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HARVARD Kennedy School
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North American Oil and Gas Reserves: Prospects and Policy

Faculty Research Working Paper Series

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Harvard Kennedy School

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Harvard Kennedy School

August 2012
RWP12-039

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Environment and Natural Resources Program

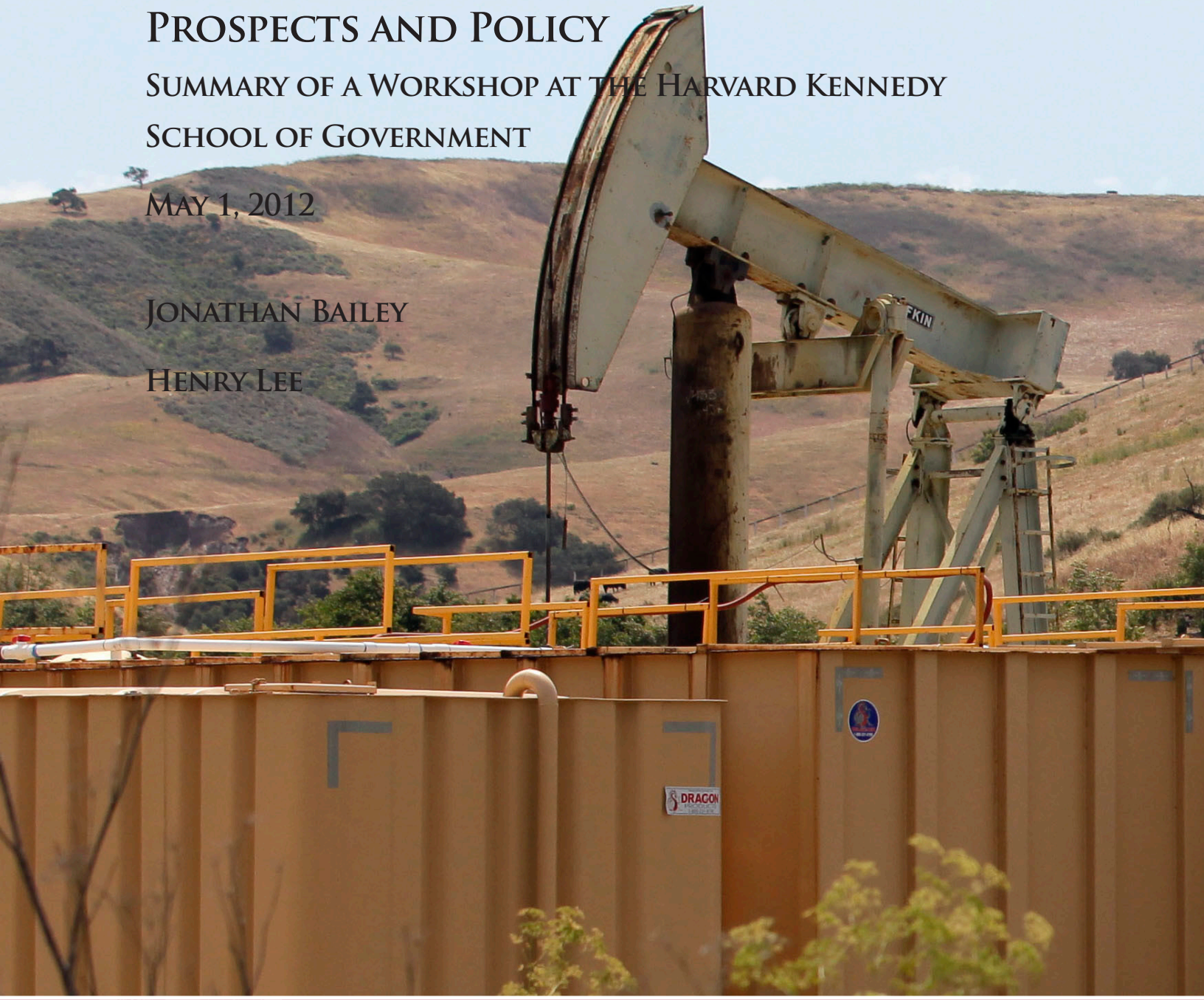
North American Oil and Gas Reserves: Prospects and Policy

Summary of a Workshop at the Harvard Kennedy School of Government

May 1, 2012

Jonathan Bailey

Henry Lee



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NORTH AMERICAN OIL AND GAS RESERVES: PROSPECTS AND POLICY

SUMMARY OF A WORKSHOP AT THE HARVARD KENNEDY SCHOOL OF GOVERNMENT

MAY 1, 2012

JONATHAN BAILEY

HENRY LEE

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BELFER CENTER for Science and International Affairs

JULY 2012

FORWARD

Expanding estimates of North America's supply of accessible shale gas, and more recently, shale oil, have been trumpeted in many circles as the most significant energy resource development since the oil boom in Texas in the late 1920s. How large are these resources? What challenges will need to be overcome if their potential is to be realized? How will they impact U.S. energy policy?

To address these questions, the Belfer Center for Science and International Affairs and two of its programs — the Environment and Natural Resources Program and the Geopolitics of Energy Project — convened a group of experts from business, government, and academia on May 1, 2012, in Cambridge, Massachusetts. The following report summarizes the major issues discussed at this workshop. Since the discussions were off-the-record, no comments are attributed to any individual. Rather, this report attempts to summarize the arguments on all sides of the issues.

The policy implications of significant additional supplies of domestic oil and gas to the United States are far ranging. Due to time constraints, many important issues were not covered in the depth that they deserved. Examples would include the impact of additional oil and gas supplies on existing U.S. efforts to reduce carbon emissions and its historical commitment to support other fuels, such as coal and nuclear power, or newer options, such as wind and solar energy. Further, as one participant pointed out, officials from industry are constrained under U.S. antitrust laws from sharing proprietary information.

I would like to thank BP and the Roy Family Endowment for providing financial support for the workshop. I would also like to thank Dan Schrag, William Hogan, and Meghan O'Sullivan for their counsel and advice. Ashley Gagné and Jo-Ann Mahoney were part of a team, led by Amanda Sardonis, who handled all the administrative and logistical details leading up to the event. Finally, Jonathan Bailey conducted the background research and served as the rapporteur for the workshop. I owe all of these individuals my gratitude and thanks for all their efforts on this project.

Henry Lee

ENVIRONMENT AND NATURAL RESOURCES PROGRAM (ENRP)

The Environment and Natural Resources Program at the Belfer Center for Science and International Affairs is the center of the Harvard Kennedy School's research and outreach on public policy that affects global environment quality and natural resource management. Its mandate is to conduct policy-relevant research at the regional, national, international, and global level, and through its outreach initiatives to make its products available to decision-makers, scholars, and interested citizens.

More information can be found on ENRP's web site at www.belfercenter.org/enrp. Or contact enrp@hks.harvard.edu. Environment and Natural Resources Program, Belfer Center for Science and International Affairs, Harvard Kennedy School, 79 JFK Street, Cambridge, MA 02138, USA.

Cover Photo: In this photo taken Wednesday, June 1, 2011, an oil pump jack is seen in Santa Maria, Calif. In a place where oil exploration long co-existed with agriculture, a three-story contraption humming day and night in the heart of Santa Barbara wine country struck residents as a mere curiosity until someone uttered the petroleum industry's dirty word: fracking. (AP Photo/Jae C. Hong)

INTRODUCTION

For a generation, policymakers in North America have been concerned about increasing dependence on imported oil and natural gas and the resulting exposure of North American economies to global supply constraints. Yet in the space of a few short years the narrative has changed abruptly. With the major recent expansion of extraction of unconventional sources of oil and natural gas, North America has not become the major importer of LNG previously forecasted, and crude oil imports into the U.S. have declined. Enormous growth in shale gas, which now accounts for 30% of U.S. natural gas production, has contributed to prices at as low as $2/MMBtu, with massive spreads against the $14/MMBtu charged in Singapore and other East Asian countries.

The change in estimates of production, exploitable reserves, and prices has attracted national attention. President Barack Obama in his 2012 State of the Union address heralded a future of cheap natural gas. *Fortune* magazine devoted its April 30 edition to the issue. Yet concerns about adequate regulation, particularly of environmental issues associated with fracking, have led to public debate about the full implications of the boom in unconventional oil and gas resources.

To explore the issues in more detail, a group of academics, industry experts, policy analysts and commentators, and practitioners convened at the Harvard Kennedy School on May 1, 2012 to discuss the prospects for North American oil and gas as well as the policy implications that these recent changes imply.

This report summarizes the discussion. As with the workshop, this report does not strive for consensus. Rather it articulates different perspectives on the prospects for North American oil and gas and the various policy challenges that they present.

A. PROSPECTS

The last five years have been an extraordinary time for oil and gas in North America. In 2008, shale gas production was less than 3 Tcf (or 8 Bcf/d), yet by 2011, production had jumped to 7 Tcf (or19 Bcf/d). At the same time, estimates of technically recoverable reserves were increasing dramatically. The EIA more than doubled its estimate of technically recoverable U.S. reserves to 827 Tcf in 2011, only to reduce its estimates earlier this year to 482 Tcf, citing new data from the Marcellus formation.

While much of the media attention on fracking has been associated with shale gas, shale and other unconventional oil have also seen significant increases in production. Much of this production has come from North and South Dakota, but Montana, Colorado, Pennsylvania, Texas, and New York all have significant exploitable reserves. Yet the story is not just about new reserves; unconventional extraction techniques pose real opportunities for enhanced recovery from old oil wells where some 60-70% of the oil remains.

As we consider the prospects for North American oil and gas reserves three big themes emerge:

1) Reserve and production growth

2) Price and implications of firm-level economics

3) Scale and location of demand.

A.1. RESERVES AND PRODUCTION GROWTH

Participants agreed that due to the recent unconventional oil and gas development and the potential for enhanced production from old wells, recoverable North American oil and gas reserves have increased substantially over the last few years. While some participants went as far as to talk of the continent being a ”new Middle East,” most stressed that production costs, uncertain depletion rates, and growing environmental concerns meant that translating geological and technical estimates into actual supply may be a greater challenge than many people realize.

Liquids

Participants were presented with a range of forecasts for North American oil and gas production growth through 2020. The EIA and IEA projected U.S. petroleum liquids supply to grow by 0.8 million barrels of oil per day (mb/d) and 1.8mb/d by 2020 from 2011 production levels of around 9mb/d. The National Petroleum Council’s projections were bolder, projecting as much as an additional 2.3mb/d over 2011 levels. Citi’s internal modeling resulted in even more extreme

predictions, with an estimated 6.6mb/d additional U.S. liquids supply by 2020. Citi's forecast included an additional 2.5mb/d from deepwater sources and 2.3mb/d from shale liquids. Citi predicted that due to lower production costs, firms would prioritize shale liquids over deepwater extraction. It was pointed out that there are less than 100 deepwater offshore wells compared to 5,000 shale liquid wells. Participants generally agreed that the divergence in the pace of production growth between the two sources would continue.

Another aggressive independent forecast based on a bottom-up analysis of wells suggested that unconventional sources are likely to account for a significant portion of medium-term growth in North American production. It was noted that the ramping up of production in the Bakken and Eagle Ford formations has been faster than previously acknowledged. While in December 2011, Eagle Ford was producing less than 200,000 b/d, the most recent data shows that production is at over 300,000 b/d of crude. Given that Eagle Ford had no production at all in 2009, the ramp up has occurred much faster than projected and may indicate that production from other fields could also develop quickly. Based on these production curves, the independent forecast estimated that by 2020 the technical potential of shale and tight oil could be 3-6 mb/d.

However, many other participants, including several from industry, were less bullish about U.S. growth in liquids. They noted that even after the recent surge in oil production from shale formations and other sources, the United States remains a significant net importer of crude oil. They argued that due to both the technical difficulties of ramping up production and policy and infrastructure uncertainties, more conservative estimates for production growth were appropriate. They argued that the United States will likely remain a significant net importer of crude oil for the foreseeable future, although imports from outside the western hemisphere could decrease to zero.

Since the workshop focused on North American oil resources, participants discussed the potential impact of crude oil production in Canada and Mexico. The boldest forecasts suggested that total North American liquids production could increase by 11-12mb/d by 2020, with Canada accounting for up to 6mb/d of incremental supply. Most participants did not expect Mexico's imports to increase over the decade.

North American natural gas reserves

Several participants argued that natural gas growth in North America would primarily be driven by pursuit of shale liquids over the medium term. Production growth was primarily expected to come from the United States with the potential for some additional Canadian production.

A range of forecasts were presented to participants, including a conservative view from the IEA that would see negligible production growth through 2020, with production remaining around 23

Tcf/y. The EIA was bolder; projecting growth of up to 26 Tcf/y, equivalent to an additional 8 Bcf/d. Citi was even more optimistic; projecting growth to 28 Tcf/y, equivalent to an additional 15 Bcf/d.

The major differentiator between the forecasts was the pace of additional shale gas production. Citi went as far as predicting that shale gas would account for 10 Bcf/d of the additional 15 Bcf/d production that they predicted by 2020. Not everyone agreed with Citi's forecasts. Several participants argued that its short term estimates were much too high and it would take longer to ramp up production, especially at the lower prices now experienced in the market.

Technology

There was general agreement that growth in U.S. production was heavily dependent upon assumptions about technology and learning curves. Hydraulic fracking techniques have been in use since 1947, but have advanced rapidly in the past fifteen years.

Some participants argued that market consolidation and the entry of the major firms might accelerate technology innovation. Others were skeptical. They pointed out that shales vary substantially between fields, and so a firm that has made progress on the learning curve in one field would not necessarily be able to apply the same techniques and innovations to another.

Yet the pace of technological advance is increasing. The EIA admitted that its production forecast models have been frequently beaten by real world activity. A range of observers noted that industry learning curves have been stronger than expected, pointing to firms leaving areas undrilled in order to focus on wells and fields that are likely to be more profitable. For example, firms left fringe areas of the Barnett undrilled so that they could move on to the Marcellus.

It was also noted that the cycle time between shale technology experiments appears to be falling, accelerating the pace of innovation. A parallel was drawn to California and steam-enhanced oil recovery. However, some participants argued that this fast pace may be disrupted by larger firms. These companies have the potential to increase R&D spending, but one participant argued that they may have an incentive to slow the pace of experimentation in order to maximize return on R&D investment and avoid a temporary surplus of supply.

It was pointed out that some horizontal drills are now 10,000 feet long compared to 2,000-3,000 feet only a few years ago. While some participants projected that these longer laterals would reduce costs and increase peak production per well to around 550b/d from 350b/d, others argued that the marginal rate of production would decline with extended lateral drilling. The latter were more pessimistic about whether the recent pace of innovation could be maintained. Others were more optimistic.

One participant pointed out that there is potential for expanding the use of fracking, not just to new formations in North America, but to old abandoned oil wells. Fracking technologies used on old wells in the San Joaquin Valley have increased production in that field from 15b/d to 1,500-2,000b/d.

A.2. Price and Implications of Firm Level Economics

Several participants estimated that oil prices would be in the range of $70-120/b through 2020. However, others suggested that prices might fall below this range for a short period of time if the present gap between supply and demand grew wider. Most felt that U.S. oil production was likely to be relatively price inelastic, on the assumption that most U.S. wells were profitable at $50-60/b. An independent bottom up analysis suggested that transportation and infrastructure costs could contribute to higher production costs and argued that less productive shale liquids might have production costs of $80/b through 2015, dropping to $70/b by 2016-20.

There was much less consensus on where North American natural gas prices would be over the medium term. While most participants argued that the current price of $2.34/MMBtu (up from $2.00/MMBtu a few weeks prior) was unsustainably low, projections for the medium term remain uncertain, ranging from a low of around $4/MMBtu to as high as $9/MMBtu. There was no consensus on this topic.

Firm level economics

What will drive natural gas prices above their present low levels? Participants cited several factors. First, day rates for rigs have been growing as demand for drilling equipment has increased. Second, decline rates in certain formations have been faster than anticipated, although several individuals argued that this shift was caused by changes in the types of wells being drilled and differences in the amount of activity in certain basins as compared with other basins.

Third, many E&P firms signed expensive leases at a time when natural gas was projected to be at $8-10/MMBtu and now find themselves having to exploit the leases or risk losing them. This is part of the reason why so many E&P companies have farmed out leases to larger firms in order to raise sufficient cash to continue operating these leases. There is likely to be some rationalization in the industry, and this too will put upward pressure on price.

As long term contracts unwind it is likely that increasing supply will shift to the spot market, where prices will rise. It is also possible that the spot market has been suffering from a lag effect in which the lack of effective infrastructure has meant that even when wells have been drilled there has not been a gathering system in place to enable production. This scenario has meant that the market has repeatedly seen significant volumes of pent up supply appearing as soon as

infrastructure is completed. As pipeline construction continues and exploration slows due to low prices, this lag effect may be reduced, if not eliminated.

Larger companies and internationals

Several participants argued that some firms have been operating at below variable cost, but these were thought to be primarily international firms. A PFC energy study estimated that some basins can be developed prices as low as $3/MMBtu, but that some of the international companies have variable costs of $7/MMBtu. China, Norway, France, India, and others have all made purchases adding up to $17-19 billion in investment since 2009. In many cases, these investments have been intended to allow them to "learn the technology", which they can then export to other parts of the world.

However, many participants were skeptical about whether the U.S. experience is easily transferable abroad. U.S. ownership rules related to sub-surface rights have been a key driver of support from individual land owners, who earn royalties and leasing fees from production. In other countries, where sub-surface rights are held separately, the political pressure to expand production is likely to be weaker and environmental concerns given more prominence. Indeed, efforts to mobilize investment in order to exploit shale resources in India, Poland, and France have all sputtered.

As smaller companies face increasing economic pressure, they may try to sell their leases, if not their companies, to larger firms. History suggests that the latter will bring greater technical skill, a better ability to manage service contractors, and a greater focus on reducing waste. Participants agreed that this will likely drive down costs and increase efficiency.

But some participants argued that the entry of the larger companies may also slow the expansion of supply, as competition could be reduced. At one point there were over 100 firms active in the Barnett gas field. That competition led to rapid increases in supply and put downward pressure on local prices and upward pressure on labor and equipment costs. As larger companies entered the field, production projects have consolidated within the basin, which, some participants felt, will eventually lead to lower output. Some felt this trend would expand to other basins, lowering overall production and increasing prices.

A.3. Scale and Location of Demand

Demand for oil

The United States has seen a reduction in demand for crude oil of around 2mb/d from its peak demand in 2005-6. This has been driven by structural changes in demand, including demographic shifts and behavioral changes, such as reductions in vehicle miles driven. New CAFE standards

and better industrial conservation are likely to accelerate this reduction over the medium term. One estimate suggests that demand will decline by a further 1-1.5mb/d by 2020.

Demand for natural gas

The future of natural gas demand is far less clear, and supply could significantly outrun demand. Additional demand is likely to come from residential and industrial uses. In particular, many coal power stations are likely to be retired soon (particularly if new EPA regulations on carbon intensity are implemented). One participant estimated that within 15 years coal might account for 35-40% of U.S. power generation compared to 48-50% today.

However, while a number of chemical companies have signaled that they are considering big capital investments, it is not clear how many will actually deploy capital and how fast. Many have suggested that they are waiting to see how prices stabilize before making investments, as they expect to enter long term contracts with natural gas suppliers.

The United States is likely to be among the lowest cost providers for ethylene and other feedstocks, and as a result, energy-intensive industries like fertilizers, steel, glass, and petrochemicals may see a revival in the United States. Furthermore, cheaper energy generally could have a stimulative effect on the economy. One set of forecasts estimated that low energy costs related to natural gas could contribute 1.4% real GDP growth/year.

Growth in CNG use in vehicle fleets is another potential source of demand. One set of forecasts estimated that 1 Tcf/y of additional natural gas demand could come from CNG vehicles by 2020. However, many participants were skeptical of this claim, arguing that the cost differential between CNG and petroleum is insufficient to shift demand. Further, there is a lack of existing infrastructure to support a network of CNG fueling stations. Participants were more optimistic about the use of LNG in large trucks.

There were divided views on whether gas-to-liquids might provide an opportunity to use natural gas to profitably produce petroleum products. Many participants argued that GTL plants involve enormous capital expenditure and that based on Shell's experience in Qatar, they are only likely to be successful with low long term gas prices, relatively high crude oil prices, and very long term contracting for supply and production. While some participants argued that the scale of the spread between North American natural gas and crude oil prices provided the potential for profitable GTL, others were not convinced the spread would last into the medium term.

Natural gas is also used to produce methanol, a liquid transportation fuel as well as a precursor to numerous chemical products. Several participants argued that producing methanol from natural gas is less costly than GTL processes and it would be relatively inexpensive for automakers to

enable cars to use gasoline-methanol blends. There was insufficient time to discuss the economics of widespread conversion to methanol, but it was an option that deserved scrutiny.

Infrastructure

One of the most significant challenges is how to link new sources of oil and gas to demand. Given that many of the reserves are mid-continent, the pipelines required to link them to coastal demand centers are significant. The debate surrounding the Keystone XL pipeline may be the most prominent example of this issue, but it is unlikely to be the last. With 2mb/d of additional production expected from the Dakotas by 2020, existing pipeline capacity will be overwhelmed. Already, North Dakota is moving some oil by rail. However, one participant pointed out that, compared to electricity transmission lines, most pipeline decisions have not faced major local or national opposition and progress is being made.

North America already suffers from having refining capacity located a significant distance from shale liquids and gas, but the situation may be exacerbated by recent consolidation in the refining industry. If North American production increases substantially through 2020, the United States may actually end up short of refining capacity in locations that are closest to domestic resources.

Legislation such as the Jones Act also complicates matters by limiting the movement of refined products within the United States. In particular, these laws prevent finished gasoline from being shipped to the East Coast from Houston, despite this being the cheapest route. The restrictions on exporting crude and LNG are also a challenge, particularly when GTL can secure $14/MMBtu in Singapore, compared to the current price for natural gas of $2.34/MMBtu in the United States.

B. POLICY

While the technology and supply side story for North American oil and gas reserves looks positive, there are a number of policy challenges to the bolder production forecasts. Shale gas has been presented as both a potential breakthrough for relatively low carbon intensity economic growth and as an environmental threat. As one participant noted, the policy issues are ultimately "people" issues, not technical or supply issues. Firms, investors, regulators, and policymakers will have to address this "people" perspective more directly than they have to date if the potential of shale gas and liquids is to be fulfilled.

As we consider the policy implications of North American oil and gas reserves, four big themes emerge:

1) Environmental and community concerns
2) Regulatory institutions
3) Energy independence
4) Exports

B.1. Environmental and Community Concerns

Carbon and methane emissions

The debate over greenhouse gas emissions from producing, transporting, and burning natural gas is not specifically focused on shale gas, but rather on whether natural gas can serve as a bridge fuel to a less carbon intensive energy mix. Several experts have argued that methane emissions from natural gas use could increase greenhouse gas emissions, and that increasing gas consumption over the next two decades would be a major environmental mistake. This view did not gain much traction among the participants, who questioned the estimates of methane emissions behind this analysis. Although there was strong support for increasing the use of natural gas, several individuals argued that the industry should identify ways to reduce natural gas's greenhouse gas footprint.

Water

Water is the most visible of the major environmental concerns. A recent Resources for the Future study suggests that the public is most focused on the risk to groundwater from fracking. Another participant shared data from a University of Texas study of residents in the Barnett field, which reported that people in that area are more concerned about water contamination than the revenue they might be able to capture from shale gas production on their property.

Many participants argued that there are real risks around water and fracking that needed to be considered. Some mentioned the risk of groundwater contamination, others noted that fluid from wells is rarely 100% recycled and is often trucked long distances for disposal. It was also pointed out that we know very little about the long term effects of high methane content in disposed water, or if water drawn for use from local sources is altering ecosystems.

One participant noted that studies of the impact of fracking on water sources are improving. He pointed to a MIT study that looked at the 25-40 documented accidents over the last 6-7 years of natural gas production from over half a million wells. This finding indicates a very low accident rate, a contextual element which is not reflected in the discourse around shale and fracking.

Other participants emphasized the need for more thorough and systematic data collection and analysis, noting that regulators have taken only limited action to conduct comprehensive water management studies, and that the level of measurement and disclosure of water incidents by firms is low and that this makes data on performance unreliable.

Community disruption

The Resources for the Future study noted above found that even if people were convinced that the threat from fracking to groundwater was minimal, they were very concerned about the community disruption caused by new wells and associated infrastructure. The pressure on relatively remote areas of the Dakotas and Pennsylvania has been dramatic, including increased traffic on local roads, and resulting impacts on home prices and the air quality near schools. Participants noted that some states have begun investigating ways to compensate communities for disruptions, with Pennsylvania providing issuing grants to affected groups.

B.2. Regulatory Agencies

States

Participants pointed out that enforcement of most environmental regulation is delegated to the states, and this delegation is unlikely to change even if the federal government is given greater responsibility. Others argued that states have different geology, topography, economics, and politics, and that state officials have a better understanding of these differences than officials in Washington. There was a strong feeling that the division of regulatory responsibility between the

federal and state governments is not likely to change significantly. Hence, efforts should be made to increase cooperation between the two levels of government, rather than shift the locus of responsibility.

Others argued for shifting more responsibility to the federal government. Their argument is that regulations can differ significantly from one state to another. This retards the ability of the industry to grow and innovate. There was a concern that while states with experience with oil and gas operations, such as Oklahoma and Texas, have the capacity and knowledge to regulate oil and gas development, states without prior experience do not.

Role of industry

It was repeatedly underscored that one of the major challenges is the lack of transparency around the environmental and community impacts of industry activities. Given the potential for thousands of wells to be drilled over the next decade, companies ought to be doing more to actively manage risk and engage regulators and communities. Several participants argued that some firms have been slow to measure, disclose, and regularly report their impact on the environment and the local communities. . Parallels were drawn to how industry previously got out ahead of regulators on air particulates from diesel engines by crafting positive long term solutions.

It was suggested that the industry needs to establish clearer and tougher self-regulation. One participant noted that the National Petroleum Council has announced the establishment of a consortium of 11 companies to develop standards and practices for exploration and production of Appalachian shale. Some participants felt this consortium might provide a model that could be replicated in other regions.

However, others were less positive. They pointed to the Marcellus Shale Coalition as an example of an industry group that shares ideas, but has made little actual progress on measurement of operational activity, disclosure, or improving industry practices.

Some participants pointed out that that industry needs to be especially sensitive to any actions that could be seen as anti-competitive behavior. For example, if larger companies work together to push standards that would disproportionately hurt smaller E&P firms, these smaller firms will claim that the industry was using unfair market power and will seek redress in court. Others were skeptical of the risk of anti-trust action and pointed out that a dozen or so firms account for over 80% of the fracking jobs, and that if they were to sign up to greater measurement, disclosure, and improvement, real progress could be made regardless of the smaller E&P firms.

B.3. Energy Independence

The production volumes outlined in the Prospects section clearly indicate that North America and the Unites States have the potential to become less reliant on imports of oil and natural gas. Some have argued that this creates the potential for greater energy independence.

Economics

A number of participants pointed out that the United States is exposed to global oil prices regardless of how many barrels of oil it imports. Certainly lesser volumes of imports will reduce some of the macroeconomic impacts, but it would be wrong to argue that the United States could eliminate the problem of global energy security.

Given that autarky is not a practical policy option for North America, participants explored how energy independence needs to be considered in the context of imports and exports, both of oil and natural gas, but also of other goods and services.

If domestic production is ramped up and oil imports fall, aggregate consumption and savings will go up and the current account balance will return to levels prior to the disruption. The only significant difference is that in an energy independence scenario, spending is bottled up within the domestic economy rather than being spent on foreign oil.

In essence, participants broadly agreed that energy independence is an unhelpful term, as North America is likely to continue to be exposed to OPEC's activities and price volatility in global energy markets.

Politics

Even if the economics of energy independence do not support U.S. energy isolationism, participants agreed that there were likely to be political ramifications from increased North American oil and natural gas production. Several participants argued that it would likely reduce U.S. engagement in the Gulf, and that China was already concerned that the Unites States would be less involved in protecting oil tanker lanes at sea. Whether these scenarios come to pass remains to be seen.

Participants also focused on the interplay of domestic and foreign politics. It was noted that it is not clear if the energy independence rhetoric will trump domestic environmental and community concerns. If North America becomes an exporter of shale liquids and natural gas, will local communities be as supportive of production for the perceived benefit of Europeans and Asians?

B.4. EXPORTS

Setting aside the relevance of the term "energy independence", participants agreed that there was an important discussion to be had about whether North America is likely to become a net exporter of crude oil and natural gas products, as well as a more substantial exporter of finished petroleum products.

Current U.S. exports status

Several participants noted that while the Unites States is a net importer of crude oil, in 2011 it became a net exporter of refined products such as kerosene, jet fuel, and gasoline. Participants explained that this is in part due to reduced domestic consumption, but also an increase in the use of ethanol, displacing highly priced gasoline. Growing domestic production of oil and the spread between the price of Brent and WTI crude has allowed Gulf Coast refineries to profitably produce more finished products for export. These refineries are processing significant volumes of imported crude oil to create final petroleum products. It was argued that the U.S.'s reliance on imported crude means its status as a net exporter of final petroleum products is more of an accounting outcome than a reflection of reality.

LNG

While a number of LNG receiving facilities exist in the United States, debate is now shifting to the question of whether export LNG facilities should be permitted and built. While several participants thought that this was an obvious way to capture value from higher international natural gas prices, others were more skeptical. Some pointed out that it is very expensive to build an export LNG facility and that "converting" an export facility to an import one still requires substantial new work. There was also some concern that by the time any LNG export facilities were online, Asian and European markets might see price declines as regional shale gas reserves are exploited and the LNG supplies become more plentiful.

However, several participants argued that on the margin, exporting LNG would play an important role in narrowing the price differentials between Europe, Asia, and the United States and in reducing global price volatility. Will Congress and the American public be willing to see U.S. supplies of "inexpensive" natural gas sent to China as opposed to fueling the U.S. economy? The answer to this question is far from obvious.

CONCLUSION

For a generation, North America has been concerned with peak oil and the potential for long-run oil and natural gas price increases. The case for either is much weaker today than ten years ago. The prospect for relatively abundant and less expensive energy sourced from within North America has the potential to dramatically change the context in which energy policy will be made.

While some forecasts for production growth may be too bold, and current natural gas prices may be too low for long run firm profitability, the medium term prospects for the North American energy landscape look strong. Industry has seen remarkable technological breakthroughs, and the pace of R&D and innovation has been increasing. There is still the potential both for consolidation and sharing of current technology and for its application in new and innovative ways.

Yet environmental and community concerns remain a real challenge. While many argue that these concerns can be managed and the resources exploited safely, getting the institutional arrangements in place to guarantee this will not be easy. Reassuring an increasingly skeptical public may also require more effort from state and federal regulators and particularly from companies. However, the range of interests in favor of growing production and the number of states with the potential to be sources of production suggests that the pressure to effectively handle public concerns will be considerable.

One final conclusion suggested by the workshop is that we should remain humble about our ability to forecast what will happen in the future. There was a wide range of projections about price and supply among the participants. Managing uncertainty clearly must remain a key element of our oil and gas planning.

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