BACKGROUNDER

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Oil and Gas Energy Security Issues

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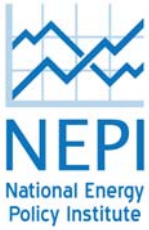

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Abstract

Imported oil and gas make up a significant proportion of total consumption in the United States; dependence on oil and gas imports constrains the foreign policy of the importing country and can increase geopolitical tensions between importers and resource holders. However, the United States and other countries are likely to remain dependent on oil and gas imports for many decades and will, therefore, need to balance the security disadvantages of international trade in oil and gas with the economic advantages. Here, I consider a possible scenario in which U.S. oil imports are limited to 20 percent of domestic consumption by 2030. I explain why I believe this scenario is unlikely and outline realistic policy measures that the U.S. government should put in place to manage the security effects of foreign dependency and to reduce import dependence over time.

This background paper is one in a series developed as part of the Resources for the Future and National Energy Policy Institute project entitled "Toward a New National Energy Policy: Assessing the Options." This project was made possible through the support of the George Kaiser Family Foundation.

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Introduction

Energy security refers to the connection between energy markets and national security in the production, transmission, and use of energy. The energy security landscape is two-dimensional, defined by economic and political–military axes. Both axes of energy security deserve attention. The topography between the two axes depends on the particular energy source under consideration. For example, for nuclear power, inhibiting the proliferation of nuclear weapons is the most important metric along the political–military axis. For coal, mitigating climate change is the key metric along the economic security axis. For oil and gas, both axes are important. Along the economic security axis, the prominent variables are the risk of economic disruption from supply interruption of imports, and the consequences of paying significant dollars to exporting countries that may not be in sympathy with the values or interests of the United States and its allies. Along the political–military axis, import dependence influences the foreign policy incentives and actions of the United States, its allies, and its adversaries.

In this paper, I focus on the geopolitical aspects of oil, and to a lesser extent gas, import dependence. I have dealt with the other aspects of energy security elsewhere (Deutch and Schlesinger 2006; Deutch 2007).

My thesis, simply stated, is that the historical record suggests that the security problems created by oil and gas import dependence will not be eliminated by government action. The appropriate advice to our national leaders is to prepare to manage difficult crises, and perhaps even conflict, in the years ahead. It is most likely that the United States and other countries will remain dependent on oil and gas imports for many decades and will need to balance the security disadvantages with the economic advantages of international trade. Although it is sensible to adopt policies that will reduce this dependence over time, it is futile to seek to eliminate entirely or artificially constrain the use of these resources, on which the economies of both producing and consuming countries depend. I offer some recommendations as to how this mutual

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interdependence can be managed, as well as policies that should be considered for reducing dependence over time.

When Does Import Dependence Become a Public Policy Problem?

Import dependence becomes a problem for the public and for political leaders when imports make up a significant fraction of total usage and when the commodity is vital to the functioning of an economy such that the reliability of supply is critical. These conditions are not unique to energy, but the scale and ubiquity of energy attracts the most attention.

The principal economic concern is that an abrupt supply interruption is likely to cause a price shock that disrupts the economy. A price shock occurs in response to an interruption because users of energy cannot adjust quickly by reducing their use of energy fuels or switching to other fuels. Other economic consequences from ongoing dependence include a large deficit item in the current balance of trade account, an adverse effect of the high cost of energy on the competitiveness of export products, and the perceived net loss of jobs resulting from importing energy from abroad. Most economists believe that the best protection against supply interruption is to encourage diversity of supply and transparent, competitive energy markets.

A considerable literature describes efforts by the Organization of the Petroleum Exporting Countries (OPEC) to control the price of oil and the economic consequences for consuming countires, of intentional OPEC actions to influence price or disrupt supply. This paper does not adopt this economic framework. Rather, the paper addresses the impact of oil import dependence on the foreign policy of the United States and other consuming countries. The way to understand this linkage of import dependence and foreign policy is not by a study of OPEC's ability to directly impact world oil prices or create oil supply shocks. Indeed, its cartel market power and action to cut off supply have been limited. Instead, the linkage is revealed by an analysis of how import dependence influences the political behavior of producing and consuming countries.

In practice, producing countries attempt to control supply, and importing countries seek state-to-state agreements with producers to secure supply to improve their particular advantage. The geopolitical consequences of such supply arrangements cannot be interpreted solely in economic terms. Because import dependence means that a nation relies on foreign sources of supply for a commodity that is critical to the functioning of its economy, dependence inevitably influences the foreign policy of the importing country, and its reluctance to jeopardize supply may constrain the country's options in pursuing broad foreign policy objectives. Significant

reserves and production of oil and/or gas gives the exporting country leverage in achieving its policy agenda. Additional strains arise between consumer and supplier states if resources are located in parts of the world, such as the Persian Gulf, that may be unstable and not particularly friendly to the United States and its allies or their objectives.

Iran presents an excellent example. Iran's contribution of about three million barrels of oil per day on the world oil market constrains the United States and several of its important allies that depend on oil imports—including Germany, France, and Japan—from pressing Iran too strongly on issues such as its covert nuclear weapons program or its sponsorship of terrorism in Iraq, Afghanistan, Lebanon, and Gaza.

How the Geopolitical Aspects of Natural Gas and Oil Differ

The security aspects of oil are well known. Oil reserves are found principally in the politically unstable Persian Gulf (Iran, Iraq, Saudi Arabia, and Kuwait) and in countries that are not friendly to the United States (Venezuela and Russia). A group of producers, organized in OPEC, seeks to set oil prices in the dollar-dominated world oil market by controlling supply, with mixed results. The reliability of supply and the avoidance of the price shocks accompanying supply disruption have been persistent concerns for import-dependent countries for at least three decades. More recently, competition for access to supply has grown through state-to-state agreements between the industrialized member countries of the Organisation for Economic Co-operation and Development (OECD) and the rapidly growing, large emerging markets, such as India and China.

A portion of the oil revenues that flow to those major resource holders that are unfriendly to the United States are sometimes put to bad uses, such as financing terrorists or insurgent groups. For example, it is widely reported that Iran finances the terrorist activities of Hezbollah and that Venezuela provides funding to insurgent groups in Latin America. Clearly these activities present security concerns for the United States and the countries that are affected by interference from hostile states.

The security aspects of natural gas are similar, but not identical, to those of oil. Compared with oil imports, natural gas imports play a smaller role in most importing countries—mainly because it is less costly to transport liquid crude oil and petroleum products than natural gas. Natural gas is transported by pipeline over long distances because of the pressurization costs of transmission; the need to finance the cost of these pipelines encourages long-term contracts that dampen price volatility.

However, natural gas is an attractive fuel, and its attraction is growing because of its clean burning characteristics, compared to oil or coal, and because of its price advantage, on an energy equivalent basis, compared to oil. Accordingly, analysts predict significant future growth in natural gas consumption worldwide and growth in the trade of natural gas. Significant investments are being made to meet this future demand by bringing so-called "stranded" gas to market. At distances between production and consumption of greater than 2,000 kilometers offshore and 4,000 kilometers on onshore, it is more economical to transport natural gas either in liquid form, as liquefied natural gas (LNG), or perhaps as another liquid product, such as methanol.

Current trends suggest that natural gas will gradually become a global commodity with a single world market, just like oil, adjusted for transportation differences. Natural gas in Qatar and Nigeria, once considered stranded is now being sold as LNG in world markets. Iran's natural gas remains stranded because of political factors. The outcome of a global gas market is inevitable; once this occurs, the tendency will be toward a world price of natural gas, as with oil today, and the prices of oil and gas each will reach a global equivalence based on energy content.

Moreover, dramatic developments are expanding the economically recoverable natural gas resource base. Exploration and production are moving to deep water and offshore sites. The development of technologies to produce gas from unconventional sources—tight gas; coalbed methane; and, most importantly, gas from shales—means that the United States, and eventually many other countries, are unlikely to be dependent on imports of natural gas to any significant extent for some time. For at least the next decade, therefore, the principal concern will be with the security implications of oil import dependence. Accordingly, this paper focuses on oil.

Security Implications of the Global Trade in Oil

Several trends in the global trade in oil have troublesome security implications. First, all experts project an inexorable increase in global oil demand, with especially rapid demand growth from the larger emerging economies, such as India and China. Although the current global economic downturn provides a period of respite from increasing consumption and high prices, most experts anticipate a return to growth and, therefore, increasing demand for oil and gas, especially from emerging economies. Advances in technology will continue to improve the productivity of oil and gas exploration and production—and perhaps the efficiency of oil and gas use—but not sufficiently to offset a long-term trend toward greater use and higher real prices. Accordingly, both producing and consuming countries should anticipate, at least for the next two

decades, increased demand and the accompanying geopolitical implications, absent significant policy initiatives to reduce demand.

Second, increased production will be required from the Persian Gulf—Saudi Arabia, Kuwait, Iran, and Iraq—as well as from other countries that are either politically fragile or unfriendly to the United States and others, such as Nigeria, Ecuador, Venezuela, and Russia. This means that consuming countries must learn to work together to advance their interests with the major resource holders and to recognize the importance of maintaining political stability, especially in the Persian Gulf. One important step that would improve cooperation among consuming countries would be to admit China and India to the International Energy Agency (IEA).

Third, national oil companies (NOCs) are increasing their control of reserves and production. To some degree, NOCs, many of which are very competent in managing oil exploration and production, serve the political interests of their governments, which view their oil resource as a means to advance political objectives, in addition to obtaining revenue. The result is an increasing trend toward state-to-state agreements between producers and consumers, especially the new consumer countries. A noteworthy example is China's arrangements with Angola and Sudan. State-to-state agreements are an undesirable move away from open and transparent world oil markets, toward the use of oil as an instrument to influence political outcomes. Iran's 2.9 million barrel per day oil export constrains the European Union's willingness to take action against Iran's nuclear weapons program or against Iran's interference in Iraq.

Fourth, as demand for oil spreads around the world and the production of conventional oil is replaced by production in extreme environments, such as the Arctic and deep offshore waters, the distribution system—tankers, pipelines, and oil storage facilities—becomes larger and more extended. This distribution infrastructure is highly vulnerable to attack by terrorists. Consumers and producers have a common interest in taking measures to reduce the vulnerability of this infrastructure and in adopting plans for dealing with disruption.

Fifth, international trade in natural gas is growing in importance, transported either by pipeline or tankers carrying LNG or gas-to-liquids products, such as methanol. The expectation of more plentiful natural gas resources in North America has reversed the assumption of the recent past that natural gas imports to North America will become an essential part of supply in coming years. Of course, if the international gas trade grows, it brings related import dependence security concerns.

Without change, the net effect of these trends is toward greater geopolitical tensions among three parties: the developed OECD importers, the rapidly growing emerging economies as they increase their already considerable demand in world oil markets, and the major resource holders. At best, this situation will become a three-sided competition, as each party seeks to gain advantage with respect to world oil. At worst, the situation will deteriorate, as economic competition in oil and gas markets turns into political competition for access to resources. Many credible scenarios could lead to political, and even military, conflict. For example, if political and economic conditions do not improve in many of the major resource holder countries, these countries could experience internal upheaval resulting in new regimes with more extreme leadership. Many believe that uncertainty about access to oil could lead some western countries to topple the uncooperative governments of oil-producing states. China's inevitable appetite for oil and gas certainly adds strains within the region and to U.S.–China relations.

Two additional points are worth noting. First, geopolitics is not static; rather, the political stability in the Persian Gulf region or other regions can change, perhaps substantially. Geopolitical change, in turn, will have an effect, either greater or lesser, on the significance of oil import dependence for U.S. foreign policy. Second, one can imagine that over time, countries like Iran, Venezuela, and Iraq will become more democratic and market oriented. It is tempting to assume that such a democratic trend, should it occur, would necessarily mean reduced concern with oil import dependence. Perhaps so, but this is a proposition that is not evidently true: the interests of a democratic regime can differ sharply from those of the United States, especially when it comes to energy policy.

"What If?" Scenarios

Analyzing the effect on policy of changes in oil import dependence sharpens one's appreciation of the connection between import dependence and foreign policy. However, the difficulty of this approach is that it is mere speculation, and the outcome is dependent on the nature of the assumed changes. Three examples follow.

How would U.S. foreign policy differ if it were not dependent on imported oil? This question begs the answer that the United States would have an entirely different Middle East policy and a different military posture in the region as well. But the policy impact is quite uncertain because it depends on other circumstances prevailing in the region that are not specified by the question. For example, are Persian Gulf countries such as Iran and Saudi Arabia wealthy or impoverished? Do other countries remain dependent on oil imports from the Persian Gulf? What is the status of the Arab–Israeli conflict and of proliferation in the region? The point

is that we know that oil dependence complicates the present political relationships and freedom of action of the United States. An absence of oil import dependence certainly will permit the United States to pursue other interests in the region and world more freely, but the extent of the advantage cannot be precisely defined.

If the United States were not dependent on imported oil, would our force posture and defense expenditures be reduced and the need for military presence in the region eliminated? This question is related to the previous one; its implication is that the implicit purpose of a significant portion of U.S. military posture is to ensure the security of the Persian Gulf oil supply.[1] This reasoning suggests that a fraction of the U.S. military budget associated with maintaining military capability for intervening in the region should be allocated to the objective of ensuring the security of the oil supply. The size of this military expenditure could then be compared to alternative policies for reducing oil import dependence, thus achieving energy security at lower cost.

This argument has two serious flaws. First, there are many reasons for U.S. military capability and deployments in the Middle East aside from protecting the security of world oil supplies. Over the years, these reasons have included preventing nuclear proliferation, dampening the potential for regional conflict with Israel, and deterring possible Soviet intervention across the Caucuses. So although it is clear that reduced dependence on Persian Gulf oil would not increase the need for the military capability to intervene in the region, it is by no means clear that reduced import dependence would reduce the military requirements in the region. Second, and more importantly, there is no theoretical or practical method to balance quantitatively the trade-off between measures that reduce import with defense expenditures; benefits at the margin are not measurable.

If oil prices declined sharply what would be the effect on countries such as Iran, Venezuela, and Russia? These countries are dependent on oil revenues both for supporting their domestic economy and for financing foreign activities. Clearly, a significant decline in oil revenues of any of these countries would constrain the extent of its foreign activities and put pressure on its domestic economy. Cutting back the resources these countries can devote to foreign activities is welcome. But the consequence of domestic stress caused by fiscal pressure is less clear. In the extreme, the loss of revenue could destabilize the government and lead to

[1] At the extreme, a portion of the cost of the Iraq war could be “allocated” in part to oil dependence (Stiglitz 2008).

regime change. The successor regime might be better or worse from the viewpoint of the United States.

Options for U.S. Policy Response

Recognition of the significant geopolitical costs of oil and gas import dependence immediately raises the question of the appropriate policy responses. Understandably, the initial impulse is to adopt an "energy independence" policy—essentially the cessation of oil and gas imports for the undeniable national security benefits and the alleged economic benefits that would derive from a reliance on domestic resources only.

Most experts believe that the goal of energy independence is unattainable because of the high level of dependence on imported oil and gas in the U.S. economy, as indicated in Table 1.

Table 1. U.S. Crude Oil and Petroleum Products Imports from All Countries (thousand barrels)

Decade	Year-0	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9
1980s		2,188	1,866	1,844	1,990	1,845	2,272	2,437	2,709	2,942
1990s	2,926	2,784	2,887	3,146	3,284	3,225	3,469	3,709	3,908	3,961
2000s	4,194	4,333	4,209	4,477	4,811	5,006	5,003	4,916		

The level of imports has risen steadily over the past three decades; currently, for example, crude oil and petroleum products imports account for about 60 percent of U.S. consumption. The net import share of U.S. liquid fuels consumption fell from 60 percent in 2005 to 58 percent in 2007. The Energy Information Administration (EIA) Annual Energy Outlook 2009 rather optimistically projects (see Table 1) that this trend will continue: in EIA's reference case, the net import share falls to 41 percent in 2030. The projected consumption level is essentially flat over the period because of the assumptions contained in the EIA National Energy Modeling System (EIA 2009b). The projection includes a significant increase in oil prices, the introduction of new energy efficient technology, and some change in consumer preference. For example, imported crude oil prices are projected to increase from an expected $50 per barrel in 2010 to $200 per barrel in 2030, and motor gasoline prices from $220 per barrel to $600 per barrel (at the pump, including federal and state taxes) during the same period.

It is important to inquire about the possibilities for reducing this level of dependence and the economic cost of achieving important reductions. Indeed, this is a central purpose of Resources for the Future's *Towards a New National Energy Policy: Assessing the Options*

project that is supported by the National Energy Policy Institute (NEPI), an entity of the Tulsa-based George Kaiser Family Foundation. However, the accompanying question must be, how much of a reduction would be enough? As R. James Woolsey (2007) has stressed, a more nuanced meaning of energy independence is reducing import dependence so that oil is not a lever that exporting countries can use, explicitly or implicitly, to constrain U.S. foreign policy interests. No objective calculation can answer this question. Conceptually, the criterion for an "acceptable" level of imports should be set by the magnitude of a supply disruption that the economy could absorb with low economic cost and disruption. In turn, resiliency to supply disruption depends on the availability of alternative sources of supply—in other words, fuel switching and demand curtailment. My guess, and it is no more than that, is that this level might be 20 percent. Reducing petroleum imports from today's level of more than 50 percent to 20 percent of liquid fuels in 2030 is an ambitious goal that would take significant money and time.

A reduction in oil imports is achieved through a reduction either in total oil consumption or in the proportion of oil consumption derived from imports and as a percentage of total oil use as a result of adjustment to market conditions (e.g., fuel switching as a result of high oil prices) or targeted import reduction measures (e.g., an import tax).[2] Because most oil use in the United States is for transportation, the possibilities are as follows.

1. Lower oil consumption resulting from higher oil prices (or poor economic conditions) or improved fuel efficiency from vehicle size, power plant improvements, or hybrid designs.
2. The introduction of alternative liquid transportation fuels, such as biofuels or liquid fuels produced from natural gas, shale, or coal.
3. The substitution of natural gas as a transportation fuel.
4. A switch to hybrid-electric or all-electric cars.

It is worthwhile to consider the effort needed to achieve a reduction in oil crude and product imports to a level of 20 percent, say, by the year 2030. Table 2 includes a summary of the liquid fuel supply and disposition for the United States for the year 2030 compared to 2010 as presented in the reference case of the *Annual Energy Outlook* (EIA 2009a).

[2] I mention an import tax here as possibility that is sometimes proposed. I do not favor an import tax because it restrains free trade and almost certainly would induce prompt and stern retaliation.

The EIA reference case projection takes into account three important trends: (a) higher prices that will moderate demand growth; (b) the introduction of flex-fuel vehicles that permit alcohol–gasoline mixtures and alternative fuel vehicles, including vehicles fueled by compressed natural gas, methanol, and ethanol; (c) increased market penetration of gasoline hybrid and diesel hybrid vehicles; and (d) the introduction of plug-in hybrid- and all-electric vehicles. The point is that the EIA reference case makes ambitious, if not heroic, assumptions about how much progress the country will make in reducing its consumption of petroleum as the economy grows (we hope) and in introducing alternative transportation technologies.

One may ask if the United States is likely to reduce more successfully oil import dependence and what the economic consequences might be of such improvement. Consider how the aspirational 20 percent import objective might be achieved by the year 2030. The third column of Table 2, "JMD aspirational scenario," indicates my speculation about how this level might be reached using the EIA reference case as a starting point. This optimistic scenario is based on an expectation that the prospect for increased U.S. domestic natural gas supply is much more promising than is assumed in the EIA forecasts.

Experts are generally sharply increasing estimates of natural gas reserves from "unconventional" resources, especially shale gas, in the United States and elsewhere in the world. In my judgment, natural gas substitution is the most likely way—or perhaps the only way short of draconian government regulation or a stagnant economy—to achieve the 20 percent objective. Accordingly, the aspirational scenario assumes significant substitution of natural gas on the demand side for (a) compressed natural gas vehicles, (b) diesel fuel in industry, and (c) residual fuel oil. In addition, I am more optimistic about electric vehicles. On the supply side, I have assumed: (a) significant growth in gas-to-liquids, (b) greater domestic production of petroleum, and (c) more optimism in coal-to-liquids and liquid fuels from cellulosic biomass. For each of the measures, the base is the EIA 2030 forecast, and of course the assumptions are uncertain and open to objection. Perhaps the most ambitious assumption in the EIA 2030 scenario and the JMD aspirational scenario is the growth in domestic crude oil production. Crude oil production has been falling in the United States for many years and the prospect for a reversal in this trend is dubious.

George Kaiser of NEPI adopts a different line of reasoning to arrive at a level of imports that is sufficiently low to remove the ability of foreign oil producers to influence the U.S. economy and foreign policy. Kaiser proposes reducing global demand for imported oil to open a gap between global production capacity and demand, thus reducing cartel power. Kaiser assumes that the U.S. target for the reduction of demand for imported oil is four million barrels per day,

achieved in stages, from the 10.1 million barrels per day presently imported (see Table 2); he argues that this amount of demand reduction is possible.

A reduction of 4 million barrels per day of imported oil from the EIA (2009a) 2030 estimate of 8.27 million barrels per day in imports would result an import level in 2030 of 4.27 million barrels per day of imports or about 20 percent of liquid supply. This result is comfortingly close to the JMD aspirational case, but only accidentally so because the bases of the calculations are quite different. Moreover, the 20 percent import level is arbitrary and might be adjusted up or down as geopolitical circumstances warrant.

Kaiser suggests a number of measures to compensate for the four million barrels per day demand reduction: conversion of 20 percent of transportation vehicles to the direct or indirect use of natural gas (5 percent compressed natural gas, 0.33 billion cubic feet per day or 15 percent, 0.84 billion cubic feet per day hybrid- or all-electric vehicles from natural gas–fired power generation, respectively) and stronger corporate average fuel economy (CAFE) standards for the remaining 80 percent of the fleet. Kaiser and I share the view that recoverable domestic natural gas resources are sufficient to accomplish fuel switching without driving up natural gas prices unreasonably.

Table 2. U.S. Liquid Fuel Supply and Disposition Projected for 2010 and 2030

U.S. liquid fuel balance	EIA *Annual Energy Outlook 2009* reference case with stimulus		JMD aspirational scenario
	2010	**2030**	**2030**
	Primary Liquid fuel supply, MMb/d[a]		
Domestic crude oil	5.52	7.14	7.50
Net crude imports	8.31	6.88	
Net product imports	1.80	1.39	**3.61**
NG[b] plant liquids	1.87	1.87	2.00
Refinery gain	0.94	0.82	0.82
Other inputs	1.15	2.77	3.83
Ethanol	(0.85)	(1.72)	(1.50)
Biodiesel	(0.05)	(0.13)	(0.20)
Liquids from gas	(0.00)	(0.00)	(1.00)
Liquids from coal	(0.00)	(0.20)	(0.50)
Liquids from biomass	(0.00)	(0.33)	(0.63)
Total primary supply	**19.59**	**20.87**	**17.76**
	Liquid fuel consumption, MMb/d		
LPG[c]	1.88	1.58	1.60
E-85[d]	0.00	1.20	1.50
Motor gasoline	9.43	8.24	6.74
Replace with NG vehicles			**(1.00)**
Replace with electric vehicles			**(0.50)**
Jet fuel	1.45	1.94	2.00
Distillate fuel oil	4.10	5.14	3.46
Replace with NG			**(1.68)**
of which (diesel)	(3.46)	(3.46)	(3.46)
Residual fuel oil	0.72	0.71	0.35
Other[e]	2.22	2.11	2.11
Total liquid consumption	**19.80**	**20.90**	**17.76**
Imported oil price, $/b[f]	**78.00**	**125.00**	
Natural gas price, $/MCF[g]	**6.05**	**8.40**	
Imported oil as a percentage of liquid supply	52%	40%	20.30%

Note: The values in parentheses are non add items to the liquid consumption sub total. Items in bold face show natural gas substitution for liquid fuel.

[a] MMb/d, million barrels of oil per day; [b] NG, natural gas; [c] LPG, liquefied petroleum gases; [d] E-85, 85% ethanol + 15% gasoline; [e] other includes aviation gasoline, waxes, lubricants, asphalt, and heavy oils; [f] b, barrel; [g] MCF, thousand cubic feet.

Sources: AEO s (2009), updated for stimulus, Table 11, Liquids fuel supply and disposition); AEO EIA (2009a, Appendix C1, Price case comparisons).

Caveats

The aspirational scenario achieves the 20 percent import objective by greatly expanding natural gas use. In the scenario, natural gas displaces the equivalent of 4.8 million barrels per day of oil. This is roughly equivalent to 9.15 trillion cubic feet per year. In its reference case, EIA projects about 24 trillion cubic feet per year of domestic natural gas production in 2030, so clearly, this scenario posits an expansion of domestic gas production over the EIA forecast of 38 percent. My assumption is that this expanded natural gas production comes entirely from North America, for if the supply were imported, say as LNG, the purpose of the reduction would be, to some extent, negated. On the other hand, because natural gas reserves are assumed to be plentiful in this scenario, the cost of the adjustment to the economy would be low.

However, another point deserves emphasis. The energy security of the United States is tied to the energy security of its close allies and partners. Thus, if the United States were to reduce its petroleum imports to 20 percent of its liquid fuel use, but members of the European Union, such as France and Germany, and the countries of developed Asia, such as South Korea, Taiwan, and Japan, continued a high import level that influenced their conduct of foreign affairs, then the objective of energy independence would certainly be impaired. For the United States to realize the national security benefits of energy independence, both this country *and its allies* must reduce import dependence. The aspirational scenario presented above shows how difficult it would be for the United States to achieve a 20 percent oil import objective; this would be much harder for countries like Japan and Germany, which possess essentially no domestic oil reserves.

My conclusion is that “energy independence,” even in the limited sense of an acceptable 20 percent oil import target, is an unrealistic objective. But import levels do matter. From the national security perspective, less imported oil is better, and there are reasons other than import reduction to adopt government policies that encourage a reduction in petroleum use—for example, beginning the long-term transition from dependence on fossil fuels, foreign or domestic.

What Policy Measures Should the United States Government Adopt To Manage Oil and Gas Import Dependence?

If it is unrealistic to expect U.S. government policy to reduce oil imports to "aspirational" levels, what policy measures should the U.S. government put in place to manage the security effects of foreign dependency?

Integrate Domestic and International Energy Policy

The single most important measure is to integrate the energy policymaking process at the White House level. Every decision on a domestic energy matter has a foreign policy implication, and many foreign policy decisions have major impacts on domestic energy matters.

The United States has not effectively established domestic and foreign policy linkage. Inevitably, this linkage must take place in the Executive Office of the President where the equities of various agencies—the U.S. Department of State, Department of Energy (DOE), Department of Defense, Environmental Protection Agency, and so forth—are debated, weighed, and decided. No single mechanism ensures effective integration, and many different models are possible: an assistant to the president for energy matters, for example, or responsibility vested in the National Security Council or the National Economic Council. Each of these arrangements has pros and cons, and every president should be expected to choose an approach that meets the particular circumstances and personalities of his or her administration. The Obama administration in its early months appears to have chosen *all* of these mechanisms, and the efficacy of this choice is as yet unknown

Encourage Greater Efficiency in the Use of Oil and Gas in the United States and around the World

The most important way to encourage energy efficiency is to ensure that domestic energy prices reflect free-market energy prices. Allowing energy prices to rise to world levels signals price expectations to the private and government sectors that will determine the level of investment in adopting technology that increases energy productivity. *Subsidies that keep domestic energy prices low are therefore not desirable*.

Many countries with large and growing oil and gas consumption—for example, India, Mexico, Indonesia, Venezuela, and several Middle Eastern countries—subsidize domestic prices and hence artificially encourage greater consumption. Convincing these countries to move to world energy market prices should be an important objective of U.S. energy diplomacy.

Political deliberations within the United States will continue to influence policies to reduce the growth of petroleum use, including (a) an increase in the tax on motor gasoline; (b) increased CAFE; and (c) Renewable Fuel Standards that prescribe the amount of alternative fuels, such as gasohol and biodiesel, that must be blended with retail gasoline. Most energy experts, convinced by economic reasoning, favor market adjustment through the application of a tax on petroleum use rather than the application of mandatory regulation that tends to be economically inefficient. Unfortunately, the prevailing political climate in the United States is opposed to energy taxes, so regulation is the likely path forward.

Promote Research, Development, and Demonstration of Technologies That Displace the Use of Oil for Transportation

The federal government's program objective should be to establish technical performance, cost, and environmental effects to guide private investment. Below, I describe key areas of research and development that should be promoted.

- Alternative liquid fuel technologies, including biofuels (for example, ethanol from cellulosic feedstock) and liquids from tar sands, shale, and coal, should be explored. These alternatives face challenges. In particular, large-scale biofuels production based on corn or sugar feedstock competes with food production. And synthetic liquid and natural gas production from shale and coal requires significant water input and, as I shall discuss shortly, produces significant greenhouse gas emissions.
- Using electricity to displace motor gasoline in hybrid-electric or all-electric cars has the potential to back out oil use in transportation. But these technologies depend on the prospects for carbon-free electricity generation. The desire to avoid global climate change is likely to lead to policies in the United States and elsewhere to control greenhouse gas emissions. The electricity-generating technologies that will be of increasing interest are: (a) renewable electricity-generating technologies, such as wind, geothermal, and solar power; (b) nuclear power; (c) natural gas–fired electricity generation, which emits substantially less carbon dioxide per kilowatt electric hour of energy produced than coal; and (d) coal-fired electricity generation with carbon capture and sequestration (CCS).
- CCS probably will be required for new coal-fired electricity generation facilities (Deutch and Moniz 2006). Eventually, emissions charges could reach a level that makes a CCS retrofit to existing plants economically justified (MIT Energy Initiative 2009). The probable imposition of CCS requirements on emissions from coal-fired power plants is likely to apply to shale, coal-to-liquids, and tar sands as well. To demonstrate that this

technology is a practical option, the world urgently needs between 5 and 10 projects, at scale, that demonstrate the technical performance, economic cost, and, most importantly, a functioning regulatory framework.

- Nuclear power is also an important carbon-free electricity option. However, high cost, legitimate public concerns about reactor safety, a lack of progress on waste management, and the spread of enrichment and reprocessing technologies of the nuclear fuel cycle, along with the implied danger of nuclear weapons proliferation, inhibit new orders for nuclear plants in the United States and Europe.

DOE has a mixed record in managing its research, development, and demonstration programs. The department is better suited to research and exploratory development—a *technology push* orientation that reflects its strong laboratory system. DOE has been less successful in demonstrating to the private sector that the technical, economic, and regulatory characteristics of a technology option are ready for private investment. This *market pull* orientation has been difficult for DOE to adopt successfully, in part because of frequent changes in program direction mandated by Congress or directed by a new administration, in part because of fluctuating research development and demonstration budgets, and in part because of an absence of tools for selecting and managing demonstration projects. The present inadequate federal system for encouraging innovation in the private energy sector will require the government to adopt new research and development mechanisms and better harmonization of government and industry energy technology efforts (Ogden et al. 2008).

Organize Consumer Countries To Adopt Common Policies

The IEA was established in the 1970s in response to the OPEC oil embargo so that the major OECD oil-importing countries would adopt common policies to respond to the threat of price and supply disruption by a supplier cartel. At that time, the principal importing countries were the developed OECD economies. The IEA developed common policies for sharing scarcity among members in the case of a supply disruption and for establishing common standards for national and industry oil inventories.

Today, as the most significant growth in the demand for oil is coming from the larger emerging developing economies—notably China, India, Indonesia, Brazil, and Mexico, which are not OECD or IEA members—the IEA cannot serve as a forum for adopting common policy for the new major oil-consuming countries. Several consumer country issues need to be addressed: (a) establishing the joint benefit from transparent, open, oil markets rather than

bilateral state-to-state producer–supplier agreements; (b) planning for new oil and gas pipeline routes from Central Asia and the Caspian region; and (c) joint planning to reduce the vulnerability of the international energy infrastructure from natural disasters and possible attacks by terrorist groups.

Promote Stability in the Persian Gulf

For the foreseeable future, importing countries will be dependent on oil production from the Persian Gulf—in particular, Iran, Iraq, Saudi Arabia, and Kuwait. These nations are anticipated to contribute about 50 percent of OPEC oil production in 2030, which is expected to be about 40 percent of world oil production (EIA 2009a). Inevitably, the geopolitical stability of this region is important to the United States and other oil-importing countries, and this concern will influence the options that the United States and other countries will be willing to consider in advancing other important foreign policy interests. The most vivid example is Iran, where the advantages of greater and more reliable Iranian oil production for world markets must be balanced against the objective of blocking Iran's path to a nuclear bomb. A strong U.S. military and diplomatic presence in the region is important both for energy interests and for broader national security interests.

Encourage Greater Supply Oil and Natural Gas from Non-OPEC Countries, Including the United States

For the next several decades, the greater the oil supply, the greater the benefit to all consumers. Additional supply is especially welcome from non-OPEC countries because it adds diversity and stability of supply. The United States has long sought to encourage non-OPEC oil supply, but without great success. It is important to appreciate that some effort to increase domestic U.S. oil supply is important, not because it is likely to change significantly the balance of imports, but because it is a necessary step in demonstrating to other countries the importance of increasing global oil production. For example, both Brazil and Mexico have tremendous potential for producing more oil and gas. The United States cannot credibly argue that these countries should produce their domestic resources at a greater rate if it makes no move to increase its own domestic production. Indeed, some commentary here suggests that the United States should "save" its resources while other countries fuel U.S. demand. Here is a vivid example of the linkage between domestic and international aspects of energy policy: the issue of increasing domestic oil production must balance the environmental consequences of increased production against the benefit of demonstrating resolve to other countries.

Conclusion

The four goals of national energy policy should be to (a) provide reliable and affordable energy, (b) avoid the dangers of climate change, (c) begin the long transition to an energy economy not dependent on fossil fuels, and (d) manage the security consequences of the energy economy, especially the security consequences of oil and gas import dependence.

Energy security cannot be evaluated in exclusively economic terms by, for example, estimating the economic cost of a supply disruption of a particular magnitude and duration. Import dependence influences both directly and indirectly the foreign policy positions, leverage, and relationships of consuming countries and the influence, capacity, and options of producing countries. Energy, and especially oil, is an instrument of geopolitical power.

Although all would welcome it, in practice, at least for the next several decades, neither the United States nor its allies will be able to reduce import dependence to acceptably low levels. Accordingly, the United States must manage energy security in a realistic manner that ensures that both the international repercussions of domestic energy policy actions and the domestic energy consequences of foreign policy actions are central in all policy deliberations.

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