CHAPTER ONE

The Geopolitics of Energy

From Security to Survival

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Since the industrial revolution, the geopolitics of energy—who supplies and reliably secures energy at affordable prices—has been a driver of global prosperity and security. Over the coming decades, energy politics will determine the survival of life as we know it on our planet.

The political aspect of energy, linked to the sources of supply and demand, comes to public attention at moments of crisis. When unstable oil markets drive up prices and volatility hinders long-run investment planning, politicians hear their constituents protest. But energy politics have become yet more complex. Transportation systems, particularly in the United States, are largely reliant on oil, so disruption of oil markets can bring a great power to a standstill. Access to energy is critical to sustaining growth in China and India—to employ the hundreds of millions who remain poor and to keep pace with burgeoning populations. Failure to deliver on the hope of greater prosperity could unravel even authoritarian regimes—and even more so democratic ones—as populations become more educated and demanding.

Two of the major global energy consumers, the United States and the European Union, have similar needs but different practical perspectives on energy imports. The United States is overly dependent and focused on oil, with consequent special attention to the Middle East. The EU is highly reliant on imported gas, making Russia an important supplier and factor in the EU's energy policies and raising tensions particularly between

Germany and the central European states. Before the onset of the 2008 financial crisis, rising demand for oil and gas imports and limited capacity to expand short-term supply drove up prices, supplier wealth, and producer leverage, allowing producers such as Russia, Venezuela and Iran to punch above their weight in regional and international politics. With the current slowdown in global demand from at least the traditional demand centers in Europe and the United States, lower oil prices have rattled the economies and politics of producer states that have come to depend on large export revenues to maintain stability at home and support muscular foreign policies abroad. That is especially poignant in countries like Iran and Venezuela, which highly subsidize social programs and fuel at the expense of economic growth and diversification.

Traditional geopolitical considerations have become even more complex with global climate change. The U.N. Intergovernmental Panel on Climate Change (IPCC) has documented that the use of fossil fuels is the principal cause of increases in atmospheric concentrations of greenhouse gases, which in turn are driving up the mean temperature of the planet. A changing global climate is already resulting in significant loss of glaciers and shrinkage of polar icepacks. It will lead to severe flooding in some places and drought in others, which will devastate many countries' food production, encourage the spread of various illnesses, and cause hundreds of thousands of deaths each year, particularly for those living in the developing world. Nearly 2 billion people were affected by weather-related disasters in the 1990s, and that rate may double in the next decade.[1] At the same time as countries are competing for energy, they must radically change how they use and conserve energy. The politics of the debate over scrambling to secure hydrocarbon resources versus reducing consumption through efficiency and use of alternatives—particularly how to pay for the cost and dissemination of new technologies and how to compensate those who contribute little to climate change but will experience its most severe effects—is emerging as a new focal point in the geopolitics of energy.

Ironically, volatile oil and gas prices and the actions that must be taken to address climate change—namely, pricing carbon at a cost that will drive investment, new technology, and conservation to control its emission—will drive another existential threat: the risk of nuclear proliferation. Higher energy and carbon prices will make nuclear power a more attractive option in national energy strategies, and the more reliant that countries become on nuclear power, the more they will want to control the fuel cycle. The risk of breakout from civilian uses of nuclear power to weapon-

ization will increase dramatically, as will the risk of materials and technology getting into the hands of terrorists.

Confronting these challenges requires an understanding of the fragility of international oil and gas markets and also of the nexus among energy security, climate change, and nuclear energy and proliferation. This chapter addresses that interconnection and the kinds of measures that will be needed to ensure a politically, economically, and environmentally sustainable energy strategy.

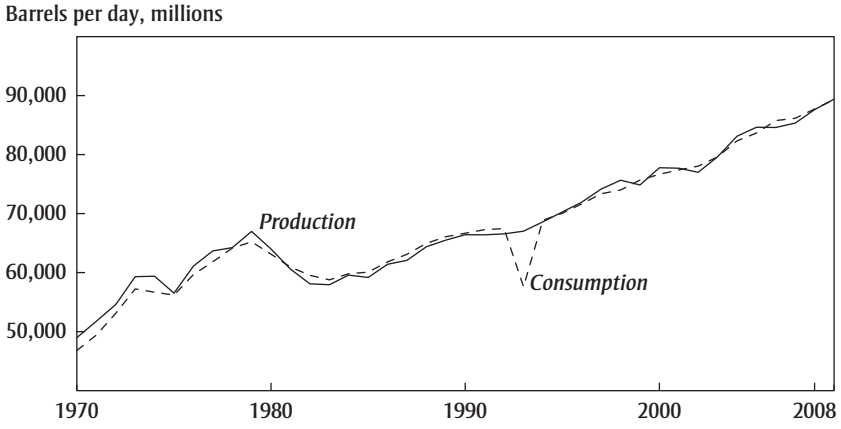
Shallow Markets, Sharp Politics

International economic and political developments can exacerbate the effects of inelastic supply and demand on global energy markets, causing massive price fluctuations even when the underlying nature of the market remains unchanged. Under such volatile conditions, political power has accrued in the hands of energy exporters, making it more difficult to gain consensus among net importers on international policies, such as deploying international peacekeeping forces to Darfur and imposing sanctions on Iran to gain leverage against the risk of nuclear weaponization. And price volatility has also exacerbated the impact of bad economic policies in energy-exporting states when revenues have collapsed during economic downturns—dealing a critical blow in the collapse of the Soviet state in 1991, for example.[2] Over the long term, reducing market volatility serves the self-interest of both energy importers and exporters.

To frame this discussion, recall that the price of oil rose from $21 a barrel at the beginning of 2002 in the run-up to the Iraq war, to $29 at the start of hostilities on March 19, 2003, to $48 at the start of President Bush's second term in January 2005, to $145 in July 2008[3]—an overall rise of over 400 percent. Prices then fell during the recession in late 2008, hovering at about $50 a barrel in the spring of 2009 with decreased consumer demand.[4]

To change the dynamics of energy markets from instability to security, both importers and exporters must get beyond the cyclical price incentives that perpetuate the current structure of international oil and gas markets. For net importers, that will mean diversifying energy sources, with greater reliance on renewable energy and energy conservation. For exporters, that will mean internal economic diversification to reduce dependence on export revenues. Yet when energy prices are high, exporters have generally used revenues to consume more. When energy prices are low, the

FIGURE 1-1. Oil Demand and Supply Balance, 1970–2008



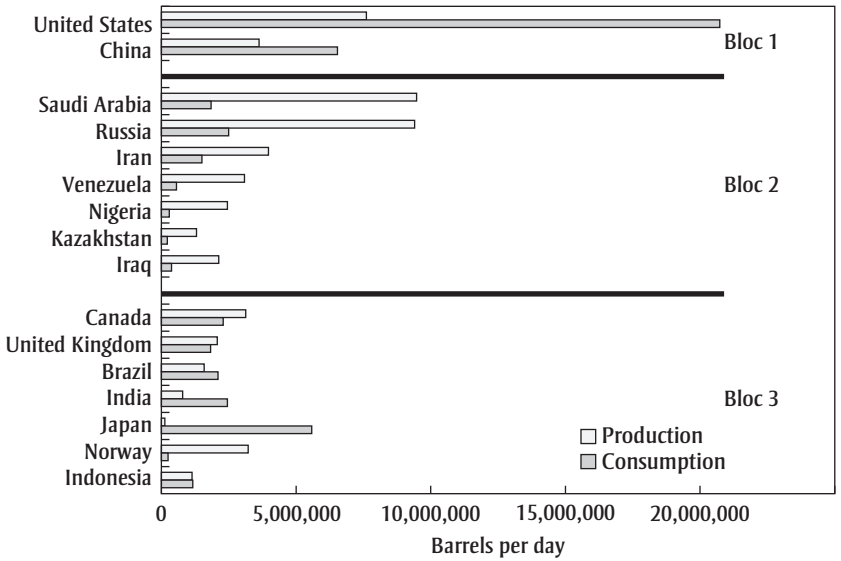
Source: Energy Information Administration, *International Petroleum Monthly* (February 2008).

political will to tax energy to create incentives for conservation and innovation sharply diminish. The result, illustrated in figure 1-1, has been an almost tandem rise of international oil production and consumption, with the exception of a sharp drop in consumption in 1992–93 when the Soviet Union collapsed. Until political leaders break this mismatch in pricing and political incentives, the underlying structure of oil and gas markets will continue to undermine the long-term security interests of both importers and exporters.

Figure 1-2 illustrates the demand and supply factors behind oil price volatility. Bloc 1 in the chart represents the fastest-growing sources of demand for oil: the United States and China. Bloc 2 consists of Saudi Arabia, Russia, Iran, Iraq, Venezuela, Nigeria, and Kazakhstan. These are countries upon which oil importers de facto rely to meet short-term supply shortages. Bloc 3—Canada, the United Kingdom, Brazil, India, Japan, Norway, and Indonesia—shows other important drivers of supply or demand, most notably Japan and India, which rely massively on oil imports.

On the supply side, there is limited ability to expand production rapidly in the short term, and even long-term prospects are mixed. Figure 1-3 shows that in the past decade, Russia and Saudi Arabia have accounted for the largest increases in oil supply. Existing Russian fields are now pro-

FIGURE 1-2. Oil Production and Consumption, 2007

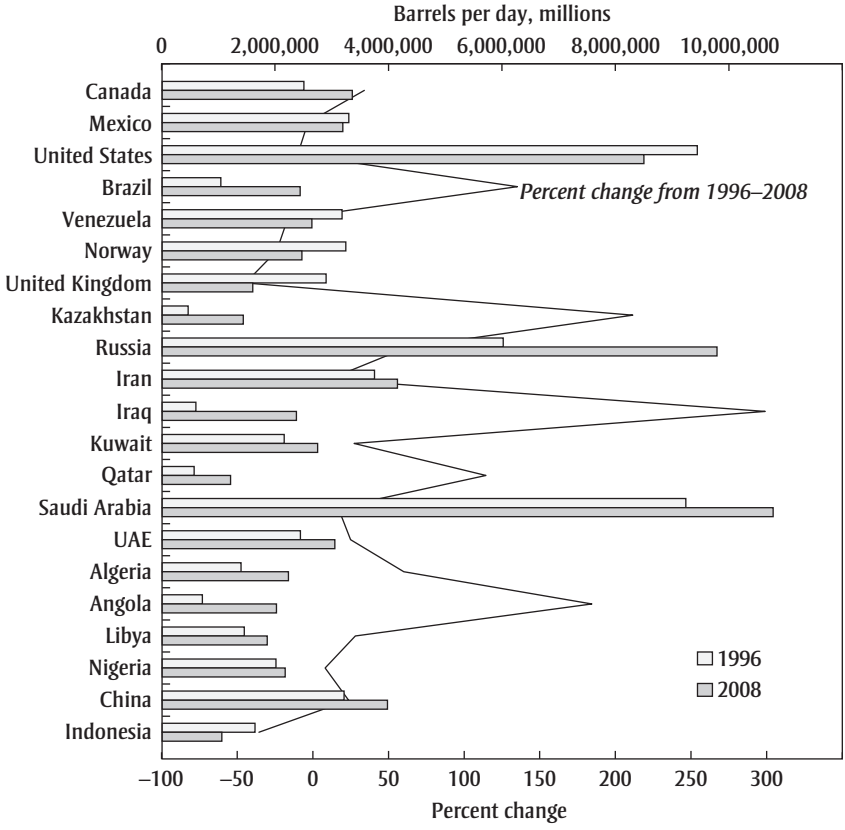


Source: See CIA *World Factbook* 2007 and 2008 (www.cia.gov/library/publications/the-world-factbook/); figures through third quarter of 2007.

ducing at their peak, and Saudi Arabia has limited additional short-term capacity. Due to commercial disputes, local instability, or ideology, Russia, Venezuela, Iran, Nigeria, Mexico, and Iraq are not investing in new long-term production capacity.[5]

Given limited supply elasticity, political volatility gets magnified through fluctuating and unpredictable prices. Key sources of instability include conflict in the Middle East, the risk of the Iraq war spilling into the Persian Gulf, the risk of U.S. and/or Israeli conflict with Iran over its nuclear program or over Iranian support for militias in Iraq, conflict in the Niger Delta, populist state controls in Iran and Venezuela, and the difficulty of securing major oil transport routes. Saudi Arabia pledged to increase oil production by 200,000 barrels a day of heavy sour crude at the Jeddah Summit on June 22, 2008, which was essentially offset by offshore attacks on Shell's $3.6 billion "Bonga" floating production, storage, and offloading vessel on June 19 by the Movement for the Emancipation of the Niger Delta (MEND), which, in combination with kidnappings of oil workers and sabotage of onshore pipeline infrastructure, kept between

FIGURE 1-3. Petroleum Production, 1996–2008



Source: See Energy Information Administration, "International Energy Statistics" (http://tonto.eia.doe.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=5&pid=53&aid=1).

600,000 and 900,000 barrels a day of Nigerian high-quality crude output off-line. Despite efforts to repair infrastructure, Nigeria—once Africa's largest oil producer—is, under these circumstances, being outpaced by Angola and branded an unreliable producer, thus underscoring the limits of energy security in a tight supply environment.

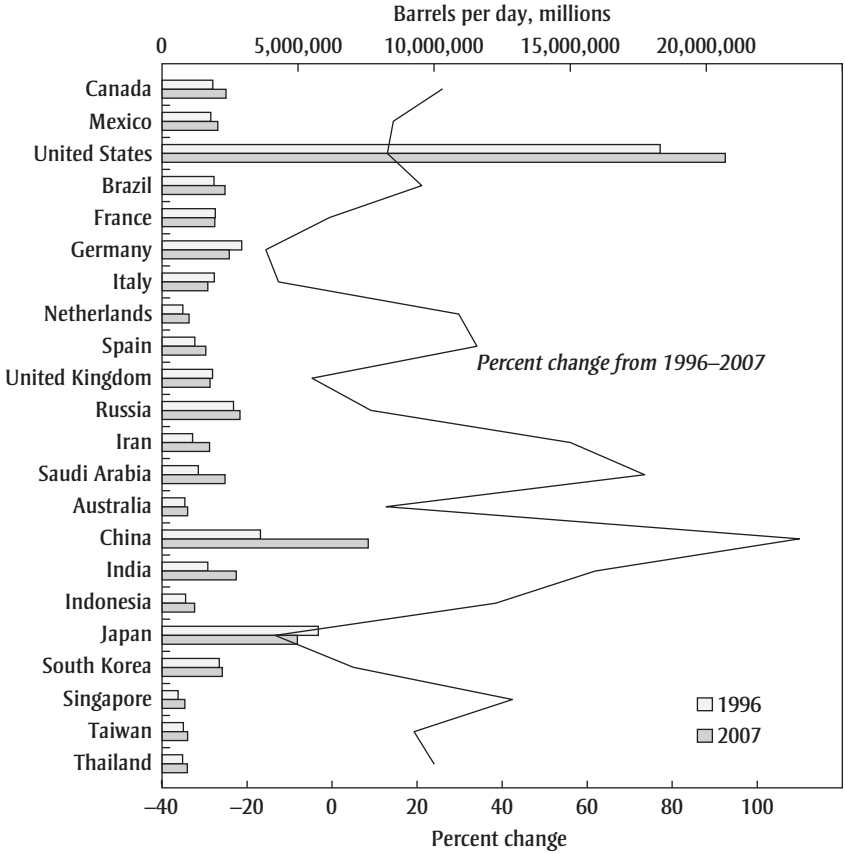
Political risk is exacerbated by choke points in transit routes. Nearly 40 percent of world oil exports pass through the Strait of Hormuz, nearly 28 percent through the Strait of Malacca, and nearly 7 percent through Bab el-Mandeb, the narrow strait connecting the Red Sea and the

Gulf of Aden.[6] Tehran's threats in 2007 to block the Strait of Hormuz if attacked over its nuclear program illustrates how several energy issues—oil transit, civilian nuclear energy use, and nuclear proliferation—can be intertwined in a volatile mix of international security and conflict. The difficulty of getting pirate attacks around the Horn of Africa under control, if they had occurred in 2008 rather than 2009, could have had disastrous impacts on energy prices when prices were already soaring. Yet in the context of a global recession in 2009, the price impact has been limited.

Supply-side fragility is accompanied by limited elasticity of oil demand in the short run, a result of the transportation sector's high level of reliance on gasoline and other petroleum-based motor fuels. Figure 1-4 illustrates how the United States and China have driven the largest share of rising oil demand since the mid-1990s. Change in this arena, such as switching to alternative fuels, requires long-term investments in technology and infrastructure. In the medium term, there are options such as increased use of hybrid cars that plug into the electricity grid.[7] Ironically, the 2009 recession could further entrench the structural factors that could cause a return to increased demand for oil in both the United States and China. In the United States, a temporary spike in demand for hybrid vehicles in the summer of 2008 turned into an about 30 percent year-on-year reduction in demand in January 2009.[8] That, together with the overall crippling of the auto industry, which has driven Chrysler to bankruptcy, has made it harder for automakers to finance the transition of their fleets. Beyond that, economic pressures to create jobs quickly will drive economic stimulus funds toward infrastructure investments, and those investments that can be made most quickly are based on highway transit.

Against those structural factors, the massive price swings seen from peak oil prices of $145 a barrel in the summer of 2008 to about $50 a barrel in the spring of 2009 are easier to understand, even if the precise inflection points in price trends are hard to predict. First, the subprime mortgage crisis drove investors from real estate to oil and other commodities. Speculative oil demand exacerbated tight and costly supply, pushing oil prices upward. When the U.S. financial crisis turned into a global economic recession by late 2008, the demand and price trends reversed. The International Monetary Fund estimates that global GDP will contract by 1.3 percent in 2009, affecting both industrialized and emerging economies. Demand for energy has contracted with global GDP, as has speculative investment in energy commodities. U.S. crude oil consumption is down by 1.45 million barrels a day, which is 6.8 percent less than last year, and crude stocks

FIGURE 1-4. Petroleum Consumption, 1996–2007



Source: See Energy Information Administration, "International Energy Statistics, 1996–2007" (http://tonto.eia.doe.gov/cfapps/ipdbproject/iedindex3.cfm?tid=5&pid=54&aid=2&cid=&syid=1996&eyid=2007&unit=TBPD).

rose by 5 million barrels in December 2008, which is the largest gain since 1970.[9] The result has been a reverse free fall down the price curve that brought energy to record highs in mid-2008.

Still, structural factors will likely drive an eventual price reversal. Falling prices have begun to curtail long-run investment in exploration and production (E&P) as more expensive projects are put on hold;[10] that, in turn, will feed back into the long-run outlook. E&P planned under high oil prices to bring online more oil and gas to alleviate the tight supply mar-

ket will not have taken place on the size and scale needed. While some international oil companies claim that they will stick to their investment plans, OPEC indicates that about thirty-five new projects could be on hold, cutting by about half the increases projected in global production capacity expected by 2014.[11] As argued above, the recession constrains the capacity of the private sector to invest in massive restructuring in the short term to accelerate the transition to a less fossil fuel–intensive infrastructure base.

To get out of this cycle of volatility, then, national leaders will need to change the structure of energy markets and reduce dependence on both fossil fuels and fuel exports as a revenue source. That will require investments in conservation to reduce demand and to expand renewable sources of energy. Sustaining such investments will require consistent price signals to industry, investors, and consumers. And that will require national leaders to take actions that may have short-term financial and political costs. In the meantime, one of the costs paid is in U.S. national security due to the volatility to which we subject the economy and the power we transfer to energy suppliers willing to use their wealth in ways that complicate U.S. national interests.

Energy and Power Politics: Iran, Venezuela, and Russia

Iran, Venezuela, and Russia have had some of the most obvious political impacts on the realities of today's oil market. Their customers and investors have at times set aside their political concerns to preserve their commercial interests. All three countries have used their energy wealth and leverage to strengthen their regional influence with more vulnerable neighbors, and all three have used the stature that they have acquired through their regional interventions and wealth to complicate U.S. interests.

Iran is developing a nuclear program despite UN Security Council resolutions 1696, 1737, and 1747 demanding that Iran suspend the enrichment of uranium and fully discloses the nature of its nuclear program. When the International Atomic Energy Agency (IAEA) board of directors referred Iran to the UN Security Council (UNSC), countries from every part of the world opposed Iran's development of the capability to produce a nuclear weapon. Yet the country remains defiant.

In part, that may be out of the hope that Russia and China will block any serious sanctions, largely because of their commercial interests in Iran. China is moving into gas development projects in Iran, where Western companies are kept out by the sanctions regime. Both Russia and China

have generally resisted using international sanctions to exert pressure on other countries, in part to serve their own commercial interests, in part to avoid precedents authorizing the UN to scrutinize sovereign decisions on national security. The National Intelligence Estimate (NIE) of 2007 found that Iran's nuclear weapons program had been suspended in 2003 and that it had not been restarted as of mid-2007. However, with indigenous civilian nuclear capacity and technical expertise, there is potential for breakout—although it is important to distinguish between aspirations for breakout and the ability to do so, given that building uranium enrichment and/or reprocessing capacity is far more complex than building a civilian nuclear reactor.

While high oil revenues do not translate directly into market power and influence for Iran, they can embolden the country's most militant leaders to assert themselves on the nuclear issue. With the recent fall in oil and gas prices, the same leaders are faced with the prospect of not being able to provide the massive fuel and social subsidies that buy support for their regimes. However, the global nature of the economic downturn could actually make it easier for President Mahmoud Ahmedinejad to pass painful subsidy reforms without squandering as much political capital in the process. Here, price volatility translates into political volatility.

President Hugo Chávez's engagement with China and Russia, which is based on the promise and ability to deliver on energy agreements in the future, is risky, considering that Venezuela cannot guarantee its capacity to meet future production projections. The difficulty of and costs involved in extraction of reserves and lack of adequate maintenance and investment in technology, infrastructure, and new drilling render Venezuela ill-equipped to meet and sustain current OPEC quotas. Chávez has done such damage to the investment climate that exploration and production have not risen with growing demand and higher oil prices. He is undermining the very industry on which the entire country's economy and welfare system is predicated, then looking to China and Russia to fill the void of foreign investment, while trying to gain political leverage by posturing against the United States.

In addition to being one of the world's top-ten oil producers and a top supplier to the United States, Venezuela's Orinoco tar sands are estimated to be the largest deposits of their kind in the world, potentially rivaling conventional world oil reserves. Their strategic importance for global energy is enhanced by improvements in extraction technology and by potential future recovery rates with the turn to unconventional oil. When

oil prices recover from the financial downturn, of the unconventional sources for oil—including Canadian tar sands—the Orinoco tar sands are the most economical. A poor investment climate combined with aggressive political rhetoric, unsound economic policy, and the current economic crisis poses a risk for development of these reserves, which could enhance global oil supply.

Venezuela's influence must be seen in the wider context of globalization and its impact in Latin America. Globalization has helped millions in Latin America to tap into technology, markets, and capital in a way that has made many countries and people wealthier. However, the gap between the "haves" and "have nots" has grown. Those who have not made it are increasingly better-educated and resentful for what they do not have. That resentment is strongest among those who are making the transition out of poverty but who cannot see how to advance further. Such individuals become vulnerable to populism, and when given a chance to vote, many will use their ballots to express their frustration. It is in this context that Venezuela and Hugo Chávez have brought their wealth to bear. Chávez's message of populism and his support for local leaders have the potential to galvanize local frustrations within Brazil and Mexico. In Bolivia and Nicaragua, the Chávez myth, seen from the outside, suggests that the poor could be given more at little cost.

Not every Latin American country has gone down Chávez's populist route, but he presents new challenges to a regional order based on democracy and market principles. For democrats in the region, the first challenge is to ensure that there is not a backlash against democracy from those leaders and countries that feel threatened by popular frustration. The second is to reform governance and policies to give the "have nots" the sense that they can have a better future. Whether Latin American leaders can educate their people to create the capacity to benefit from globalization, whether governments can target subsidies to those who need to be pulled into society, and whether the United States will open its markets to technologies, services, and products—these factors together will fundamentally affect perceptions of democratization in the region and whether it becomes a source of stability or a vent for populism.

Russia's veto power in the UN Security Council; its unique position in supplying gas, electricity, and oil to Europe; and its control over one of the two largest nuclear arsenals in the world make it important to understand the ways in which energy has transformed Russia internally and the nature of its role in the international community. In addition to being the world's

TABLE 1-1. Total Energy Consumption

	Gas consumption 2006	*Gas imports from Russia 2006*	*Russian imports as a percent of 2006 gas consumption*
Slovakia	5.5	6.30	114.44
Finland	4.3	4.52	106.08
Bulgaria	3.0	2.85	93.82
Czech Republic	8.5	7.13	84.06
Greece	3.2	2.40	74.04
Austria	9.4	6.85	72.89
Hungary	12.5	8.32	66.45
Turkey	30.5	19.65	64.44
Poland	13.7	7.00	51.12
Germany	87.2	36.54	41.91
Italy	77.1	22.92	29.73
Romania	17.0	3.95	23.26
France	45.2	9.50	21.04
Switzerland	3.0	0.37	12.42

Source: "BP Statistical Review of World Energy, 2007 and 2008" (www.bp.com/sectiongenericarticle.do?categoryId=9023783&contentId=7044475) and Energy Information Administration, "Russia Country Analysis Brief" (www.eia.doe.gov/cabs/Russia/NaturalGas.html). Full-year data for 2006 are the most current published data as of this writing. Countries that import more than 100 percent of their gas consumption are either using the excess volumes to replenish national gas stores or are re-exporting a portion of their imports.

second-largest exporter of oil, Russia has the world's largest proven gas reserves—it controls over a quarter of the world's reserves, or 47,040 billion cubic meters—and also has the world's largest electricity grid.

Table 1-1 illustrates the importance of Russia's role as gas supplier for Europe. On average, European countries rely on Russia for 23 percent of their imported gas (the equivalent of three-quarters of Russian gas exports), and that number is expected to grow (depending on what happens with new Norwegian Arctic gas discoveries, which are expected to double current production levels from a dwindling North Sea supply). Russia's dominance in the primary energy mix is much higher among a number of eastern and central European countries. In this sense, Russian gas supplies can determine the economic vitality of Germany, Greece, Austria, Finland, and others. Generally, pipeline gas connections tend to create a long-term mutual dependence that militates against confrontational acts such as cut-offs or boycotts by the producer, the consumer, or the transmitter. Thus, even at the height of the cold war, gas supplies from the USSR to central and Western Europe continued without interruptions. However, in the last decade Russia has repeatedly demonstrated its will-

ingness to use gas as a political weapon, in conjunction with commercial arguments about price, most vividly during confrontations with Ukraine in January 2006 and February-March 2008.

Oil is a fungible commodity, whereas natural gas delivered by pipeline—as most of the world's natural gas is, despite the nascent growth of a potential global market in liquefied natural gas (LNG)—entails a more concrete relationship between a discrete producer and a discrete set of consumers. Diversification of gas supply therefore is costly and requires a time-consuming licensing and construction process. New infrastructure, in turn, requires contractual commitments to underwrite financing for what are often multibillion-dollar projects. For example, the Nord Stream gas pipeline—known previously as the North European Gas Pipeline (NEGP)[12]—will connect gas fields in the Khanty-Mansiysk Autonomous Oblast to German and other European consumers. Two parallel pipelines will be laid under the Baltic Sea from near Vyborg in Russia to near Greifswald in Germany, with a capacity of 27 billion cubic meters a year for each of the two "threads." The first thread is meant to be commissioned in 2010 and the second in 2012. Assuming that Gazprom's plans proceed as announced, Nord Stream will have the capacity to deliver nearly 25 percent of Europe's incremental gas import needs by 2015. However, many industry experts think that Nord Stream will experience construction delays and that its ultimate cost will be a multiple of the initial price tag of €5 billion ($7.68 billion).[13] Nord Stream, moreover, will only further entrench Germany's dependence on Russian gas.

Russia's energy market power has allowed Russia to consolidate political power internally and has made Russia resistant to external political influence. Within Russia, former president Putin reversed the halting trend toward democratization that occurred through the 1990s by controlling the appointments of governors and the upper house of parliament and consolidating control over most broadcast media. He orchestrated a change in rules for parties to get into the lower house of parliament, in turn tightening the ties between political parties and the Kremlin. He appointed Kremlin officials to corporate leadership positions in the gas, oil, rail, airline, shipping, diamond, nuclear fuel, and telecommunications industries.[14] With power thus centralized, Putin rejected in increasingly belligerent tones any external criticism of Russia's political system and policy choices. He accused the Organization for Security and Cooperation in Europe of aiming "to deprive the [December 2007 parliamentary] elections of legitimacy" by pulling out of plans to observe them.[15] Russia con-

tinues to refuse to ratify the Energy Charter Treaty, which would set the terms for energy production and transit in Russia and other countries. Despite virtually every country in the word rejecting Russia's decision to recognize the "independence" that it orchestrated for South Ossetia and Abkhazia after its incursion into Georgia in August 2008, Russia has been immune to external pressures to relent on its position.

It is in this context that the United States and Russia now purport to hit a "reset" button on their relationship. Russia's policies toward Iran and whether it cooperates with the United States and the rest of the international community to avert Iran's acquisition of a nuclear weapon will be the most significant test of whether Russia believes that its energy wealth allows it to ignore wider accountability for its actions.

On one hand, Russia has stated that it has no interest in having Iran acquire nuclear weapons, and it has been part of the group of the five permanent Security Council members and Germany that is involved in negotiations with Iran. At the same time, Russia has resisted the imposition of tough sanctions against Iran, seeking to carve out exceptions for Russia's sale of civilian nuclear technology for Iran's Bushehr nuclear power plant and to weaken UN sanctions while providing cover for China to follow suit. Russian officials or former officials have indicated that they see prospects for the International Atomic Energy Agency to close out the file concerning the historical questions about Iran's nuclear program. According to these individuals, that will require returning the Iran case from the UNSC to the IAEA.

Russia, in effect, has positioned itself either to unravel or make viable an effective diplomatic package against Iran. If it splits the "P5 plus 1" (the five permanent UNSC members plus Germany) by insisting that the UNSC should not consider sanctions against Iran, Russia will undermine any effective diplomatic effort, giving Iran further leeway and virtually ensuring that it develops nuclear weapons capability. Such actions will raise the risk of U.S., Israeli, or other military action against Iran. Yet Russia also has the capacity to make clear to Iran—and to its Islamic constituents and neighbors—that the international community is not blocking Iran from a civilian nuclear program. To the contrary, Russia's cooperation can make it possible to offer Iran a more advanced civilian nuclear plant, assurances of enriched uranium fuel, and provisions for transfer of spent fuel back to Russia.

The Iran case and Russia's role in it underscore key elements of today's complex geopolitics of energy: market power to act in isolation, leverag-

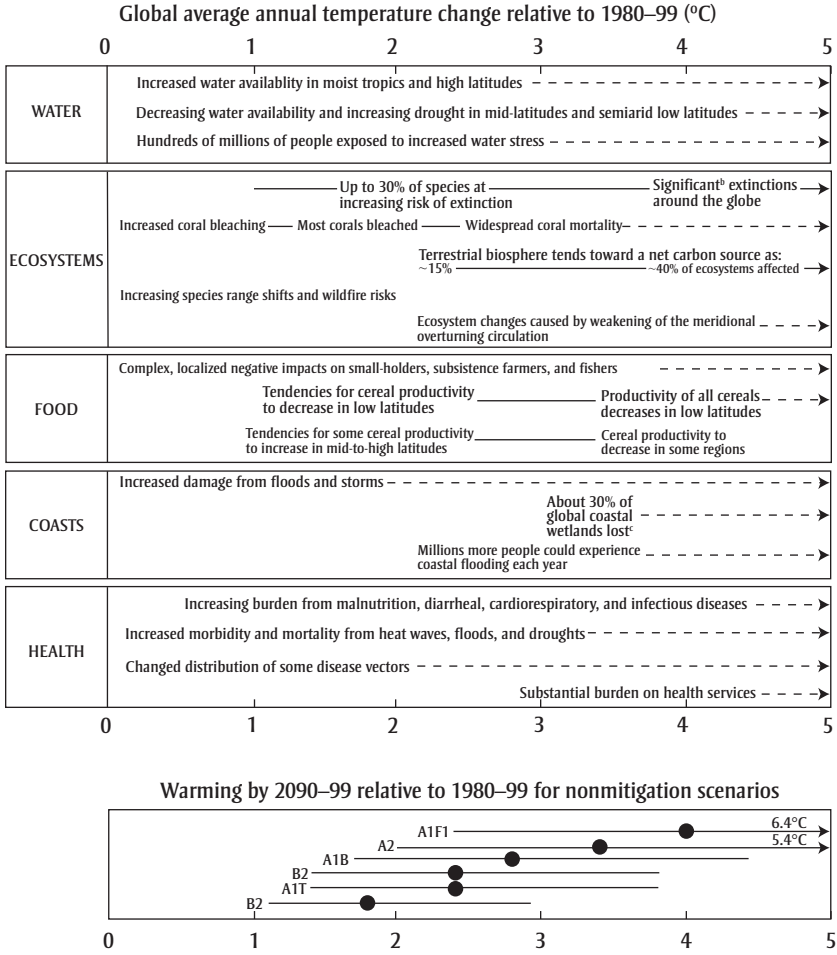
ing energy power through veto power at the UN, emerging risks and opportunities associated with civilian nuclear power, structural dependence embedded in gas markets and pipelines, and limited recourse to use international rules to promote accountability. For consumer nations—and those who see the wider risks of vesting so much political power in energy-rich states—the short-term options are limited, as production is managed by producer countries. Better management of consumers' emergency inventories could help, and bringing China and India into an emergency stocks management system would seem crucial since they are the biggest drivers of increased oil demand yet are outside the International Energy Association's stocks management system. The more critical changes come in the medium term, through conservation, alternative fuels, massive lifestyle changes, new building codes, and new technologies that burn less energy. It is these very types of policies that are also central to a different yet even more existential aspect of the geopolitics of energy: climate change.

The Geopolitics of Climate Change

Avoiding the destruction of the planet through the emission of greenhouse gases (GHGs) is one of the most complex challenges that the human race has ever created. Climate change puts the survival of many natural systems and biodiversity at stake, potentially leading to a myriad of deleterious consequences for human security. The difficulties lie in the intersection of earth sciences, technology, economics, and politics. The emission of greenhouse gases will have the same impact regardless of the source—Beijing, Detroit, or Newcastle—hence it is impossible to solve the global problem without involving all states or at least the major GHG emitters. The problem of human-induced climate change arising from the concentration of greenhouse gases in the atmosphere was created by the industrialized world, so emerging market economies resent that they must share the cost of avoiding or responding to the problem. Yet emerging economies are the fastest-growing source of greenhouse gas emissions. Deforestation accounts for 20 to 25 percent, which is roughly equivalent to U.S. emissions.[16] Worse yet, the biggest catastrophic impacts will be on developing countries, such as Mali and Bangladesh, that are not driving the problem.[17]

Science, technology, and domestic politics further complicate the picture and split even the developed economies. Figure 1-5, from the Intergovernmental Panel on Climate Change, illustrates the interrelationships among temperature, GHG concentrations, and impacts of a changing

FIGURE 1-5. Examples of Impacts Associated with Global Average Temperature Change[a]



Source: From Intergovernmental Panel on Climate Change, "Climate Change 2007: Synthesis Report—Summary for Policymakers."

a. Impacts will vary by extent of adaptation, rate of temperature change, and socioeconomic pathway.

b. Significant is defined here as more than 40 percent.

c. Based on average rate of sea level rise fo 4.2 millimeters/year from 2000 to 2080.

climate. The IPCC has stated that the maximum temperature increase that the world can sustain without suffering irreparable damage is about 2.0 degrees centigrade by 2050. There is less certainty about what concentration of GHGs will prevent anything more than a 2.0 degree temperature increase, but the estimates fall in the range of 450–550 parts per million (ppm) of CO_2e (equivalent carbon dioxide).[18] The lower the level, the costlier and harder it is to achieve. The world is currently at a level of about 420 ppm of CO_2e. There is also uncertainty about the level of annual reductions in greenhouse gas emissions that are needed to stabilize the atmosphere at a concentration of 450–550 ppm of CO_2e, but estimates range from 50 to 85 percent in annual reductions of CO_2e emissions relative to 1990 levels.

The objective of a climate change policy is to create the incentives that will drive changes in technology, technology dissemination, and consumption patterns and lead to new developments in how energy is produced in order to reduce the annual emission of carbon to a level that does not exceed 450 to 550 ppm by 2050. That is a monumental task. For example, if current practices and technology stay the same, estimates indicate that greenhouse gas emissions could increase by 25 to 90 percent by 2030 instead of decreasing on the order of 50 percent or more annually by 2050, which should be the trajectory.

Currently the technologies and policies to achieve that target do not exist. Conservation, efficiency, alternative fuels, and cleaner use of fuels all have to be part of the equation. However, the combinations currently available do not achieve the desired end. In order to succeed, the international community must find a way to price carbon in order to curb consumption, spur technological innovation, affect fuel choices, and stimulate investment. Some argue that, in the long term, there must be a stable long-term price for carbon of at least $30 per ton of CO_2e to achieve the necessary economic and technological incentives.

Yet pricing carbon has divided the world geopolitically. No country has adopted an explicit tax on carbon on the scale of $30 per ton. Cap-and-trade systems in Europe or those emerging in regions of the United States do not yet come close to that level of implicit carbon price. Within the United States, the more proactive states have adopted standards for the use of renewable fuels and fuel efficiency. Some states, like Florida and California, have set targets for overall GHG emissions, creating an implicit cost for carbon, but they are not setting the stable, explicit price signals that are needed for innovation. Japan, for example, has called for

a 50 percent annual reduction in CO_2 emissions by 2050, but the Japanese government has kept a cap-and-trade system and a carbon tax off the table as policy options.

In addition, agreement not to subsidize domestic energy prices is a necessary component of any emissions control policy. Major energy producer and consumer nations alike distort domestic demand by subsidizing fuels. While India, China, and the producing states of the Middle East have recently begun to raise domestic energy prices, they continue to subsidize prices below their real cost of production; in contrast, if domestic consumers paid world market prices for petroleum and electricity, that would not only temper domestic demand but encourage efficiency improvements.

From the debates over policy, economics, technology and science during the Bush and now the Obama administration, four geopolitical blocs on climate change have emerged, with a fifth waiting in the wings. The first is anchored by Europe and to a lesser extent Japan, with both supporting the adoption of binding emissions targets. The second is driven by the United States together with Australia and supports setting a long-term goal with nationally binding medium-term commitments but not an internationally binding treaty that holds countries collectively to account. The third consists of the emerging market economies, led by China and India; it has resisted any form of binding international targets, focusing its demands on technology dissemination and financing for the cost differential for clean technologies. The fourth group comprises developing countries that will bear the brunt of flooding, desertification, and other catastrophic effects of climate change; their demands center on financing to adapt to the impacts of climate change. The emerging fifth group consists of energy suppliers who see the world shifting away from the use of fossil fuels. They could emerge either as facilitators of a transition toward a more carbon-free world if they invest their wealth in technology dissemination—and thereby position themselves as winners in a greener international environment—or they could act as spoilers, seeking to drive up prices and profits to capture the greatest earnings during the transition away from fossil fuels.

Among these groups, the United States has the capacity to play a pivotal role. China and India will not move toward more proactive domestic policies if the United States does not set the example. Along with Europe and Japan, the United States has the capacity to demonstrate that green technology and conservation can be compatible with growth and a foreign policy that is more independent of energy suppliers. The United States

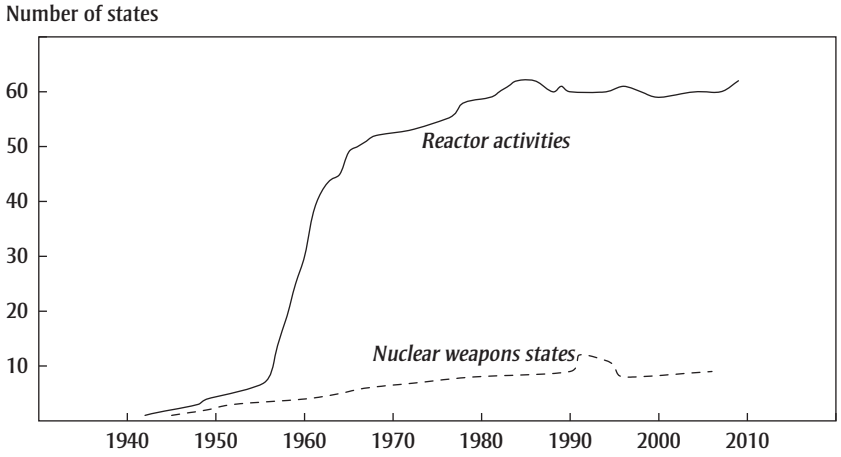
also stands to benefit from accelerated commercialization of green technologies and the development of global markets in energy-efficient and clean energy technologies. The ability of the United States to lead, however, will depend on domestic action—on whether it will undertake on a national basis a systematic strategy to price carbon and curb emissions. If it does, the scale and importance of the U.S. market can be a driver for global change. If it fails to act, then the United States will find that over time the opportunity for leadership to curb climate change will be replaced by the need for crisis management as localized wars, migration, poverty, and humanitarian catastrophes increasingly absorb international attention and resources. Eventually, its failure to act will come back to U.S. borders in a way that will make the Katrina disaster seem relatively tame.

The Geopolitics of Nuclear Proliferation

Perhaps the most existential risk, which parallels that of climate change, is that of nuclear technology and materials getting into the hands of rogue states or terrorist organizations. That could result in the devastation of cities or nations and set off reciprocal actions leading to the levels of destruction seen in Hiroshima and Nagasaki. High fossil fuel prices, the risks associated with energy suppliers and transport routes, and, ironically, policies to combat climate change—namely, the pricing of carbon—could accelerate the drive for civilian nuclear power, which could increase the risk. For economic, environmental, and security reasons, more and more countries can be expected to incorporate nuclear power into the mix of their power generation capabilities.

Today, just twelve of the fifty-six states with civilian research reactors—thirty of which have civilian nuclear power for electricity generation—can enrich and commercially produce uranium.[19] Arguably, nine countries currently have nuclear weapons: China, France, India, Israel, North Korea, Pakistan, Russia, United Kingdom, and United States. Most of these countries acquired nuclear weapons after acquiring civilian nuclear power capabilities (see figure 1-6). Nuclear weapon states have enough fissile material in their stockpiles to create tens of thousands of nuclear weapons, and there is enough separated plutonium (Pu-239) from civilian use to make just as many weapons. India diverted the plutonium used in its first nuclear test in 1974 from its Cirus research reactor a decade earlier. Imagine the risk if the number of nations producing enriched uranium were to double or triple as developing nations sought to enhance their

FIGURE 1-6. Nuclear Power States



Source: Scott D. Sagan, "Nuclear Power without Nuclear Proliferation?" *Bulletin of the American Academy of Arts and Sciences* LXI, no. 2 (Winter 2008), p. 43.

energy security through a misguided sense of energy self-reliance while adopting carbon-free nuclear technology to produce electricity. That calls for an intensified effort now, before it is a crisis, to strengthen the firewalls between civilian nuclear power and nuclear weapons programs.

A guaranteed external supply or "bank" of low-enriched uranium (LEU)—which can then be calibrated according to individual light-water reactor specifications (the most common type of reactor in use)—can serve as a back-up or reserve mechanism within the context of the existing global nuclear fuel market and should be sufficient if the real motivation is electricity generation for energy-starved states. As long as countries are fulfilling nonproliferation obligations, they should have access to LEU for nuclear fuel; according to IAEA director general Mohamed El-Baradei, that does not mean that states should give up their rights under the Nuclear Nonproliferation Treaty (NPT). Relevant proposals include the following:

—Global Nuclear Energy Partnership (GNEP): a U.S. proposal for the United States and international partners to supply developing countries with reliable access to nuclear fuel and emissions-free power generation in exchange for their commitment not to develop uranium enrichment and plutonium reprocessing technologies, thereby closing the fuel cycle

—Global Nuclear Power Infrastructure (GNPI): a Russian proposal for the creation of a system of international centers that will provide nuclear fuel cycle services under the supervision of the IAEA on a nondiscriminatory basis

—Nuclear Threat Initiative: a proposal to stockpile low-enriched uranium under the auspices of the IAEA as a last-resort fuel reserve for countries electing to forgo a national enrichment program.

The G-8 energy ministers acknowledge that nuclear nonproliferation and security should be ensured through agreed frameworks and international initiatives, such as GNEP and GNPI, in cooperation with international institutions such as the IAEA.[20] Regional entities such as the EU, NATO, ASEAN, and others also have engaged in nonproliferation activities and commitments.

Two major concerns, however, are that a world nuclear fuel bank could trigger a race in which states rush to join the nuclear club in the period before the bank is established and that an external bank could be perceived as an infringement on national sovereignty, with the result that economic incentives may not outweigh national or political imperatives. The Atoms for Peace program arguably facilitated India's and Pakistan's transition from peaceful nuclear technologies to nuclear weapons, while the NPT has been circumvented by the United States–India Peaceful Atomic Energy Cooperation Act. The potential for non-nuclear states to feel excluded and vulnerable needs to be addressed and mitigated.[21] The goal must be to give aspirants for civilian nuclear power the confidence to obtain nuclear fuel through an international fuel bank and to forgo enrichment programs while placing their entire nuclear programs under the IAEA Additional Protocol.[22] Furthermore, the World Bank and international financial institutions could finance nuclear plant construction as part of the deal for nuclear aspirants ratifying the Additional Protocol.[23] From the nonproliferation standpoint, it is better that a country import its centrifuges rather than develop the technology on its own. Such measures may not stop Iran's nuclear ambitions, but they may help other countries from breaking out from civilian nuclear programs to weaponization.[24] They will also reduce the risk of having nuclear material leak into the hands of rogue states and terrorists. To achieve the credibility necessary to lead the international community in forging such a revitalized regime against proliferation, the United States will need to follow through on the promises that it has made to what the non-nuclear weapons states see as

"horizontal proliferation," namely ratification of the Comprehensive Test Ban Treaty (CTBT).

Realizing a safer international nuclear regime will require revitalizing the bargain between nuclear and non-nuclear weapons states under the Nuclear Nonproliferation Treaty. Article 4 of the NPT assures non-nuclear weapons states of their right to peaceful civilian application of nuclear power and to "the fullest possible exchange of nuclear technology" if they adhere to the treaty's provisions and forgo the pursuit of nuclear weapons. Since the drafting of the NPT in 1968, experience has demonstrated ways in which monitoring and surveillance should be enhanced to reduce the risk of leakage, and these measures have been incorporated into a voluntary Additional Protocol. In return, nuclear weapons states are committed under the NPT to reduce their arsenals and seek eventual nuclear disarmament.

It is the disarmament part of this agenda that former secretaries of state Henry Kissinger and George Shultz and former secretary of defense William Perry, along with former senator Sam Nunn, have proposed in their renewed call for the elimination of nuclear weapons.[25] Even those who think that full nuclear disarmament is unworkable or unwise recognize that U.S. ratification of the CTBT is the most critical step to restore the credibility and vitality of the bargain the NPT established between vertical (deepening within nuclear states) and horizontal (across states or other entities) proliferation. At the 1995 NPT review conference, non-nuclear weapons states accepted U.S. commitment to the ratification of the CTBT as a basis for the indefinite extension of the NPT—in effect, a deal for their permanent commitment to forgo nuclear weapons. In order to advance the actions needed now to curtail the vertical proliferation of nuclear weapons, the United States cannot ignore its 1995 commitment on CTBT.

A new package is needed on proliferation and testing that includes the following:

—a commitment by NPT signatories to accept the Additional Protocol

—development of an international fuel bank under the IAEA that would assure nations of a supply of nuclear fuel as long as they observe the NPT

—a means to centralize the control and storage of spent nuclear fuel

—a ban on testing that would complicate the ability of any aspirant for nuclear weapons to break out of a civilian nuclear program.

The ban on testing is pivotal in the geopolitics of nuclear power. A comprehensive test ban would have the greatest impact on states that want to

use civilian programs as a platform for the development of nuclear weapons. Nuclear weapons states have other means to service and replenish their arsenals. Those truly committed to civilian nuclear power should not have a need to enrich uranium, and in most cases the scale would be sufficiently small that it would not make economic sense for them to do so. If any entity were to test a nuclear weapon, it should be immediately detectable, and it should trigger sharp multilateral pressure to abandon the program. That was the case with North Korea, when China, the United States, and Japan quickly secured UN condemnation and sanctions after North Korea's nuclear test in October 2006.

A comprehensive test ban creates the incentive to sustain the status quo among nuclear states and to constrain states from developing nuclear weapons capacity. The CTBT isolates those who seek to advance their ambitions for nuclear weapons. Russia would need to be part of this package—as a supplier of fuel and a secure source for storage and reprocessing—which would entail massive commercial benefits to Russia. The United States should seize on this opportunity to ratify and implement the CTBT and in so doing strengthen U.S. leverage to broker an international package to stop nuclear leakage and curtail the risk of breakout from civilian programs.

Conclusion

For more than a century, energy, politics and power have been clearly intertwined as a force in international security. The stakes are only getting bigger as the issues go beyond national prosperity and security to the viability of the planet. Policymakers and citizens must understand the nature of this change and recognize that inaction—simply not attempting to forge coalitions or provide constructive guidance on how states use energy—will be catastrophic.

It will be crucial to resist allowing short-term electoral cycles in the United States or elsewhere to drive energy policy and politics. Inevitably, some politicians will call for energy independence, an unrealistic and unattainable goal. That is simply not possible in an interconnected world that requires access to global markets, capital, and technology, whether a nation is a net importer or exporter of energy.

In the short term, diplomacy and effective reserve management will be critical tools, but they are not fully developed. Expansion of the International Energy Agency's reserve management system to China and India

has failed several times for political reasons. Technical support to help China and India coordinate with others will be an important confidence-building measure because the two nations currently see themselves as pitted against the rest of the international community. Energy diplomacy also needs to be made a central foreign policy consideration. Key questions include the following:

—Where can nations jointly benefit from further exploration and development?

—What transit systems merit international cooperation and investment?

—Can regional security arrangements mitigate risk and create shared incentives across states, especially in the Middle East, the Persian Gulf, and Central Asia?

—Can the five permanent members of the UNSC reach an understanding to suspend the use of their veto rights on issues related to energy politics in order to stimulate a full debate around tough questions that get sidetracked through veto threats?

—Should nations commit to an E-15 group, composed of the largest economies and energy users, as a means to force a focus and sustained agenda on the policies and politics behind energy supply and use?

—How do domestic energy and economic growth concerns drive the foreign policy choices of China and India and their roles in multilateral institutions?

Focused answers to those questions could be the foundation for national, regional, and international energy strategies that foster cooperation on energy issues rather than allow short-term political considerations to shape what generally may appear to be zero-sum competitive outcomes.

In the medium and long term, both geopolitical interests and environmental sustainability call for a radical departure from current patterns in the use of fossil fuels, which compromises the national security of most states and threatens the entire planet. A shared medium-term strategy among states to foster convergence on political, environmental, energy, and economic goals should include

—measures to price carbon emissions and to coordinate prices across states, if not create transnational carbon markets

—financing and policy measures to support the development, testing, demonstration, commercialization, and dissemination of clean and efficient technologies that can transform the terms of debate on energy use

and climate change (for example, addressing liabilities associated with carbon capture and sequestration)

—means to stimulate investment in clean technologies to reduce private sector and temporal risk for the developed countries, to finance the differential between clean and traditional technologies for emerging economies, and to develop infrastructure and adapt to climatic changes in developing countries

—common international standards for firms to disclose the use of carbon and establish guidelines for emissions per unit value of output in order to promote public accountability and guide investment decisions

—a new form of an international framework for climate change that reflects the complexity of the interaction of technology, economics, and politics and leads to better and tighter standards for performance over time.

On the nuclear side, no issue is more important than creating a strong firewall between civilian power and weaponization programs now, before more countries seek to break out from civilian programs. Hard as that may be, it will be easier than getting new entrants into the ranks of nuclear weapons states to disarm. For this process to begin, the United States must start with ratification of the Comprehensive Test Ban Treaty, with India and Pakistan acting in concert with the United States.

These are major challenges, but they are not unattainable. If such actions are taken now, there is a chance that the geopolitics of energy can move the international community toward constructive long-term outcomes. If not, the geopolitics of energy will make all nations less secure and bring into question the very viability of their future.

Notes

1. Ian Noble, "Adaptation to Climate Change and the World Bank," presentation at UNFCCC seminar "Development and Transfer of Environmentally Sound Technology for Adaptation to Climate Change," Tobago, June 14–16, 2005.
2. Yegor Gaidar, *Collapse of an Empire: Lessons for Modern Russia* (Brookings, 2007), p. 39–70.
3. See Energy Information Administration, "Petroleum Navigator" (http://tonto.eia.doe.gov/dnav/pet/hist/rclc1d.htm).
4. Falling demand was due to the falling dollar and U.S. economic downturn.
5. Although that could change in Iraq with the invitation of oil companies, although the short-term nature of the contracts on offer might actually hinder efficient and rapid growth.

6. See Energy Information Administration (EIA), "World Oil Transit Chokepoints" (www.eia.doe.gov/cabs/World_Oil_Transit_Chokepoints/Background.html).

7. David Sandalow, *Freedom from Oil: How the Next President Can End the United States' Oil Addiction* (New York: McGraw-Hill, 2008).

8. See www.mixedpower.com/toyota-prius/recession-hurts-sales-of-hybrid-cars-temporarily/.

9. See Energy Information Administration, "International Energy Statistics for Consumption and Stocks, 1970–2008" (http://tonto.eia.doe.gov/cfapps/ipdbproject/iedindex3.cfm?tid=5&pid=5&aid=5&cid=&syid=1970&eyid=2008&unit=MBBL; http://tonto.eia.doe.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=5&pid=54&aid=2).

10. See Adam Schreck, "IMF: Mideast Growth to Slide in 2009," for the impact of the recession on oil-producing countries in 2009 (www.google.com/hostednews/ap/article/ALeqM5hBx3VzsoP571dwg1s91L4t9C-lewD983BIVO0).

11. See "Falling Oil Supply Risks a Price Rise," March 27, 2009 (http://online.wsj.com/article/SB123808291973348921.html).

12. Originally the North European Gas Pipeline (NEGP), it was re-named Nord Stream gas pipeline in October 2006.

13. As of March 31, 2008, the estimated cost had risen to €7.4 billion (US$11.7 billion) (Interfax report).

14. Neil Buckley and Arkady Ostrovsky, "Putin's Allies Turn Russia into a Corporate State," *Financial Times,* June 18, 2006.

15. Oleg Shchedrov, "Putin Accuses U.S. of Meddling in Russian Vote," Reuters, November 26, 2007.

16. Valerie Kapos, Peter Herkenrath, and Lera Miles, "Reducing Emissions from Deforestation: A Key Opportunity for Attaining Multiple Benefits," Feburary 2007 (www.unep-wcmc.org/resources/publications/unep_wcmc%20RED%20Feb07.pdf).

17. One of the most densely populated and poorest nations in the world, Bangladesh's devastation of the largest mangrove forest in the world to make room for grazing animals and to harvest firewood is at least a force multiplier of the monsoon flooding exacerbated by climate change.

18. CO_2e signifies "equivalent carbon dioxide," which is the internationally recognized measurement of greenhouse emissions.

19. Brazil, China, France, Germany, India, Iran, Japan, Netherlands, Pakistan, Russia, United Kingdom, and United States.

20. From the Joint Statement by Energy Ministers of the G-8, the People's Republic of China, India, and the Republic of Korea, Aomori, Japan, on June 8, 2008.

21. A Fissile Material Cut-off Treaty (FMCT), originally proposed by the UN in the early 1990s, would oblige nuclear weapons states to refrain from producing fissile material for weapons. In 2004, President George W. Bush opposed international verification of an FMCT. Verification would be effective and technically feasible, and assurances could be made so that highly enriched uranium declared for naval reactor fuel would not be diverted to weapon use. "Global Fissile Material Report 2006: First Report of the International Panel on Fissile Materials" (www.fissilematerials.org), p. 2.

22. Reprocessing is not a critical part of the fuel cycle and can be postponed indefinitely by storing spent fuel. Reprocessing nuclear fuel is attractive to those who focus on supply scarcity, because it eliminates most high-level nuclear spent fuel waste—although it produces a much larger volume of intermediate- and low-level waste—and fuel scarcity concerns; hence, the push for national enrichment plants. However, repro-

cessing creates Pu-239, which carries a proliferation risk. The Additional Protocol strengthens and expands the IAEA's verification safeguards to ensure that non-nuclear state parties to the Nuclear Nonproliferation Treaty (NPT) are using nuclear materials only for peaceful purposes. The United States signed the Additional Protocol in 1998, but it is not in force because the necessary legislation to implement it has not yet been passed.

23. Debate currently surrounds the World Bank's $US5 million carbon fund and whether it should include a provision for nuclear financing.

24. In addition, more proliferation-resistant technologies, such as thorium reactors, should be promoted as part of an overall policy; however, the abundance of uranium supplies in geographically diverse locations will make creating incentives for such technology difficult.

25. George P. Shultz, William J. Perry, Henry A. Kissinger, and Sam Nunn, "A World Free of Nuclear Weapons," *Wall Street Journal,* January 4, 2007, p. A 15.