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Energy Security

An Agenda for Research

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Introduction

U.S. policymakers talk more today about energy security than they have at any time since the energy crises of the 1970s. Yet scholarly understanding of the challenges at the intersection of energy and national security, and of the various policy tools available to address them, is surprisingly weak. On April 12–13, 2010, the Council on Foreign Relations (CFR) convened a group of thirty-six scholars and practitioners to assess the current state of knowledge about oil, gas, and national security, and to identify those areas where research was most needed.¹ Participants included experts from academia, industry, government, and international institutions, and brought backgrounds in economics, political science, international relations, science, engineering, and law to the discussion.

This report is divided into sections that mirror the format of the workshop, and it highlights research needs that emerged from the discussions. The discussions were split into sessions that assessed the problem (the first four sections of this report) and sessions that explored policy options (the following four sections). While the workshop discussions have been supplemented by a light literature review, the vast bulk of the burden of identifying research needs was borne by the workshop participants. Scholars and practitioners are encouraged to contact the author if they believe that any of the issues identified here are better understood than this report suggests.

Oil and the U.S. Economy

The U.S. economy is now substantially less vulnerable to rapid changes in patterns of oil production, consumption, and trade than it was four decades ago. Oil imports have risen, but total oil consumption has declined significantly relative to the size of the U.S. economy. Efficient global markets for trade in oil, backstopped by U.S. and other strategic petroleum reserves, have made the United States far less vulnerable to major supply disruptions, including deliberate cutoffs.

There is still, however, considerable disagreement about how important oil is to the U.S. economy, and how that importance might evolve in the future absent changes in policy. The workshop discussions suggested several areas on which new research might shed light.

WHAT COUNTS AS A SECURITY ISSUE?

Several participants emphasized the importance of not subsuming all economic impacts of oil consumption under the umbrella of “energy security.” Matters like small but persistent drags on the U.S.

economy and day-to-day price volatility might be important to address for economic reasons, but they did not appear (at least to many) to be major security issues.

Two potential exceptions stood out. The first is the relationship between oil shocks and recessions (or severe and protracted periods of low economic growth). In contrast with small drags on U.S. growth, recessions can lead to qualitative changes in U.S. policy priorities and significantly reduced capacity for government spending, and hence can have substantial security consequences. There is considerable debate, however, over whether past oil shocks have caused recessions.² (This includes an ongoing debate over whether the recession that began in 2007 was caused by oil price increases.³) Further research in this area would be valuable. In particular, it would be useful to develop better indicators that predict when oil price increases lead to recessions (if they do at all) or to sustained periods of very low growth.

The second exception is related to the U.S. balance of trade. Oil imports contribute substantially to the U.S. trade deficit. There is debate within the security studies and international political economy communities over whether the large U.S. trade deficit is a major national security vulnerability.⁴ To the extent that it is, it would be useful to understand better the relationship between oil and the balance of trade. In particular, it would be useful to understand how (and to what extent) the money that the United States spends on oil gets recycled into the U.S. economy. Proceeds from sales of oil to the United States ultimately return to the United States in one of three forms: purchases of U.S. goods and services (trade), purchases of U.S. debt (public or private), and purchases of U.S. assets. Scholars have a poor understanding of this mix.⁵ Research should illuminate how the money that the United States spends on oil gets recycled into the U.S. economy; how that depends on the sources of U.S. oil; and how that might change in the future.

There is a link between these two lines of research. The impact of oil shocks (and of high sustained oil prices) may depend on how petrodollars are recycled. Intuitively, for example, the United States might have weathered the 2002–2008 oil shock better had more if its oil expenditures returned as money spent on U.S. goods and services rather than on capital for inexpensive home loans. It would be useful for research to explore how the way in which petrodollars are recycled affects the response of the U.S. economy to oil price shocks and to sustained higher prices for oil.

DEPARTING FROM MARKETS

Analyses of the impact of oil on the U.S. economy invariably assume that oil is always allocated by markets (albeit sometimes at very high prices). It is not obvious that this will always be the case. Indeed one might imagine that, under some circumstances, states would not allow markets (and prices) to determine allocations of oil. Workshop participants could not definitively identify such situations, but most were not prepared to exclude them either. Three possible scenarios, however, were suggested: a multiyear war among great powers; a political drive to strongly control price volatility, which might require more rigid producer-consumer relationships to be feasible; and a non-Western push, possibly by China, to a new model for governing global trade in oil. Future research into what circumstances, if any, might lead states to abandon (wholly or partially) the use of international markets to allocate oil supplies would be valuable. If such circumstances exist, researchers should also assess their likelihood and potential consequences.

QUANTIFYING POTENTIAL SUPPLY DISRUPTIONS

Quantitative analyses of the spectrum of potential oil supply disruptions are surprisingly rare. The most prominent exception, upon which many analyses of the potential costs to the U.S. economy of supply disruptions are based, is essentially a sophisticated synthesis of expert opinion—which itself often lacks solid foundation.⁶ Three types of analysis would thus be valuable.

First, analysts would benefit from better inputs into their evaluations of specific potential supply disruptions, and from the more grounded estimates of potential disruptions that would result. For example, analyses of the vulnerability of tanker traffic in the Strait of Hormuz rely on data regarding the vulnerability of warships rather than of actual oil tankers. Better understanding of the latter would enable more authoritative analysis of the real potential for a sustained disruption.⁷

Second, analysts would benefit from better tools for understanding how multiple supply disruptions might interact. One participant, for example, noted that multiple supply disruptions could strain the global supply of skilled labor, making it difficult for the oil industry to recover. Understanding other channels through which multiple supply disruptions might compound each other would be useful.

Finally, the last careful survey and analysis of expert opinion in this area was conducted in 2004.⁸ It would be useful to repeat the exercise.

HOW SECURE IS THE MARGINAL BARREL OF OIL?

Estimates of the economic consequences of oil price volatility for the United States normally assume that those consequences are proportional to the number of barrels of oil consumed. Thus, the consequences of reducing consumption are proportional to the amount by which consumption is reduced.

Reduced U.S. consumption, though, also tends to result in reduced global production. (The same is true for reduced consumption elsewhere.) That, in turn, changes the mix of production sources, which should change the underlying volatility, either amplifying or diminishing the benefits from reduced consumption. No work appears to have been done to understand this dynamic, or its consequences for the externalities from U.S. oil consumption. Several research questions are thus appropriate. First, what is the relationship between policy-driven changes in U.S. consumption and global oil production? This depends both on the response of other consuming nations and on decisions by producers. Second, how does the mix of oil sources vary with production volume? (This, of course, has been extensively studied.) Third, how do these changes affect oil price volatility? Putting this together, what are the consequences for estimates of the externalities from oil consumption?

THE FUTURE OF OPEC AND OIL SUPPLIES

Several individual OPEC states exploit their market power to raise oil prices to a level that is not consistent with a fully competitive market. There is less agreement as to whether (or when) OPEC acts effectively as a cartel to increase prices.⁹ Research that helps answer this question, particularly in light of new data from the last decade, would be valuable. (Major assumptions about OPEC behavior strongly influence the predictions of most oil market models.) Similarly, research that explores the possible implications of OPEC performance for political and resource developments over the coming decades would help inform analyses of oil and security. Research might, for example, examine the

effects on internal OPEC dynamics of greatly increased Iraqi production, or of substantially greater Iranian influence in the Middle East.

THE ROLE OF REFINING AND TRADE IN REFINED PRODUCTS

Two trends related to petroleum refining and refined products may have implications for the relationship between energy, the U.S. economy, and security. Neither of these is well understood. First, analyses of oil markets tend to assume that oil is a fungible commodity. As oil supplies become more diverse, though, it will become more difficult for different supplies to substitute for each other as refinery inputs. Refineries tailored for Venezuelan heavy oil, for example, cannot simply substitute other (lighter) oil supplies during a disruption. Analysts need to better understand the consequences of such rigidities for market responses to disruptions. Second, the volume of trade in refined products has steadily increased. This increase will only be compounded as biofuels gain a greater role in product markets. There has been little analysis of the likelihood and potential impacts of disruptions in these refined products; this is an important gap to fill.¹⁰

UNDERSTANDING SUPPLY ELASTICITY

The case for minimal government intervention in oil markets is based partly on the belief that producers and consumers will respond fairly well to long-term price changes. It is further based on the belief that there is usually substantial slack in oil supplies, which allows moderate disruptions to be absorbed with relative ease. The price shock of 2002–2008 provides an important new case to understand whether this is true. Several participants noted that there has been some preliminary research into producer responses to disruptions and steady demand increases during this period, but that there is a need for substantially more. In particular, in order to understand how disruptions will ultimately be reflected in prices, it is important to understand producer responses to slow but steady shocks, as well as producers' abilities to respond to disruptions that occur during times that production capacity is strained.

Oil-Producing States and National Security

Oil has consequences for national security not only through its effects on the states that consume it, but through its effects on the states that produce it, too. Oil revenues can either strengthen or weaken oil producers. They also have the potential to reorder political relationships around the world.

OIL REVENUES AND TERRORISM

A direct connection between oil revenues and international terrorism is frequently invoked in public discussions of energy security. However, most participants agreed that, in practice, the connection is

much more complex. Individual terrorist operations tend to be inexpensive (even when accounting for the cost of failed operations), suggesting that large revenue sources are not necessary for funding individual operations.¹¹ At the same time, some terrorist organizations are extremely expensive to fund, and hence can benefit substantially from high oil revenues to state supporters. Hezbollah, for example, costs hundreds of millions of dollars per year to operate, something that is much easier for Iran to do when its oil revenues are high.¹² Several participants noted that what distinguishes Hezbollah is that it operates an extensive political and social apparatus in addition to carrying out terrorist activities. This suggests that the important relationship between oil revenues and terrorism is through the funding of social and political environments in which terrorist groups can operate effectively. From this vantage, operating al-Qaeda is not actually cheap; despite the low cost of individual attacks, the organization depends on an extremist-friendly environment in countries like Pakistan and Saudi Arabia, which can be expensive to support.

This perspective has not been carefully fleshed out. Analysis that combines an understanding of the conditions in which terrorist planning and recruitment is effective, an understanding of how such conditions are fostered through financial flows (such as support for radical education), and an understanding of the link between the capacity to deploy such funds and oil revenues would be valuable. Another useful unexplored approach to this question would examine the hypothetical situation in which oil prices were far lower than they are today, and would ask what the consequences would be for areas where terrorist groups tend to thrive.

OIL AND POLITICAL RELATIONSHIPS

Participants had substantive disagreements as to the connection between oil and international political relationships. The discussion focused on two areas of potential linkage. First, some argued that consuming states tend to adjust their behavior in ways that are favorable to suppliers. (For any given consumer, the “suppliers” category can be further divided into states that physically supply oil to that consumer and states that simply have positions as major producers.) For example, some asserted that China modifies its behavior toward Iran because of its dependence on Iranian oil supplies, while others contended that the link is overstated; others argued that the United States modifies its behavior toward Saudi Arabia, despite the low volume of oil actually shipped between the two countries, because of the central Saudi position in oil markets, while others questioned whether there was any strong empirical evidence for that assertion. Second, some participants argued that states with large oil reserves are able to use commercial access for oil companies as a source of diplomatic leverage. One participant noted, for example, that Iraq tried to use access to oil contracts in the 1990s to create pressure for the lifting of economic sanctions.

Both types of propositions deserve systematic investigation. (There is substantial, though inadequate, case study literature, but little comprehensive analysis.¹³) The question at hand is not whether a connection between political decision-making and oil relationships is wise or desirable, but to what extent (and in which ways) it actually exists. Such research is an essential foundation for the analysis and design of policies to reduce pernicious consequences of oil consumption and trade.

There would be substantial value in research that combined a stronger understanding of the connection between oil and political relationships with potential future scenarios for production, consumption, investment, and trade to project possible geopolitical consequences. How, for example, might a shift in consumption from the West to Asia affect broader political relationships? What

might the geopolitical consequences of low prices—and hence consolidation of production—be? How might the rise of Chinese oil companies affect the relationship between producer states, China, and developed countries that are home to major oil companies? And how might trade based on bio-fuels or refined products (instead of oil) affect diplomatic relationships?

OIL REVENUES AND STATE WEAKNESS

Most U.S. discussion of oil-producing countries focuses on how oil revenues can empower countries along the lines just discussed. However, many participants emphasized the consequences of oil production for weak states. These fell into two categories. First, in some states, increased oil revenues appear to harm governance and economic growth; this is the so-called resource curse.¹⁴ It can affect U.S. security, since poorly governed states often “export” their internal problems to wealthier states. More than one participant, for example, noted that the man who attempted to bomb a U.S. airplane during Christmas 2009 was from Nigeria, an oil-rich state with disastrous governance. The resource curse can also affect oil markets to the extent that poor governance deters investment and yields volatility. Second, in some states, sudden (or even slow) declines in oil revenues can result in security problems by starving personal and state budgets and by generating unrest. Mexico, for example, depends on oil revenues for about two-thirds of its federal budget.¹⁵ Were oil revenues to fall sharply, the Mexican government would face substantial fiscal pressures, possibly with significant consequences for its acute internal security situation (which has spilled over into the United States).

Research is needed both to understand the landscape of current and potential security problems and to understand the effectiveness of potential policy responses. There is substantial literature on the resource curse.¹⁶ It has largely been framed in economic terms, and has reasonably focused on the consequences for producer states themselves. Policymakers would benefit from a juxtaposition of this research with analysis on the potential for states’ internal problems to become international security problems, in order to identify those situations in which the resource curse is most likely to have international security consequences. They would also benefit from an expansion of the research agenda to major candidate countries that have not been studied, such as Iraq.

On the flip side, research into those states that might be vulnerable to low oil prices in ways that might have consequences for international security would be valuable too. Such research should look at the potential for domestic unrest and reduced government capacity in the face of low oil prices; at the impact of reduced revenues both for the overall economy and for government revenues; and at the different impacts of gradual and sharp declines in prices. It should then investigate where those dynamics might translate into international security consequences.

Potential solutions must be researched as well, particularly in the case of countries hurt by increased oil revenues. (The negative effects of low oil revenues should presumably be addressed by broader economic and fiscal policies that diversify countries’ economies and steer them away from economic and government dependence on oil revenues; they might also be addressed by decisions not to take steps that would lead to sudden, or even slow but ultimately large, drops in oil prices.) One particular area of focus is the Extractive Industries Transparency Initiative (EITI). Participants generally agreed that it is still unclear whether, when, and how the EITI and similar mechanisms work.¹⁷ Participants noted that there are several important “laboratory” cases coming up (Sierra Leone, Ghana, Mauritania, and Mozambique) and that careful and early study would be invaluable.

Research should also be conducted into why well-understood policies that can help avoid or ameliorate the resource curse are often not adopted. What internal dynamics tend to prevent such policies from being implemented? Are there other theoretically suboptimal policies that might better align with affected countries' political economies, and hence have a greater chance of being successful?

NATIONAL OIL COMPANIES

The rise of national oil companies (NOCs) occupies a prominent place in discussions of energy security. NOCs are a diverse group, ranging from world-class companies like Norway's Statoil and Brazil's Petrobras to struggling firms like Mexico's PEMEX and Venezuela's PdVSA (which itself was once a highly capable company). NOCs are of concern to many oil observers because they are often (though not always) inefficient, leading to strains on global oil markets. Since NOCs control access to most of the world's conventional oil reserves, understanding their dynamics is critical to understanding future evolution of the oil landscape.

Participants noted two areas in particular need of study.¹⁸ First, researchers need to better understand the factors that influence NOC decision-making and efficiency, as well as how and why those vary among companies. This is simple to describe but requires substantial in-depth research into individual cases. (There was particular interest in understanding Chinese NOCs.) Second, at least one participant noted that there appears to be a connection between high oil prices and state decisions to nationalize oil resources. This connection can have pernicious effects, deterring investment at lower prices (since independent firms worry that they will not see the full upside) and harming production precisely when markets are at their tightest. Gaining a careful empirical understanding of this relationship would help researchers and policymakers better anticipate future oil production developments.

WHEN DO PETROSTATES "MISBEHAVE"?

There is ample (and frequently invoked) anecdotal evidence of a relationship between high oil prices and disruptive activity on the part of petrostates. Iran, for example, intensified its nuclear developments as oil prices increased in the mid 2000s (though that was also accompanied by the U.S. invasion of Iraq and by some technical breakthroughs in its program). Venezuela, meanwhile, expanded its destabilizing efforts in Latin America during the same period. Meanwhile, however, other states that were awash in oil revenues, such as Nigeria and Angola, did not embark on similar activities. Indeed, it is surprising that while there is ample debate over whether oil revenues lead to problems with petrostates, there is little systematic study of when and why oil revenues lead to problematic behavior.¹⁹ Systematic research focused both on cases and on comparative analysis would be valuable. The result of such research could also be applied to understanding whether similar challenges might arise in the future, or whether the recent cases of Iran, Venezuela, and Russia are anomalous.

The Relationship Between Energy Security and Climate Change

Climate change and energy security are often mixed together in policy discussions. Yet most participants agreed that for the United States, at least in the near term, addressing climate change is in principle primarily a challenge related to coal, while energy security is mainly a challenge related to oil. Many went beyond that to counsel separation of the two as issues for policy analysis and action. Others argued that, in practice, such separation was not feasible. Some discrete policy decisions—such as choosing whether to support development of unconventional fuels—inevitably have implications for both energy security and climate change, requiring analysts and policymakers to consider both at the same time. Moreover, political reality may force the two to be dealt with together (and, indeed, often has). In that case, analysis that helps identify the best of several competing policy options, even if none is optimal, can be invaluable. Participants identified several areas for investigation.

CLIMATE POLICY AND OIL INVESTMENT

How does the potential for climate policy affect investment decisions for oil production? Several participants noted that oil companies are already including a modest carbon price in their planning, and that, as a result, uncertainty over climate policy is not having a major impact on investment. Others were skeptical. Careful research on whether uncertainty over climate policy is, in fact, affecting oil investments would be valuable. As part of this, it would be useful to look not only at the impact of carbon pricing on oil investment, but also at the potential impact of more onerous regulation, such as low-carbon fuel standards.²⁰ It would also be valuable to assess how different countries might be affected as the result of the different emissions associated with extraction of their oil.²¹

CLIMATE CHANGE AND OIL IN THE LONGER TERM

The argument that oil is not a near-term climate change issue arises from the observation that modest carbon prices will likely have little impact on oil consumption in the United States (particularly in transportation). Nonetheless, if the United States attempts to make deep cuts in its emissions, it will eventually need to substantially curb its oil consumption. Thus, in the longer term, oil may become more of a climate change issue. If carbon prices do not rise to a level that can seriously curb oil consumption, it will be because other measures to curb oil use, such as fuel economy standards and bio-fuels subsidies, have been pursued effectively, thus reducing the necessary carbon price for the given emissions reduction goal. Given this situation, how might emissions constraints shape oil consumption in the medium to long term? What effect would such constraints thus have on the distribution of oil consumption and production? What geopolitical consequences might these changes in the patterns of production and consumption have?

PETROLEUM REFINING

Efforts to curb greenhouse gas emissions could affect petroleum refining in the United States and its close allies in the near term. In particular, a carbon price applied in developed countries but not developing ones could shift refining activity to the developing world. This shift could reorder trade in products like gasoline and diesel, with implications for security of supply and financial flows. There has been little quantitative analysis of how serious climate change efforts might reorder patterns of refining and of trade in refined products, and of the potential security implications.²² New research could illuminate this.

INNOVATION POLICY

Many analysts prefer that climate change and energy security be pursued through separate measures, such as carbon and gasoline taxes, allowing markets to sort out issues at their intersection. In many cases, though, policymakers will be forced to make decisions on matters that affect both issues at once. One of the most important areas is in government support for research, development, and demonstration activities (and generally in support for innovation). For such decisions, policymakers need tools to integrate and balance energy security and climate change in their funding decisions. (Such decisions might include whether to support certain biofuels technologies or whether to invest in coal-to-liquids.) Research that identifies ways to effectively integrate both goals in developing policies to support innovation would thus be valuable. (A broader discussion of research that is needed to support innovation policy can be found in the next section.)

RELATIONSHIPS BEYOND THE UNITED STATES

The near-term relationship between energy security and climate change is stronger in many other major economies than it is in the United States. This is particularly true in the area of natural gas, which has emissions benefits but potential energy security downsides in Europe and Asia. Intelligent analysis of U.S. policy options for both energy security and climate change thus requires a solid understanding of the relationship between these two agendas elsewhere in the world.²³

USES OF NATURAL GAS

What is the best use of natural gas? Participants suggested three, all of which have different consequences for energy security and climate change: fueling vehicles directly, which reduces oil use and may reduce emissions; generating electricity, which could be used to power electric vehicles and which could eventually reduce oil use and emissions, depending on the baseline; and enhancing oil recovery, which could increase emissions but which would enhance the domestic oil supply. This provides a useful example through which to understand interactions between energy security and climate change. Research could illuminate the tradeoffs that exist among the different options, and identify ways to choose among them.

Natural Gas and National Security

Natural gas differs strongly from oil in its physical and political characteristics. Workshop participants thus discussed the security dimensions of natural gas in a separate session.

SHALE GAS AND OTHER UNCONVENTIONAL SOURCES

Shale gas was a major focus of discussion. Estimates of U.S. gas reserves have jumped as much as 35 percent in recent years because of technological progress that has made large volumes of shale gas recoverable at relatively modest prices.²⁴ Analysts who only a few years ago worried about U.S. dependence on imported liquefied natural gas (LNG) now speak about U.S. independence from gas imports for the foreseeable future.²⁵ Much, though, remains to be understood.

The first set of questions surrounds the future course of U.S. shale gas development. How might shale gas development proceed? Is shale gas production something that will rise and then fall over a few decades, like the UK gas discoveries in the North Sea, eventually squeezing the United States when gas production declines (if it is not prepared)? Or does it indicate a much more enduring transformation in the domestic gas landscape? The volatility of U.S. natural gas prices has played a central and negative role in shaping consumer and policymaker concerns about gas in the past; how will the arrival of shale gas affect volatility in the future? Overall, how might uncertainty over the future trajectory of shale gas affect its development and strategic consequences?

The second set of questions surrounds the international landscape for shale gas. What does the future global landscape for shale gas production look like? Some have begun to consider this question, based primarily on assessments of geology and technology.²⁶ There are important political dimensions, though, that require study too. Simply because states can produce shale gas does not necessarily mean that they will. One participant cited Poland as an example: while it might seem strategically wise for Poland to exploit its potentially large shale gas resources, a strong coal lobby in that country might steer outcomes away from that. Other states might restrict production for environmental reasons or to conserve resources for longer-term exploitation. Still others may choose to reserve resources for domestic consumption, even if economics suggest that those resources would be more valuable if exported. These factors will all help determine the effect that shale gas has on global politics and security, and must be better understood.

This leads to a third set of questions: How will the development of shale gas affect international relations? The U.S. perspective tends to emphasize the consequences that will be avoided: the United States will not become dependent on LNG for the foreseeable future. But the impact may be different elsewhere. How, for example, would Chinese development of shale gas affect its relations with other possible gas suppliers, such as Russia or Iran? How will U.S. development of shale gas affect Qatar, which had intended to sell LNG to the United States? How might European development of shale gas affect EU-Russia relations? How might the United States or others use shale gas resources

to influence other consumers, perhaps through exports? One participant, for example, suggested that Israel might prefer to import gas from the United States rather than from Qatar.

There is also a potential for other unconventional gas resources to transform the global gas landscape even further. Research into the possible geopolitical repercussions of large-scale commercialization of methane hydrates, currently too risky and expensive to extract at scale, could help policymakers anticipate future developments with important policy consequences. (Estimates of the gas potential of methane hydrates are far larger than all known conventional gas reserves.²⁷)

GAS TRADE AND POLITICAL RELATIONSHIPS

Workshop participants generally appeared to believe that trade in natural gas shapes political relationships more strongly than trade in oil does, because gas development and trade tend to require large-scale investment and long-term contracts. There was considerable concern, however, that most evidence for this argument is anecdotal. Several people noted, for example, that dependence on Russian gas is frequently invoked as a major factor shaping German foreign policy but that German policymakers argue strongly that such is not the case. In-depth study of several cases where natural gas trade is believed to have strong political implications would be valuable. The study of cases where trade is conducted by pipeline, such as in the Germany-Russia case, and of cases where trade is conducted through LNG, such as between Japan and its various suppliers would be useful.²⁸ Indeed, several participants argued that it is not the specific states involved, such as Russia or Ukraine, that turn natural gas trade into a diplomatic and security issue, but rather the fact that natural gas trade requires fixed pipelines. A significant volume of case studies could be used to test whether this proposition is true.

NATURAL GAS PRICING

Much discussion focused on trends in how natural gas is priced. Oil is priced on world markets, at least on short time scales; this phenomenon largely removes state-to-state negotiations from the pricing equation, and hence reduces the diplomatic and security consequences of trade in oil. Natural gas (outside North America) is not priced on markets. There is substantial belief that if gas markets in Europe and Asia evolve to a point where they can determine prices, the result will be a reduced connection between natural gas and geopolitics.

This leads to two major areas for study. First, how is LNG affecting price setting for natural gas? Understanding the answer requires theoretical study of how LNG should affect price setting, and empirical study of how LNG contracts are being set.²⁹ LNG does not need to cover all global gas trade, or even necessarily a majority of it, to lead to global price setting for gas. Research that provides insight into how large (and of what nature) LNG markets will need to become before they can set global prices would be valuable. This research would build on a significant body of existing work on LNG and gas markets.

Second, how might internal pipeline-based European (and perhaps Asian) gas markets evolve in the future?³⁰ There is no reason, in principle, why pipeline-based systems need to be opaque and rigid, and hence politically problematic, as is the case in Europe; the United States provides a clear counterexample. But European states and their national champion gas companies have resisted inte-

gration and transparency. Might things evolve differently in the future? If so, what would the consequences be for market-based pricing of gas, and hence for relations with supplier states?

Policy Responses: U.S. Demand

Most workshop participants agreed that the greatest area of U.S. leverage in reducing the security consequences of oil consumption lies in moderating U.S. demand. Participants focused far less on efforts to curb U.S. demand for natural gas, possibly because of reduced concerns about U.S. gas dependence as a result of shale gas developments. The discussion led to a wide range of areas where participants believed that further research would be valuable.

COSTS AND BENEFITS OF ENERGY EFFICIENCY

Energy efficiency is usually a centerpiece of energy policy discussions. Yet there is considerable controversy as to the costs and benefits of energy efficiency policies. Many argue that there is a large amount of opportunity to reduce oil consumption while saving money.³¹ They contend that these opportunities go unrealized because consumers excessively discount the future energy savings that can result from using more energy-efficient equipment; because of misaligned incentives between those who buy equipment and those who operate it; and because of restricted access to credit, which prevents consumers from making investments even if those investments would ultimately save money. Others argue that many optimistic analyses of efficiency simply miss many of the costs associated with implementing energy efficiency measures, and hence overestimate those measures' net benefits.³² Research that refines estimates of the costs and benefits of energy efficiency measures would be useful. Perhaps even more valuable would be meta-analysis that explains in detail why different attempts to assess the costs and benefits of the same energy efficiency efforts yield different results.

If many energy efficiency measures indeed have negative costs, implementing them should lead to increased economic activity, which should erase some of the reductions in energy use. This effect has been studied quite extensively, particularly for oil consumption in cars and trucks, but a better understanding of the magnitude of this so-called rebound effect, particularly in industry, would be valuable.

GLOBAL IMPACTS OF U.S. EFFORTS TO REDUCE CONSUMPTION

Much of the security value of reduced U.S. oil consumption is a direct consequence of using less oil (rather than an indirect consequence of, for example, the lower oil prices that might result from such a shift). The impact of excessive and volatile oil prices, for example, is directly reduced when the United States consumes less oil. Other benefits, though, are reduced if lower U.S. consumption is offset by higher consumption elsewhere in the world, most notably any benefit arising from lower revenues to oil producers. To understand this effect better, researchers need improved understanding of the elasticity of oil demand elsewhere in the world, particularly in developing countries. This is an

issue to which this report will return in the next section (which focuses on oil and gas demand in the developing world).

OIL IMPORT TARIFFS

Participants generally agreed that taxing oil or refined product consumption is the most economically efficient way to curb consumption. They also agreed that meaningful oil taxes are probably politically infeasible in the United States. That led several people to suggest exploring taxes restricted to imported oil. Research on three questions, in particular, would be valuable.³³ First, what impact would such a tax have on U.S. oil consumption and on imports? Second, what would its impact be on the overall U.S. economy, and on the distribution of income within the economy? Third, would it be possible to structure an oil import tax in a World Trade Organization (WTO)–compliant fashion, and if not, what would the additional consequences of imposing one be?

REDUCED DEMAND AND RELATIONSHIPS WITH OIL PRODUCERS

Some participants expressed concern that a substantial decline in U.S. oil imports, combined with a significant increase in imports by other consumers, particularly in Asia, would reorder diplomatic and geopolitical relationships, with negative consequences for broader U.S. security and foreign policy. Others thought that this concern was misplaced, and that if U.S. ties with producers were reduced because of lower oil imports, it would reflect a broader assessment of U.S. interests and a diminished strategic importance of oil. With this in mind, it would be valuable for researchers to study how diplomatic and geopolitical relationships might be reordered in a world with substantially lower U.S. oil consumption, and what the consequences of such shifts would be. This research would probably be best done as an analysis of possible scenarios.

GOVERNMENT SUPPORT FOR TECHNOLOGY AND INNOVATION

Participants agreed that, in the medium to long term, technology is central to reducing U.S. demand for oil. This includes technology for efficiency as well as for vehicle electrification and for biofuels. Most participants also agreed that there was a role for government in promoting technology development beyond simply pricing the externalities from oil consumption, since firms tend to underinvest in earlier-stage technology activities. There was also, however, a widespread sense that scholars and practitioners have a poor understanding of how government can best support innovation in technologies that reduce oil demand. There was a particularly animated discussion on investment.

Several participants noted a particular weakness in understanding of gaps in investment in the development of technologies that reduce the demand for oil. This issue has recently received significant attention in the context of climate change, where most work has been focused on the power sector. There, people have noted that even relatively early-stage, and hence highly risky, projects are capital-intensive and involve long timelines—both features to which neither traditional risk capital (from venture capitalists or early-stage private equity firms) or project finance (from banks) is well suited. Those players that might be able to fund large technology investments from their balance sheets either tend to be risk-averse (in the case of utilities), or lacking in expertise in most of the relevant technologies (in the case of large integrated oil and gas companies). The result is a lack of capital for mov-

ing energy technologies from concept to broad deployment. (Scholarly understanding of how much private enterprises are actually investing in energy technology development, as well as of how they make their investment decisions, is also quite poor.)

Transportation, not electricity generation, is most relevant for oil consumption. This raises two questions. First, is there a similar financing gap for transportation technologies, and if so, what is its nature? It is not obvious that there should be a similar gap, since transportation technologies are less capital intensive than power plants and have shorter lives. In addition, in the case of biofuels, large oil companies might have the right mix of money and expertise to play a major role. On the other hand, transportation technologies are still more capital intensive to demonstrate, and can involve longer time scales, than other areas that have been the focus of recent technological transformations, including information technology and biotechnology. In addition, incumbents, who tend to be the players with money, may have mixed incentives when it comes to investing in alternatives. Second, to the extent that there is a financing gap, are there government policies that can effectively address it, and what might they be? The literature on government efforts to fill gaps in large-scale high-risk private financing is thin; the energy-specific literature in this area is even thinner.

FIELD EXPERIMENTS

There has been a small but substantial investment in recent years in field experiments that attempt to better understand consumers' responses to information and incentives related to their energy consumption. Such efforts can inform and improve policy design by helping policymakers better understand the likely impact of policies. The participants' sense was that most studies to date had focused on energy consumption in homes. Efforts to reduce oil consumption, though, will depend more on addressing energy consumption in transportation. Policymakers would thus benefit from more field experiments in the transportation sector.

REASSESSING U.S. DEMAND ELASTICITY

Elasticities of oil and product demand are essential inputs to most analyses of how oil consumption and price respond to policy interventions, as well as to baseline projections of future demand. Several participants, though, questioned whether historical values of demand elasticity were still valid. In particular, they suggested that the price run-up of 2002–2008 may have “reset” peoples' expectations about oil prices, and hence altered how they will respond to particular prices in the future. Research that helps better understand U.S. oil demand elasticity at various price points would thus be valuable.

Participants also suggested that the understanding of how the elasticity of demand would change in the presence of large-scale availability of different substitutes is insufficiently understood. How, for example, would short- and long-term elasticity be affected differently by shifts to electric vehicles, plug-in hybrid electric vehicles, and flex fuel cars?

Policy Responses: Developing World Demand

There was disagreement as to the wisdom and relevance to energy security of efforts to promote reduced demand for oil in the developing world. Most agreed that reducing developing world demand was beneficial, but there were still substantial differences over the relative value of doing so. There was, again, little discussion of developing world demand for natural gas, which could have significant security consequences, to the extent that natural gas demand will influence developing-countries' relationships with gas suppliers.

Several threads were present. First, reducing developing world demand would reduce oil prices, which would, in turn, be economically beneficial to the United States. Second, depending on how developing world demand was reduced, it could also lead to reduced price volatility. Third, reducing developing world demand would reduce oil prices, which would hurt states that depend on oil revenues—with both positive and negative security consequences. Fourth, reducing developing world oil demand could alter political relationships between major developing countries and oil producers. One participant also noted that, during a conflict, reduced foreign dependence on oil imports could reduce U.S. leverage. (This might be the case, for example, during a U.S.-China conflict over Taiwan. Other participants were generally uneasy with this suggestion.) Careful and systematic study of the value to U.S. security of decreasing developing world oil demand is largely absent from the literature and would be valuable.

This framing led to a range of ideas regarding policy. Several areas for research overlap both developed and developing world demand, and have already been discussed. These include international rebound from U.S. conservation policies and potential geopolitical consequences of a shift in demand from the United States to the developing world. Participants identified several other areas where research could be constructive.

DRIVERS OF ENERGY POLICY IN MAJOR CONSUMING COUNTRIES

Participants agreed that it was important to better understand the central drivers behind present and future trends in oil consumption in the major emerging country consumers. China, in particular, stands out because of its opaque policymaking process. One participant noted that it was particularly important for research to examine why China is moving toward smaller cars and hybrids: Is it because of technology-focused competitiveness (so-called techno-nationalism) or because of high and volatile oil prices? Participants generally agreed that understanding of demand and related policy in India and the Middle East is stronger, though still insufficient, particularly in the latter case.

ELASTICITY OF DEMAND

Participants generally agreed that however poor the understanding of U.S. demand elasticity is, understanding of demand elasticities in the major developing world countries is substantially worse. This makes it difficult both to project baseline consumption and to predict the consequences of policy interventions. Additional research to better understand demand elasticities in critical developing country markets would be valuable. Such work should pay particular attention to potential demand “tipping points,” where either consumers or regulators might take significant steps that alter demand elasticity. It should also pay special attention to the use of oil in generating power and in industry, two areas where developing countries are far more dependent on oil than the United States is.

ENERGY SUBSIDIES

Fossil fuel consumption is heavily subsidized in much of the developing world. This leads consumption to be higher than it otherwise would be, raising global prices and volatility. The extent of this problem—and the landscape of potential solutions—is poorly understood. Research in several areas would be valuable.

First, what is the actual extent of energy subsidization? One participant, for example, criticized the oft-cited International Energy Agency (IEA) estimates, which are grounded in comparisons of product prices in different markets, for not taking into account differences in local markets.³⁴ More careful research in this area would help inform analysis of policies that might reduce or remove subsidies.

Second, what are the full global consequences of energy subsidies? Most quantitative analyses focus on the effects on global consumption, particularly of oil, and on greenhouse gas emissions.³⁵ What, though, are the impacts on oil prices and spending in the Organization for Economic Cooperation and Development (OECD) countries, and the United States in particular? What, quantitatively, is the impact on price volatility in unsubsidized markets?

Countless studies have explained the macroeconomic benefits of reducing energy subsidies, yet such subsidies remain, not least because some politically powerful groups still benefit from them. Little policy-oriented study has been done on the political economy of energy subsidies, or on foreign policy interventions that might help governments overcome political hurdles to reform.³⁶ This is an important gap to address.

TECHNOLOGY DEVELOPMENT AND DIFFUSION

Scholarly understanding of how energy technology diffuses internationally, and how that diffusion might be accelerated (where desirable), is poorly understood. More work has been done on this issue in the context of climate change than energy security; again, this tends to bias studies toward a focus on the power sector.³⁷

Several areas would benefit from new research. First, what are the primary drivers of relevant technology adoption in the major developing country consumers? What are the main barriers to adoption? Second, how might U.S. policy help address those drivers and barriers where appropriate? Third, what technology development efforts are occurring in those countries—and how might they affect deployment both in those countries (domestically and through South-South transfers), and in

the developed world, including the United States? Fourth, are there areas where coordination of technology policies would be valuable, and if so, what approaches might be most effective?

AVENUES FOR INFLUENCE

Several participants noted the limited influence that the United States has on national governments in the major emerging consuming countries. This suggests two areas for investigation.

The first is the potential for influence through peer pressure. Emerging economies that face similar circumstances to each other may be more amenable to influence from their peers than from developed countries like the United States. To what extent is this true? If it is true, are there institutional arrangements that might help in channeling such influence? And if there are, is there any constructive role for the United States to play, or counterproductive role for it to avoid?

The second is the potential for influence through engagement of substate actors. In many developing countries, including China, some of the most important energy-related decisions appear to be made at the provincial and local levels. Research designed to exploit this would proceed in two steps. First, it would be valuable to better understand the relationship between state and substate decision-making in the major emerging market consumers. Second, to the extent that substate actors are critical decision-makers, creative research into policy options for steering their decision-making would be valuable.

In addition to state and local governments, nonstate actors—including NGOs, businesses, and the media—can also have important influence over consumption decisions and over policy. It would be valuable, again, to conduct research to better understand where those actors have significant influence, and how that relationship differs among countries. The findings could inform creative research into ways to leverage such influence, drawing from experience in other areas.

Policy Options: Domestic and International Supply

In contrast with popular political discourse on oil, participants tended to downplay the importance of policies to promote oil supply and domestic U.S. supply in particular. That said, while not putting supply increases at the center of U.S. strategy, many did emphasize their importance; several argued that domestic supply tends to keep the proceeds from oil consumption inside the United States, potentially dulling the consequences of price shocks. Participants identified several areas where the understanding of potential oil supply is poor. They also addressed natural gas more substantially than during the discussions of energy demand.

U.S. DOMESTIC PRODUCTION

U.S. domestic production received less attention than it normally does in public policy debates. Nonetheless, participants identified two important areas for investigation.

Security Benefits of Domestic Oil Production

Participants largely agreed that one central element of the typical case for domestic oil production—that it protects the United States from hostile providers that might cut off their oil supplies as leverage—has little, if any, foundation in real world risks. In addition, domestic production has no special advantage over production elsewhere in reducing incomes for hostile oil producers. Participants noted four areas, though, where there might be additional security benefits from domestic oil production, all of which could benefit from research that tested and quantified them.

First, what are the consequences of increased domestic oil production for the U.S. balance of trade? Second, increased domestic production should blunt some of the macroeconomic impact of oil price shocks. How large might that effect be? Third, domestic production generally involves shorter supply chains from well to pump. Hence, supplies may be less vulnerable to both human sabotage and natural disasters. This has not been effectively quantified. Fourth, during a protracted military conflict, it is plausible that global oil markets might cease to function in a way that is close to normal. An earlier section suggested research to identify whether such circumstances are plausible. If they are, what benefits, if any, would domestic production provide under such circumstances?

Domestic Production Against the Backdrop of Lower Consumption

Arguments against the significance of increasing U.S. domestic production tend to focus on the fact that domestic production cannot come close to closing the gap between U.S. supply and demand. However, that might change in a world where U.S. demand for oil had been severely reduced. The effect is difficult to predict: on the one hand, domestic production could cover a more significant part of the gap between supply and demand; on the other, it would be doing so in a world (or at least a U.S. economy) in which the importance of oil might have significantly declined. It would be valuable for research to identify whether and how the value of increased U.S. domestic production would change against a backdrop where U.S. oil consumption had been reduced to, say, fifteen, ten, or five million barrels per day.

COUNTRY STUDIES

Participants identified several supplier countries as deserving of special investigation.

Brazil

How will Brazil manage its newfound oil discoveries? Brazil has the potential to eventually supply five million barrels per day or more of oil to world markets. A better understanding of Brazilian policy toward its oil deposits may help illuminate the future landscape for oil production and politics, and point to areas where international policy involvement may be desirable.³⁸

Iraq

How will Iraq's policy toward its oil evolve? Several participants argued that Iraq has the potential to supply as much as ten million barrels of oil per day to world markets. How Iraq will manage its oil

contracts? And how Iraq will balance the United States and China when it comes to oil, which could have important geopolitical consequences? A better understanding of Iraqi options, and of how they might affect future oil supplies and their use, would help analysts understand the future oil landscape, and possibly identify areas where policy analysis is needed.³⁹

Iran

Estimates of future oil production tend to assume that political conditions in Iran will remain unchanged indefinitely. If, however, they were to change drastically, the impact on world oil markets could be substantial. If Iran were to experience substantial political reform, and hence become more open to international investment and technology in its oil and gas industry, it might become a significantly more important producer. Understanding the quantitative dimensions of this possibility is important to long-term thinking about oil and security. If Iran were to acquire a nuclear weapon, it might not only become more isolated in terms of its energy production, but it might also acquire more influence over others in the region regarding their own production decisions. There has been essentially no research into how such a situation might evolve and what its consequences for oil production and prices would be. This area is deserving of serious examination.

Qatar

Participants repeatedly raised the future of Qatar as a natural gas producer as an important area for study. Qatar plays a central role in LNG developments. Understanding how its approach to natural gas will evolve—in terms of production, trade, and pricing—is thus essential to understanding the broader course for LNG and natural gas more broadly.

CHINESE OVERSEAS OIL INVESTMENT

Workshop participants were far less concerned about Chinese equity oil investments than typical commentators in the press are. However, they still identified several areas where research would be valuable.⁴⁰

First, what is driving Chinese equity oil investment? Most casual observers assume that it is part of Chinese national strategy. Multiple participants, though, indicated that it is driven more by the interests of Chinese oil companies. Second, where is Chinese oil investment going? There is a general perception that it is going to unstable and risky areas, but at least one participant indicated that that was no longer true. What is current practice and likely future trend? Third, what is the impact of Chinese oil investment on oil markets? Many participants saw it primarily as a positive factor from this perspective, pointing out that Chinese investment added to global oil supply, thus helping balance supply and demand. Others, though, expressed concern that China was adding “risky” barrels to global supply, potentially adding to volatility. Fourth, what is the impact of Chinese oil investment beyond oil markets? Many have criticized the Chinese strategy of making oil-for-infrastructure deals that lock in long-term relationships and potentially distort markets. They have also noted that China has strongly defended states in which it has production stakes, such as Sudan, in international forums. On the other hand, some have suggested that infrastructure-for-oil deals are actually better for economic development than the typical cash deals that international oil companies participate in.

INCENTIVES FOR SHALE GAS PRODUCTION

Participants noted that shale gas has the potential to revolutionize world gas markets and relationships by radically shifting the geography of natural gas production. They indicated two particularly important areas for research on policy to promote shale gas supply.

First, several participants cautioned against assuming that price alone would be enough to incentivize shale gas production in those places with the greatest potential. Instead, political dynamics could lead to constrained production even when strategic and economic considerations indicate otherwise. The findings from research into the political economy of shale gas production could provide a foundation for creative policy research that identifies ways to affect states' production decisions.

Second, availability of technology could be a barrier to rapidly increased use of shale gas. Shale gas has generally been developed by smaller companies, rather than the large integrated oil and gas producers that are usually conduits for international technology transfer. Research that identifies places where industry structure might retard the spread of shale gas technology, as well as ways that U.S. policy might help address that, would be valuable.

Policy Options: Promoting Reliable Markets for Oil and Gas

The economic and security consequences of oil and gas production, consumption, and trade can be amplified or diminished by the way that markets for those resources function. Workshop participants discussed five relevant areas in need of research.

PHYSICAL TRANSPARENCY

Participants generally agreed that greater international transparency regarding reserves, production, consumption, imports, exports, and stocks of oil would help avoid unnecessary volatility and promote efficient long-term investment decisions. Some, for example, noted that poor understanding of Saudi reserves and Chinese consumption contributed to the 2002–2008 price shock (and to volatility during that period). They also agreed, however, that many states are hesitant to share such information (and that many companies are hesitant to share such information with states in the first place). Moreover, while poor data transparency is usually assumed to be an issue solely in developing countries, one participant noted that European transparency is weak, particularly, but not only, with regard to natural gas.

This suggests a research agenda that focuses on understanding incentives for transparency. Why do specific states choose not to share data on oil and gas? What interventions might encourage them to do more? One participant noted, for example, that there are few incentives available for promoting greater OPEC transparency, and suggested investigating the extent to which OPEC member states' concerns about reputation could be leveraged. In addition, in cases where data sharing is reduced because of technical barriers (likely in collecting rather than sharing data) are there policy interventions that could be worthwhile?

A related set of frequently discussed questions surrounds expansion of the International Energy Agency. There have been attempts in recent years to bring the major developing country energy consumers, most notably China and India, into the IEA. These attempts have aimed both to address transparency and strategic stockpile coordination (discussed below). There has been little effort, however, to study alternative institutional arrangements that might serve similar purposes if IEA enlargement remains impossible.

COMMODITY MARKETS

The 2002–2008 oil shock was accompanied by unprecedented inflows of capital into financial instruments tied to oil prices. This has led many to blame the worst parts of the shock on speculators, and to call for tighter regulation of financial markets for commodities. Others have argued that since oil-linked instruments are ultimately connected to physical markets, they cannot push prices too far away from their fundamental values; some have claimed to back up that argument with empirical evidence. Given that, and given the benefits from many oil-linked investments for market efficiency, those who have made these arguments have resisted new regulations.

There will inevitably be substantial policy developments in this area in the coming years. These could be aided by research in several areas. First, what was the impact of financial commodity investments during the 2002–2008 price shock, and what might be the effects in the future? ⁴¹ To tell a complete story, that analysis should look not only at the impact on average prices, but also on volatility, as well as on physical investment. (Financial markets might, for example, have no long-term impact on prices, have negative impacts on volatility, but have a positive impact on aligning investment with demand.) This research would benefit from more detailed data on market players and positions than has been available to date.

Second, what would be the consequences of various proposed policies, including policies that address physical and market transparency, as well as those that restrict market participants' behavior? Again, analysis should look at the effects on prices, volatility, and investment, as well as the impact of all three on the overall economy.

Third, what is the role of international coordination? As a general rule, smart financial regulations are most effective if they are implemented widely. To the extent that such regulations are identified, how can their broad adoption be promoted? Furthermore, are there regulations that would be wise if widely adopted, but that should be avoided if widespread adoption appears impossible? Conversely, are there regulations that appear to be unwise in principle, but that the United States should adopt if most others do? In each case, analysis of the possible consequences of various policies, rather than firm recommendations for decisions, would be the most important result of any research.

STRATEGIC RESERVES

Participants frequently invoked the development of strategic reserves as one reason why oil is no longer the powerful weapon that it used to be. They pointed, however, to several areas where more effective policy might be developed and to associated needs for research.

First, the United States stockpiles crude oil but does not stockpile petroleum products. There have been calls to diversify the U.S. strategic reserve, motivated in particular by hurricanes Katrina and Rita in 2005, which damaged U.S. refining capacity and hence reduced domestic supplies of petro-

leum products. Some participants argued that this showed the Strategic Petroleum Reserve (SPR) to be useless against such disruptions; others argued that the attendant U.S. release of crude oil had been done in coordination with releases of refined products from European strategic reserves, thus rendering it somewhat more effective. This suggests several questions for research.⁴² First, how effective would the U.S. SPR be in the face of a domestic refining disruption? How would the situation differ if it were used unilaterally versus in coordination with others? And how might the answers to these questions change if U.S. dependency on refined product imports changes substantially in the future, as some predict will be the case?

Second, China and India are both developing strategic reserves. What are their likely trajectories and modes of employment? How will they affect world oil markets? Many have suggested that China and India be brought into the IEA in order to involve them in stockpile coordination. What benefits would this yield? If it proves impossible to bring those countries into the IEA, what other mechanisms for stockpile coordination could be valuable?

Third, there has been on-and-off discussion of explicit trigger mechanisms for releases from the SPR.⁴³ Proponents argue that these would avoid political interference with stockpile release decisions and would promote market predictability. Opponents argue that it would be impossible to anticipate the real-world circumstances that determine whether SPR releases are prudent. And one participant argued that incentives could be provided for market manipulation by investors attempting to activate the triggers. Is there a case for explicit trigger mechanisms? If not, are there softer versions, such as firm guidelines for releases or special governance mechanisms, that might be appropriate?

MILITARY DEPLOYMENTS

The U.S. military plays an important role in maintaining stable markets for oil and gas, most notably by providing security for critical sea lanes. Its presence in producing regions can also contribute to regional stability (though it can also do the opposite). Little has been done, however, to study the cost of such deployments. A recent CFR report argued that the costs are essentially zero since the forces involved have multiple purposes; a recent RAND report, in contrast, estimated the costs at \$67.5 to \$83 billion per year.⁴⁴ New estimates, and particularly new methodologies, would be valuable.

It would also be valuable to have some quantitative cost-benefit analysis of these deployments. Energy-related deployments in the Middle East, for example, could be compared with the economic costs from higher oil prices that would likely arise if one major regional oil producer acquired control over another, either physically or politically. (The consequences of such an event, of course, would extend well beyond higher oil prices.) The economic effects of volatility arising from poorer sea lane protection could be contrasted with the costs of keeping sea lanes open.

Over the coming decades, as other countries assume more prominent roles as energy consumers, as the U.S. military faces budget pressures, and as other militaries grow in size, there may be substantial pressure and incentives to diversify much of the responsibility for maintaining security for energy trade away from the United States. (China, perhaps along with Europe, is the leading candidate to play a more prominent role.) What roles are other states likely to seek in the coming decades? What would the geopolitical consequences be for the United States? (Militaries that deploy to protect resource trade often become involved in much broader activities.) What are the relative merits of various policies that the United States might adopt in the face of such developments? How might this

change if patterns of consumption shifted (for example, if the United States substantially lowered its consumption of oil), or if patterns of production changed in major ways?

ENERGY GOVERNANCE AND INTERNATIONAL INSTITUTIONS

There was limited discussion of institutional issues during the workshop. The two exceptions were the IEA, discussed in the context of physical market transparency and stockpile coordination, and the Group of Twenty (G20), discussed briefly in the contexts of energy subsidy reform and commodity market regulation.

Researchers and policymakers would benefit from a broader understanding of the institutional landscape for energy governance. One important vein of analysis for international institutions has focused on the concept of a “regime complex,” which describes how a wide range of institutions can shape governance in a particular area, even if many of those institutions are not dedicated to that area.⁴⁵ This concept has been recently developed in two papers focused on climate change, and could be usefully developed for the energy security space as well.⁴⁶

An important complementary line of research would focus on whether new institutions are needed to manage issues at the intersection of energy and security. There has been a small amount of writing in this area, including proposals to expand emerging climate change institutions to deal with energy security, and suggestions for new energy security focused institutions, but more substantial analysis of gaps in the institutional fabrics and the merits of various solutions would be valuable.⁴⁷

Crosscutting Observations

The workshop divided energy security problems and solutions into relatively small pieces in order to focus discussion. This came at some expense, however, of a crosscutting assessment of priorities. That had a knock-on effect for the discussion of policies, since the merits of various policies depend on the relative importance of the problems that they intend to solve. (Thus, for example, there was disagreement as to the importance of policies that control energy price volatility, with those who consider volatility to be an important energy security issue assigning them greater importance than those who did not.) Some simple research that illuminates these sorts of relationships between strategic priorities and policy preferences would be valuable. It would help distinguish real debates over the effects of various policies from other more confusing and less illuminating debates that often appear to be about policy effectiveness but are actually about priorities instead.

Endnotes

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1. The intersection of energy and security, of course, extends well beyond oil and gas. The workshop concentrated on this part of the energy security landscape in order to focus its discussions.
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 6. Phillip Beccue and Hillard G. Huntington, *Oil Disruption Risk Assessment*, Energy Modeling Forum Special Report No. 8 (Stanford, CA: Stanford University, 2005).
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 8. Beccue and Huntington, *Oil Disruption Risk Assessment*.
 9. For a survey of the debate, see Theodore H. Morgan, "Modeling OPEC behavior: economic and political alternatives," *International Organization*, vol. 35, 1981, pp. 241–72.
 10. For a discussion of issues surrounding refining, see D.J. Peterson and Sergej Mahnovski, *New Forces at Work in Refining* (Santa Monica, CA: RAND Corporation, 2003).
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 12. *Ibid.*, p. 56.
 13. Isabel Gorst, *Lukoil: Russia's Largest Oil Company* (Houston: Rice University, 2007); Amy Myers Jaffee and Jareer Ellass, *Saudi Aramco: National Flagship with Global Responsibilities* (Houston: Rice University, 2007); Steven W. Lewis, *Chinese NOCs and World Energy Markets: CNPC, Sinopec, and CNOOC* (Houston: Rice University, 2007). For more case studies, see Rice University's Baker Institute Energy Forum project on "The Role of National Oil Companies in International Energy Markets."
 14. For a foundational paper on the resource curse, see Jeffrey D. Sachs and Andrew M. Warner, "Natural Resource Abundance and Economic Growth," NBER Working Paper 5398, December 1995.
 15. See data in "Economic policy: Public finances on stronger footing, mainly owing to oil," Mexico Country Report, Economist Intelligence Unit, April 14, 2010. Accessed May 21, 2010, from http://www.eiu.com/index.asp?layout=displayIssueArticle&article_id=1637047348&text=pemex%20budget&rf=0.
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