discussion at the Clean Energy Forum.

MR. JENSEN: China is a very interesting case. If you look at the LNG imports into China, over the next 4 to 5 years they are increasing at the rate of 25 percent per year. And the tendency of everybody to believe is that China is going to take off as an LNG importer.

That's very deceptive. The interesting thing that the Chinese have done -- if you really look at the economics of supplying gas to China, the Russians are in the driver's seat. But, the Russians and the Chinese

have price issues and they have political issues, and we've never done a Russian-Chinese deal. So essentially you've got these two behemoths sitting opposite one another trying to negotiate with one another and getting nowhere.

Meanwhile, the Chinese have done some very interesting things. The LNG imports are going into a string of new terminals along the East Coast that are being connected by a pipeline. The big growth that is built in for the next four to five years is already contracted, for it is going to fill up those LNG terminals. They have completed the pipeline to Turkmenistan, they're expanding it to Kazakhstan. The pipeline to Turkmenistan is equivalent to four Qatar supertrains. Six Qatar supertrains over the year broke the LNG market. That pipeline is essentially the equivalent of four supertrains. They are completing a pipeline to Miramar.

And what they're doing is, sort of sitting down with a position with all our cards set in place and saying, okay guys. What are we going to do about this? Do you want to supply us or don't you? And if the Russians make a deal, the amount of potential supply through that pipeline will essentially cap LNG imports.

There's been a presentation by one of the CNPC executives, which in his forecast going out -- and I never know whether the oil

companies in China speak for the government or not -- but at any rate, it's an oil company statement, and he has imports increasing rapidly and then 2030 just flat-out as a combination of local production, one assumes shale gas. Now, that may be advertising, but what you're saying is this rapid growth that everybody expects for China may hit a brick wall. I think it will but, you know.

MR. EBINGER: David?

MR. GOLDWYN: Yeah, I just wanted to respond on the China question. Thanks. David Goldwyn. The U.S. Government actually has quite a great deal of cooperation with China on shale gas. You have from the State Department the U.S.-China Shale Gas Initiative where the U.S. Geological Survey is doing an assessment of the Sichuan Basin and training the Chinese on how to do resource assessments.

MR. JENSEN: That's really interesting.

MR. GOLDWYN: The Department of Energy has an energy policy dialogue, I think running two years where they bring U.S. companies to China to explain the technology and talk about the investment framework and how that might help China as well, and I think the Trade and Development Agency has done training on shale gas markets and transportation for China as well.

So, I think there is actually a great deal of ongoing

cooperation, and for obvious reasons the more gas that China develops for itself the less it needs to get those resources from places of concern. So, I think it's actually quite robust, as I understand, continuing.

MR. EBINGER: Margot?

SPEAKER: If I can get one more question, and that is the policy issues involved here. We have heard a great deal over the last three or four years about exploiting America's resources for this country, with the implication that if oil is brought up from under U.S. lands or gas is retrieved in the United States, it's going to be sold here, and that's what we're talking about, that not being the case at all, particularly in Alaska, about exploiting those resources for export.

How do you all see this issue? And should, frankly, for both oil and gas -- should America's resources -- which are once they're burned, they're gone -- be kept here for long-term use in the United States? Or should we go ahead and export them because that's the best thing for the market right now?

MR. JENSEN: Let me take a crack at that. I've been around a while, in fact we were the marketability consultants of the Alaska gas pipeline way back when. And I for a long time was very much against exporting Alaskan gas to Asia, and the real reason is there are a lot of resources up in Alaska and once you put the pipeline in place it's a fact on

the ground. And if it's essentially dedicated to Asia, you've said some things about ultimately being able to use it in the Lower 48.

Interestingly enough, the debate now is -- the fact that we've discovered such big shale gas resources in the Lower 48 and the chances of building that Alaska line down to me says my opposition, which was always instinctive, is now gone. I don't much care anymore, I'm quite willing to export. But for a long time, to me the issue was if we built the pipeline, devote it to Asia, it's going to be very difficult at any future time to connect the resources to the Lower 48, and I think there were long-term implications to that that I didn't like, so.

MR. RATNER: I think part of the debate gets back to something that Ken said earlier about the rents. I mean, is it going to be -- you know, is there going to be the same opposition to exporting petrochemicals overseas to what we're seeing, you know, on natural gas? And so, is it going to go to the producers of natural gas or is it going to go to the consumers of natural gas, who then may look to export products because they have a cheap feedstock? I think that all factors into the debate.

MR. EBINGER: Well, as a longstanding supporter of exporting Alaskan oil, back when we used to debate that, I believe very strongly that you need to let markets operate and if there's market and

entrepreneurs take the attitude -- particularly on these longer-term investments -- that they're willing to take the risk, I think the minute you start talking about domestic economic protectionism it's a slippery slope, as Mike was just saying, on who benefits. And I think back to all the years when we had mandatory oil imports, quotas, and havoc we unleashed with the entitlements program with old oil and new oil. And Jim Sleschinger used to say you don't know what hell is until you go to the Congress and have to argue about, what was it, 21 different prices for natural gas or thereabouts? It just creates havoc in the marketplace, and I'd stay away from it.

MR. JENSEN: Let me make a distinction between gas and oil, and that really is the infrastructure distinction. The fascinating thing about Europe is that Russia and also now China, Turkmenistan, are command and control economies. The joke in the gas business used to be how many pipelines would have been built from West Siberia to Europe if they'd had a market economy? The answer is somewhat more than one and somewhat less than seven that are there now.

And you look at the pipeline from Turkmenistan to Shanghai -- I remember to talking to some guys at Exxon before the merger with Mobile, and they had a position to what was called the Silk Road Pipeline and they said, gee. We can't afford to walk away from that but we sure

hope to hell nobody moves on that very fast. The Chinese built it in three years, none of the major companies are there.

What you're seeing is infrastructure, which dedicates certain supplies to various markets put in on ground rules that we don't like. And my economic sense is that's inefficient and it shouldn't work, but it has implications that are longstanding and they're very much gas implications.

LNG is not the same thing, but big pipelines are in that category and, you know, you sort of say, the Chinese are saying they have a new model. I don't believe it's right, but I'm a little uncomfortable.

MR. RATNER: And also on the LNG side. I mean, a few years ago all the -- I mean, there's a reason why, you know, they're looking to convert the import terminals because they're idle. You know, in our market people made a bet on imports and they lost, so.

MR. EBINGER: You know, some people have begun to argue that with the President's announced pivot towards Asia, that maybe you know, Alaskan gas and a special deal -- not that I necessarily support this -- but a special deal with Japanese industry and the Japanese government put resources in to help building that pipeline. That the market targeted to Japan could be an important part of our long-term Japan-U.S. strategic relationship. I don't know whether that's sound policy or how real the idea even is, but it's an interesting idea.

Any more questions? One back against the door.

SPEAKER: I was just wondering from the Congressional point of view if there's actually been backing from the states because obviously as we finally saw with the Bakken, you finally get increased wellhead prices, higher severances taxes, and higher royalties. So, has there been some backing from the large states -- be it Wyoming, Texas, now Pennsylvania -- to kind of get behind these initiatives and hopefully give it the power to push -- to get the permitting process sped up? Or is this sort of completely on the back burner?

MR. RATNER: I think for the other states if you go to the DoE website and you look at the various applications, the state of Louisiana has been very active in writing. I haven't noticed anything really from any other states. Maybe -- no, I couldn't recall if there was anything from any Texas members regarding it, but most of at least what I've seen on the DoE website has come from Louisiana. I haven't seen anything from any other states supporting or -- well, I guess Congressman Markey's letter to DoE. But outside of that, I haven't really seen anything on the outside, either.

MR. EBINGER: In the middle here?

MS. MUCHANIC: Hi, I'm Christine Muchanic with Height Analytics. It seems like most of the debate is -- you know, we're basically

assuming that U.S. energy future is based on development of natural gas including, you know, hydraulic fracking. Do you think that that is a correct assumption? Are there any deal breakers in there that people just aren't focusing on that much that could really change the landscape for U.S. natural gas future, and what do you think those may be that are in the realm of realistic? Other than some catastrophic or amazing technological breakthrough that changes the game?

MR. MEDLOCK: I think if you're just looking through today's lens, natural gas really is, you know, it. I mean, when we think about what's moving the way we consume fuels in this country.

Now having said that, some people might focus to, well the EPA is going to have its final release on the study of the risks of hydraulic fracturing and groundwater, so on and so forth. In 2014 they've moved that timeline to, which is, if you ask me, absolutely ridiculous because to be perfectly honest we wait to 2014 to see, you know, a release by EPA and then a proposed rulemaking, so on and so forth, you're on into 2015 before anything's actionable. The ship will have already sailed, because by then we'll be at 35+ percent of domestic gas production and you're just not going to shut that down. The political fight will be enormous. And so, when you think about the pace at which things are going, I really think we have to continue to look at natural gas.

Now, it's important that industry really take on its own shoulders, you know, some of the responsibilities associated with continued sustainable development, right? To use a buzzword, right? But it is important that we make sure that everything is done in a safe and responsible manner so you don't have this upwelling of environmental local opposition that we've seen in the past, you know, year, basically. That's largely due to mistakes that the industry has made.

So you know, I think you're starting to see that. You're starting to see a mobilization and an education, if you will, and at least an attempt at educating the general public. It's going to be interesting to see how things play out over the next year or two, but I still even with all that said think natural gas is really what we're going to be focused on for a while.

MR. EBINGER: Time maybe for one more question, if there is one? Yes.

SPEAKER: (Inaudible) from Carnegie. My question is about the comparative economics of potential U.S. exports to the European markets versus existing pipeline gas imports in Europe, especially Russian gas but also potential Caspian gas to Europe. How does this U.S. export compare to that?

I mean, is it possible that U.S. LNG could actually help

Europe diversify its imports without a need for significant Caspian gas, for example?

MR. JENSEN: Complicated question. Basically, Caspian exports are very expenses. In market economic terms, those pipelines are costly and it's complicated in -- well. What you now have is a battle between the European Union, the Russians, and the Chinese to control Caspian natural gas. The problem with Caspian natural gas is that the good gas is on the Eastern shore of the Caspian. The Caspian is not an ocean subject to the law of the sea, which means that you do not have the ability -- basically, the literal states will argue that you cannot build a trans-Caspian pipeline to move the stuff across the Caspian without getting agreement of everybody, and that includes Russia and it includes Iran, and they're not going to say yes.

Now interestingly enough, the big oil is Kazakhstan, also in the East, but you can tanker that across to Baku and put it in oil line and take it down to the Mediterranean and ship it out. You can't do that with gas.

Now essentially, Nabucco -- which is the European effort to try to get at that Caspian gas -- the Shah Deniz gas in Azerbaijan, which is on the West shore, isn't big enough to support the pipeline. You don't have the supply really to make that thing fly, and it's been floundering --

the European Union is trying to make it go.

The Russians have been proposing South Stream, which is a pipeline that would take their stuff -- they would buy from Turkmenistan, as they do now, and they would be able to move that and move their own caucuses supplies through the Black Sea in a deepwater line. South Stream is on the table as a potential competitor to Nabucco.

The interesting thing about that is that the economics of deep water pipelining -- the Blue Stream line, which goes from north to south, is in place; 7,000 feet of water depth, so the technology is there. But west to east you need compressor stations because of friction losses. And essentially, the farther the distance the economics just go to pot in a hurry. So essentially the South Stream line I don't think is economic at all.

So essentially you get Turkmenistan sitting there saying, what do we do? We can negotiate with the Russians, we don't like them. We can talk to the Chinese. We can't figure out how to get to Europe. And all of that is part of the debate that's going on, and LNG is a means for Europe to diversify away from Russian pipeline supply, so the Russians would like to go to China.

I mean, the Caspian is really a cockpit of international natural gas, geopolitical negotiation, and it's very hard to figure out but it's fascinating.

MR. EBINGER: Picking up on that, do you know -- have you seen any data on the new finds in the Eastern Mediterranean and how they might complicate the picture further?

MR. JENSEN: Well, the new finds in Eastern Mediterranean are interesting but they're small beer in world LNG. I mean, they're big and, god, for Israel they're tremendous. You know, they potentially make Israel a potential energy exporter. But they're kind of an extension of what's been going on in Egypt and so that's not big.

The one that intrigues me very much is East Africa because there are two new discoveries there. ENI and Anadarko have discovered what looks to be -- you know, they're talking about possibility of coming up with 30 million tons of export capacity. At this point, you know, Qatar is 77 million tons. That's a big factor.

Now, I haven't been able to find anybody who could tell me what the quality of that is, but if that's got liquids in it, Katie, bar the door, because that would be very cheap to develop and that would have some impact.

MR. MEDLOCK: Just one quick additional note on your question. I think the biggest issue that will affect European gas markets is not something that will happen in Europe, it's something that's going on in Russia and it has to do with internal pricing reforms. Russia sells roughly

70 percent of its gas domestically at highly subsidized rates. That makes it difficult if you're gas-prone to generate enough cash flow, if you will, to reinvest in some of the more expensive fields they have, say, up in the Kara Sea and Yamal Peninsula.

As they begin to reform prices internally, that actually will begin to free gas prompts to be more competitive with its gas pricing into Europe. And so, that's something that's going to be interesting to watch because if they fully reform gas prices domestically, that's going to allow them to effectively engage in a price war for European market share, and that's going to be, I think, really interesting to watch over the next decade.

MR. EBINGER: Well, I want to thank all our panelists very much for an engaging discussion, and thank you all for coming.

(Applause)

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