29. Eric Kroh, "Can Biodiesel Power Haiti?" *Biodiesel Magazine*, May 2008, http://www.biodieselmagazine.com/article-printe.jsp?article_=2296.

30. Johanna Mendelson Forman, "Jatropha and Peacebuilding," Testimony before the House of Representatives, Western Hemisphere Sub-Committee, March 13, 2007.

31. "A Blueprint for Green Energy in the Americas—Strategic Analysis of Opportunities for Brazil and the Hemisphere, Featuring: The Global Biofuels Outlook 2007," Garten Rothkopf for the IADB, 2007.

32. Daniel de la Torre Ugarte, Johanna Mendelson Forman, and Charlotte McDowell, *Dominican Republic's Biofuel Potential: A Report Prepared for UNCTAD and the UN Foundation*, unpublished, November 2005.

33. Ibid.

34. Veronica Prado, "Energy Infrastructure in the Western Hemisphere," in *Energy Cooperation in the Western Hemisphere: Benefits and Impediments*, ed. Sidney Weintraub et al. (Washington, D.C.: Center of Strategic International Studies, 2007), 406.

35. Private Participation in Infrastructure Projects Database, *The World Bank Group*, 2007.

36. Georg Caspary, "The Energy Sector in Latin America," Deutsche Bank Research, September 7, 2007, http://www.dbresearch.com/PROD/DBR_INTERNET_EN-PROD/PROD0000000000215273.PDF.

37. Ibid.

38. Ray Walser, "Meeting Energy Challenges in the Western Hemisphere," *Heritage Lecture #1079*, November 3, 2008.

39. Christopher J. Gonçalves, "Energy Disputes in the Americas: Bringing Method to Madness," presented to XVII Annual Latin American Energy Conference, *Navigant Consulting*, May 2008.

40. Alana Gandra, "Eletronuclear recorre de decisão judicial sobre novas audiências públicas para Angra 3," *Agência Brasil*, January 25, 2008, http://www.agenciabrasil.gov.br/noticias/2008/01/25/materia.2008-01-25.0222121499/view.

41 "Sistema de Informacion Energetica Legal," *OLADE*, June 9, 2008, http://www.olade.org/siel.html.

42. OLADE's official Web site, News and Organization sections, June 9, 2008, http://www.olade.org.ec.

43. "Petropolitics in Latin America."

44. Mauricio B. Garron, "OLADE: Thematic Planning Meeting on Comprehensive Energy Planning," *International Atomic Energy Agency*, October 30, 2006, http://tc.iaea.org/tcweb/abouttc/strategy/Thematic/pdf/presentations/energysystemplanning/LA_Energy_Perspective-OLADE_Workplan.pdf.

45. Brazil Institute, "The Global Dynamics of Biofuels: Potential Supply and Demand for Ethanol, and Biodiesel in the Coming Decade," *Brazil Institute Report*, April 3, 2007, 3. This report noted that "alternative energy policies that protect against hydrocarbon price volatility, promote technological research, and stimulate investment can lead in the direction of less reliance on hydrocarbons and greenhouse gases." The problem now is that we lack such a policy today.

46. "Venezuela/Cuba: Accord Seeks Regional Integration," *Oxford Analytica*, January 6, 2005.

CHAPTER 10

United States: A Shackled Superpower

Gal Luft

When Americans think about energy security they think petroleum and transportation. Unlike Europeans or Japanese, whose electricity generation is dependent on imported natural gas or coal, the United States is almost self-reliant for its power generation. It owns a quarter of the world's proven coal reserves; it operates more than 100 nuclear reactors; it has untapped natural gas reserves, and its system of rivers and dams produces hydroelectric power that meets nearly 5 percent of its electricity needs. Only 2 percent of U.S. electricity is generated from petroleum. When it comes to the transportation sector, the situation is completely different. Energy consumption in the transportation sector relies almost exclusively (97%) on petroleum-based fuels. Nearly 85 percent of the energy consumed in this sector is for vehicle travel, followed by air (9%) and rail and water (6% combined).[1] The United States consumes a quarter of the world's oil supply, a gigantic amount of 21 million barrels per day (mbd), an amount of oil that can daily fill a container the size of the Twin Towers. Yet, it is the locus of a mere 3 percent of global conventional oil reserves. Putting aside the current economic recession, U.S. gross domestic product is projected to grow at an average annual rate of roughly 3 percent from 2005 to 2030 and, barring a change of course, its oil consumption is projected to jump from 21 mbd to 25.5 mbd over the same period. Domestic oil production, at 5 mbd, is expected to stay almost flat.[2] Consequently, the United States is heavily—and increasingly—dependent on foreign oil. In fact, as can be seen in Figure 10.1, U.S. dependence on imported oil has increased from 30 percent in 1973, when Arab countries imposed their oil embargo, to over 60 percent today. By 2030, the United States is expected to import close to 70 percent of its oil and a growing portion of it will come from the Persian Gulf, Nigeria and other politically unstable regions.[3]

Historically, when it comes to oil American energy policy has been focused on a narrow definition of energy security that strived to ensure sufficient supply at affordable prices. This has translated primarily into policies promoting increased

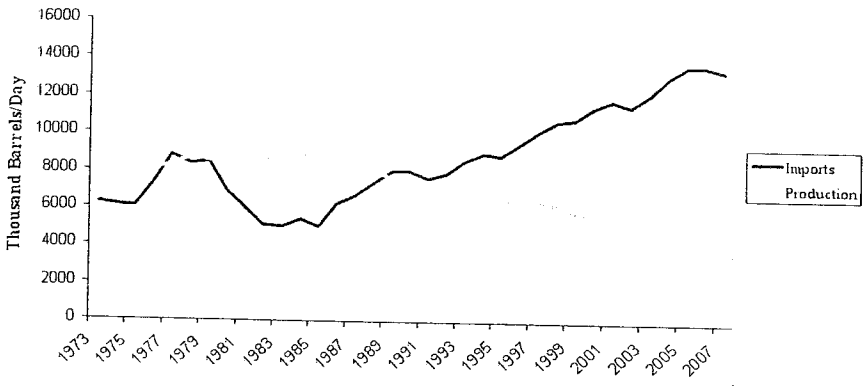

Figure 10.1 U.S. Oil Gap
Source: **Energy Information Administration**

and diversified production of energy from a range of foreign suppliers, effective measures to respond to physical oil supply disruptions through the use of strategic stocks, and a dialogue with major oil producing countries aimed to maintain responsible production policies. Conservation was also historically part of this, less so since the 1980s, when oil prices collapsed. While these policies have been successful in providing decades of relative stability in the energy market they now seem to be failing in the face of what Senator Richard Lugar calls "the new energy realism" in the global energy market, one that gives inordinate power to a small club of nondemocratic, largely anti-American oil-producing countries that otherwise would have little influence on the world scene.[4]

Because the American way of life is one of the most energy-intensive in the world, U.S. oil dependence is a source of great national security threats—"the albatross of U.S. national security" in Lugar's words—and an economically destabilizing factor. The rise of Islamic fundamentalism, the instability in the Middle East and Africa, and the natural disasters in energy producing areas are constant reminders to Americans that their oil supply, and, by extension, their way of life, is increasingly vulnerable.

Perhaps the biggest concern associated with oil dependence is that it undermines U.S. foreign policy objectives. "I can tell you that nothing has really taken me aback more as secretary of state more than the way that the politics of energy [is] 'warping' diplomacy around the world," said then Secretary of State Condoleezza Rice in a 2006 testimony before the Senate Foreign Relations Committee.[5] The impact on foreign policy expresses itself in various ways. First, the United States finds itself in an odd situation in which it funds both sides of the war on terror. On the one hand it carries most of the financial burden associated with fighting the war on radical Islam and defending the Persian Gulf from aggressors, and at the same time through its oil imports it funds the very same regimes of Iran and Saudi Arabia that are most responsible for the spread of this ideology.[6] Second, the excessive power wielded by other oil and gas producing countries like

Venezuela and Russia enables those countries to use their wealth to undermine U.S. interests in Latin American and Eurasia. Third, China is today the world's second largest petroleum user after the U.S. and its dependence on Iran and Sudan prevents Beijing from siding with the Washington on vital issues like Iran's nuclear program and the genocide in Darfur. In the future, China's pursuit of oil could create increasingly tense Sino-American competition over access to oil.

Oil dependence has considerable economic implications. Disruptions of foreign oil supplies sparked the two most serious recessions of the post World War II period. The massive rise in gasoline price in 2007–2008 has taken a considerable economic toll on working families, and petroleum purchases are responsible for roughly one-third of the U.S. trade deficit and a slew of economic dislocations from declining currency to inflation. For the two decades between 1988 and 2007, U.S. expenditures on petroleum imports averaged $78.5 billion annually. In 2008, the United States paid nearly half a trillion dollars for foreign oil, an amount that far surpasses its defense budget. This loss of national wealth is believed to be one of the causes of the economic crisis that hit the United States in full force in September 2008.

In a Hole, Yet Keeps Digging

The danger of America's growing dependence on oil from unstable regimes has been on the mind of every American president since Richard Nixon. On January 30, 1974, several months after the Arab oil embargo, President Richard Nixon addressed the nation, saying: "Let this be our national goal: At the end of this decade, in the year 1980, the United States will not be dependent on any other country for the energy we need to provide our jobs, to heat our homes and to keep our transportation moving." On July 15, 1979, President Jimmy Carter made a similar pledge: "I am tonight setting a clear goal for the energy of the United States. Beginning this moment, this nation will never use more foreign oil than we did in 1977—never."[7] Carter requested of Congress "the most massive peacetime commitment of funds and resources in our nation's history" to develop efficiency measures and alternative energy sources. In the next several years, conservation proved to be America's fastest growing energy sector. Fuel efficiency of the average American car nearly doubled. Fuel switching brought down the share of homes using oil for heating from 31 percent to 10 percent. Electricity generation from oil dropped from 17 percent of the nation's total power output to its current 2 percent (a fact that seems to have eluded many in the public sphere who incorrectly persist in calls for increased solar, wind, or nuclear power generation as ways to reduce oil consumption.) The oil shocks of the 1970s also launched a wave of technological innovation in alternative energy and gasoline substitutes. Energy saving patents were registered by the thousands, and several government bureaucracies to enforce and encourage conservation were established. As a result of all these measures, between 1979 and 1985 oil consumption in the U.S. decreased by 15 percent, oil imports fell by 42 percent and imports

from the Persian Gulf by 87 percent.[8] But America's progress toward energy independence was stopped by the collapse of oil prices in the mid-1980s. Many investors in alternative energy lost their shirts and the improvement in fuel economy of American cars stalled; in the two decades following 1987 it remained essentially unchanged. In recent years, the aforementioned impact on the U.S. economy and foreign policy brought oil dependence to the top of America's national priority list. Then President George W. Bush, a president who emerged from the petroleum industry, acknowledged in his 2006 State of the Union Address that: "We have a serious problem: America is addicted to oil," while his successor, President Barack Obama said in January 2009: "At a time of such great challenge for America, no single issue is as fundamental to our future as energy."[9]

Despite the broad agreement on the urgent need to reduce petroleum dependence, America's energy policy still suffers from institutional paralysis. Fuel economy standards in the United States are lower than any other industrial country and alternatives to oil face significant barriers to market penetration. This is caused partly due to partisan bickering but mostly due to a poor definition of the energy problem. After a century of a transportation sector dominated by petroleum—almost all of the world's cars, trucks, ships and planes can run on nothing but petroleum—Americans accept oil's strategic status as a fait accompli. As a result, instead of addressing oil's virtual monopoly in the transportation sector—the reason for oil's status as a strategic commodity—as a problem to be solved, the focus has been on policies that increase either the availability of petroleum or the efficiency of its use. This led to a public discourse that is focused too much on solutions that are politically contentious (like domestic drilling and increasing mandatory fuel efficiency standards) and by and large tactical rather than strategic or, in the case of solar, wind and nuclear power, irrelevant to the problem, as almost no electricity is generated from oil. The reality is that neither efforts to expand petroleum supply nor those to crimp petroleum demand will be enough to reduce America's strategic vulnerability. The reason for this is that such solutions do not address oil's monopoly over transportation fuel and the stronghold of OPEC over the consuming nations' economies. Yet, while there is a near consensus about the danger of continuous reliance on oil, and while it is clear that the transportation sector is, and will continue to be, the main petroleum consuming sector, every year the United States continues to put on its 10–15 million new gasoline only cars, each with a street life of 16 years, hence locking its future to petroleum-exporting nations for many years to come. Cars that can run only on petroleum are perhaps the biggest obstacle to U.S. energy security as they essentially guarantee the perpetuation of the petroleum standard and the oil cartel's continuous domination over the global transportation sector.

A new energy security paradigm is therefore urgently needed, one that requires deployment of diplomatic, military, scientific, and economic resources toward solving the energy problem, and, most important, one that enables the United States to shift the economic and geopolitical balance of power to its advantage by shifting from a petroleum-dominated transportation system to one in which

petroleum alternatives can play a significant role, and doing this while providing for the petroleum needs of the 220 million cars and trucks that will be running on America's roads during the transition period.

Militarization of Energy Security

An American columnist who was asked after 9/11 what U.S. energy policy is replied with two words: "aircraft carriers."[10] Behind the sarcasm lies a plain truth: the use of military power to ensure free flow of oil from the Persian Gulf has been the main tenet of U.S. national energy security policy since the 1980s. According to the Carter doctrine coined by President Jimmy Carter after the oil crises of the 1970s, any effort by a hostile power to block the flow of oil from the Persian Gulf to the United States will be viewed as an attack on America's vital interests and will be repelled by any means necessary including military force. Since 1980, the United States has exercised the Carter doctrine several times. When, during the Iran-Iraq War, Iranian forces attacked Kuwaiti tankers, President Ronald Reagan authorized reflagging and provided them with U.S. Navy protection. Then, following Iraq's invasion of Kuwait in 1990 President George H.W. Bush authorized military action to defend Saudi Arabia's oil fields and restore Kuwait sovereignty. In the decade between the Gulf War and the 2003 Operation Iraqi Freedom the United States strengthened its military presence in the region, building bases in Qatar, Bahrain, and Kuwait. At a cost of $50-$60 billion per year (in a non-war year) it patrolled the waters of the Gulf, imposed a no-fly zone in Iraq and provided training and equipment to the region's militaries. During the Second Iraq War, coalition forces invested a great deal of resources in critical energy infrastructure protection. Since the last several years of the 20th century, with increased geographical diversification of America's oil supplies, the Carter Doctrine has gone global, and military protection is now granted to new, albeit smaller, oil-producing regions.[11] Both the Clinton and the second Bush administrations made significant efforts to strengthen U.S. ties with emerging oil producing nations in Central Asia, West Africa and Latin America. U.S. military forces are deployed in and/or provide military assistance to Azerbaijan, Kazakhstan, Afghanistan (not an energy producer but one that could become an important transit state for Caspian energy), until 2006, Uzbekistan and until 2008 Kyrgyzstan. In Latin America, U.S. Special Forces are deployed in Colombia to help the government protect pipelines that are repeatedly attacked by drug lords and terrorists. With increased interest in African oil, U.S. military presence along the west coast of Africa, where some of the most promising offshore oil fields are known to exist, has grown considerably. In 2007, the U.S. military created the Africa Command, AFRICOM, to address security challenges in the African continent.

The problem with militarization as a way to achieve energy security is that often it delivers the opposite result. U.S. military presence in energy domains feeds a perception that the United States is an imperialist power that intends to take over oil fields. This, in turn, invites antagonism, anti-Americanism and terrorism. U.S.

military presence in Saudi Arabia was a rallying cry for Islamic fundamentalists and a prime motivator of al-Qaeda's 9/11 attacks. Iraq provides an example of the limitation of military power in providing energy security. More than 150,000 U.S. troops were deployed for several years in the country that holds the second largest conventional crude reserve. Yet, during the U.S. occupation Iraq has exported less oil than it did prior to the first Gulf War. The U.S. presence has not enabled the country to fulfill its potential to emerge as a major oil producing country, and may have caused the exact opposite. Terrorists who believe the United States is out to rob the Muslims of their oil have identified the country's energy infrastructure as a prime target. Between 2003 and 2007 Iraq's pipeline system has been attacked more than 500 times.[12] This has hindered investment in Iraq's energy sector and scared away multinational oil companies, denying the global oil market millions of barrels per day that otherwise could have been available for export.

Diversification

Contrary to common belief, the United States is *not* heavily dependent on Middle East oil. As Figure 10.2 shows, about a third of total U.S. imports come from Canada, Mexico, and Venezuela, whereas the Middle East (primarily Saudi Arabia) accounts for a little more than 18 percent of total imports. U.S. relations with its neighbors are therefore critical to its future energy security. Of the three Western hemispheric neighbors, Canada, America's top trading partner overall and also its number one source of foreign oil, offers the most promise. U.S.-Canada relations are stable and the Canadian resource base holds great potential for America's future. Apart from large reserves of conventional oil and natural gas, Canada's oil sands in Alberta, 174 billion barrels in total, are second only to Saudi Arabia in terms of proven oil resources, albeit significantly more difficult and costly to extract. Output of marketable oil sands production increased to over 1 mbd in 2007. With anticipated growth, this level of production could reach 3 mbd by 2020 and possibly even 5 mbd by 2030. But due to Canada's growing demand and the rise of China, only a fraction of this oil will be directed to the U.S. market. The situation in Mexico is different. Though it is the fifth-largest producer of oil in the world, the country's production and proven reserves are in acute decline. Mexico produced an average of 3.74 mbd during 2006, a 1.2 percent decline from 2005 and a 2.5 percent decline from 2004. Its reserves/production ratio fell from 20 years in 2002 to 10 years in 2006.[13] Mexico's largest producing field, the Cantarell offshore field in the Gulf of Mexico, is facing a steep annual decline of roughly 14 percent from the current 2 mbd to anywhere between 1.5 mbd and 0.5 mbd.[14] Apart from natural geological depletion the Mexican oil sector suffers from excessive government control, insufficient investment, corruption and mismanagement. Be it due to geology or mismanagement Mexico's oil decline could cost the United States more than 1 mbd.

An even more complicated challenge for U.S. energy security is Venezuela. The United States and Venezuela are interdependent. Venezuela supplies about 11 per-

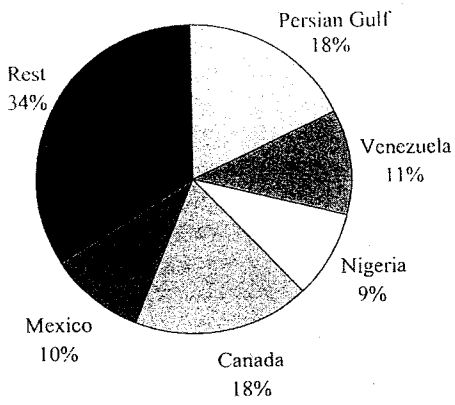

Figure 10.2 U.S. Oil Imports by Source, 2008
Source: **Energy Information Administration**

cent of U.S. oil imports and the United States purchases roughly 60 percent of Venezuela's oil output. Yet, relations between the two countries are acrimonious. In recent years, Venezuela's populist leader Hugo Chavez has tightened his grip over the country's state owned oil company, Petroleos de Venezuela (Pdvsa) and his heavy-handed policies have caused a rapid decline in Venezuela's production. His tense relations with the Bush administration brought him in September 2008 to expel the U.S. ambassador from Venezuela and recall his envoy to Washington. He also threatened more than once that "oil is a geopolitical weapon" and that he would not hesitate to use it should the bilateral relations continue to deteriorate. Chavez has also stated his intent to drive oil to $200 a barrel and to divert an increasing portion of Venezuela's oil exports from the United States to China.[15] In the near term, these threats are hollow, as the United States is the only country with significant infrastructure to refine Venezuela's specific type of crude, but as China and Venezuela develop such refining capacity more and more oil will be diverted into the Asian market at the expense of the U.S. market.

The decline of Western hemispheric producers will force the United States increasingly to turn to alternative suppliers. The National Energy Policy (NEP) report released by the White House in May 2001 (also known as the Cheney report) put strong emphasis on obtaining access to petroleum sources abroad by removing political, economic, legal, and logistical obstacles in Caspian and African nations "to provide a strong, transparent, and stable business climate for energy and related infrastructure projects."[16] At first glance, diversification of sources may seem to be a sound approach. But this solution is no more than a Band-Aid, and, in the long run, it could breed stronger reliance on the club of countries on which the United States would like to be less dependent. There are two downsides to this approach. First, oil is a globally traded, fungible, commodity, so stifling

U.S. purchases from the Persian Gulf and buying from other regions like Africa would just mean that somebody else would buy more from the Persian Gulf with no impact on price and availability. Second, reserves outside of the Middle East are being depleted almost twice as fast as those in the Middle East. The overall reserves-to-production ratio—an indicator of how long proven reserves would last at current production rates—in non-OPEC countries is about 15 years comparing to roughly 80 years in OPEC. With current growth in global demand, many of today's large non-Middle East producers such as Russia, Mexico, Norway and China are running a marathon at the pace of a sprint, and, if production continues at today's rate, many of today's largest producers will cease to be relevant players in the oil market in less than two decades. At that point, the Middle East will be the remaining major reservoir of abundant, cheap crude oil and the world's dependence on it will grow rather than diminish. This could allow Middle Eastern producers even more leeway than they have today to manipulate prices and increase their political leverage on U.S. foreign policy.

Second, deepening alliances with various African and Central Asian energy exporters may be beneficial to energy security, but by relying on additional nondemocratic countries the United States runs the risk of undermining its own foreign policy priorities such as human rights and democracy promotion. Supplying nondemocratic oil producers with advice and state-of-the-art weapons enables these regimes to stay in power and oppress their people. Such relations have proven in the past to be extremely problematic and in conflict with America's prime foreign policy goal of spreading freedom and democracy in countries where they are lacking. In the 1970s, energy security considerations dictated forgiving treatment of the Shah of Iran despite his corruption and abysmal human rights record. When the Shah fell, the Iranian people responded with an outpouring of anti-Americanism that reverberates to this date. America's support for the House of Saud and reluctance to criticize Saudi Arabia's dreadful human rights record openly, its mistreatment of women and its lack of religious freedom and contempt for Shiites, Sufis and other non-Wahhabi Muslims is already producing similar sentiment. Like the Middle East, both Central Asia and West Africa suffer from territorial disputes, authoritarian regimes, bad governance, corruption, ethnic and religious strife and terrible human rights records. Nigeria, expected to supply a quarter of U.S. oil imports by 2030, is one of the most corrupt countries in the world and despite its oil riches most of its people live on less than $2 a day. The situation in Angola and Equatorial Guinea is not much better. Central Asia's most important producers, Azerbaijan and Kazakhstan, both have human rights records that would normally deny them U.S. support. Yet, by becoming increasingly dependent on new energy producing regions the United States is forced to turn a blind eye to these social illnesses and in doing so it undermines the prospects for the kind of reforms that are the keystone of its own diplomatic efforts.[17] It is therefore not clear whether the rush to the new oil domains will improve America's energy security or replay in other arenas the problems the United States currently faces in the Middle East.

Schizophrenia Regarding China

As President John Kennedy once noted, in the Chinese language the word crisis is composed of two characters. One represents danger, and the other represents opportunity. In the same vein, the rise of China creates both dangers and opportunities for U.S. energy security. To date the United States is undecided as to whether China is a friend or foe in this respect. With 1.4 billion people and an economy growing at a phenomenal rate, China is today the world's second largest oil consumer and is becoming heavily dependent on imported oil. By 2030 China is expected to import as much oil as America does today. To fuel its growing economy China is following in America's footsteps, subjugating its foreign policy to its energy needs as Chinese oil companies buy stakes in foreign oil fields in Africa, Central Asia and the Western hemisphere. In a lecture at Beijing University in March 2004, China's deputy foreign minister, Wang Yi, admitted that Chinese foreign polices are "at the service of China's economic development."[18] China's pursuit of energy could present an opportunity to enhance cooperation, integration and interdependence with the United States. Its willingness to invest in high-risk energy-producing countries adds to the tight energy market product that otherwise would have been available. At the same time, there are ample signs that China's pursuit of energy runs counter to key strategic goals of the United States. China's attempts to gain a foothold in the Middle East and build up long-term strategic links with key energy producers is likely to challenge the Pax Americana that has prevailed in the Middle East since the end of the Cold War. In the past several years, U.S.-China competition has extended far beyond the Middle East, including Africa and the Western hemisphere, where half of U.S. petroleum imports come from. Unlike the United States, which bars companies from doing business with some unsavory regimes, China's state-owned companies turn a blind eye to the way petrodollars are used by countries like Burma, Sudan and Uzbekistan. In the global contest for oil the United States loses ground as a result of its pressure for government reform. Dictators who view democracy with suspicion much prefer to sign E&P deals with the Chinese, who pay top dollars and do not lecture them on democracy and human rights. Furthermore, if Chinese companies increase their ownership of energy assets in these countries, this may increase China's propensity to intervene in order to protect its investments. This will force the United States to invest increasing diplomatic and economic efforts to court energy-producing nations in an attempt to prevail in the global competition over access to energy. While U.S. official statements call for increased energy collaboration, the two countries are highly suspicious of each other's motives. The U.S. Congress has been exceedingly critical of China's activities and has worked to undermine Chinese acquisition of an American energy company. American technology firms are reluctant to share technology with the Chinese due to their abysmal property rights record. The Chinese, for their part, do not hide their concern about U.S. domination of the high seas and America's ability to block energy shipments to China should a crisis develop.

The Piggybank Dilemma

According to the U.S. Department of Interior there are 21 billion barrels of conventional crude oil and 187 trillion cubic feet of natural gas below federally controlled lands, mostly in the western part of the United States and in Alaska. (To put these figures in proportion U.S. annual oil consumption in 2007 stood at 7.5 billion barrels and its natural gas consumption stood at 23 trillion cubic feet.) An additional 85 billion barrels are believed to lie offshore, in the outer continental shelf. The United States also accounts for 60 percent of the world's endowment of oil shale. This alone constitutes a potential of 1.5–2.6 trillion barrels, primarily concentrated in the Green River formation in Colorado, Utah, and Wyoming, if technology is developed to extract it economically, a task made easier by high oil prices but uneconomic when prices are lower. A U.S. government-commissioned Task Force on Strategic Unconventional Fuels Resources concluded: "Depending on technology and economics, as much as 800 billion barrels of oil equivalent could be recoverable from oil shale resources yielding roughly 25 gallons per ton. Production of fuels from domestic oil shale, under various growth assumptions, could potentially exceed 2.5 mbd within 30 years."[19] A significant amount of shale gas, porous sedimentary rocks, and sandstone that stores natural gas, is located primarily in deposits in Texas, Oklahoma, Alabama, Colorado, and Arkansas. Despite America's wealth of energy resources and the plethora of political speeches calling for energy independence, over the years both Republican- and Democratic-controlled congresses have refused to increase access to oil and gas resources in federal lands, and 51 percent of America's oil and 27 percent of natural gas reserves are off limits.

The debate over the utilization of domestic reserves is complex. Environmental activists oppose drilling in Alaska on the grounds that it would hurt sensitive terrain and wildlife. Coastal states relying on tourism like Florida and California are worried about the risk of oil spills associated with offshore drilling. Despite the prominence of the debate it is not clear that increased use of domestic reserves would do much to bring down oil prices. A recent study by the Energy Information Administration estimated that under the best-case scenario opening up the Alaskan National Wildlife Reserve (ANWR) would reduce prices by $0.41-$1.44 per barrel by 2027.[20] Drilling off the continental United States would hardly affect prices until 2030. There is also a moral question: Alaskan and offshore oil are probably America's last remaining conventional reserves. Breaking this piggy bank to power SUVs would mean consigning future generations to reliance on foreign sources of oil for applications in which oil is likely to remain essential, like drugs, chemicals, paints and plastics. There is also another concern raised by the EIA: "Assuming that world oil markets continue to work as they do today, the OPEC could neutralize any potential price impact of ANWR oil production by reducing its oil exports by an equal amount."[21] Experience of the past three decades clearly shows that whenever non-OPEC producers increase their production, OPEC decreases supply accordingly, keeping the overall amount of oil in the market essentially the same.

A Blueprint for Energy Security

The popular debate on energy security in the United States leans toward the pursuit of energy independence, a concept that has been ridiculed by many policymakers. A 2007 report of the National Petroleum Council refers to energy independence as "unrealistic in the foreseeable future and incompatible with broader foreign policy objectives and treaty obligations. Policies espousing energy independence may create considerable uncertainty among international trading partners and hinder investment in international energy supply development."[22] A Council on Foreign Relations report went as far as accusing those working for such independence of "doing the nation a disservice."[23] Such voices interpret energy independence simplistically as autarky—that is, complete self-sufficiency, or not importing energy from any foreign source. But self-sufficiency is not what energy independence means. Energy independence means reduction of the role of oil in international politics by turning it from a strategic commodity to just another commodity. Independence would not necessarily lower the price of energy or reduce price volatility but it would break oil's monopoly over transportation fuels, a monopoly that gives intolerable power to a small group of oil producers. Independence could, over the long run, rid the United States of many of its foreign policy constraints.[24]

How can the United States achieve such a goal? Surely, much more can be done to squeeze more domestic oil and gas and increase the use of America's huge endowment of non-conventional petroleum sources. New technologies, such as deep water drilling and enhanced oil recovery, are reducing the environmental effects and the economic costs of accessing technically challenging oil and gas reserves. But tapping into conventional domestic reserves that, all included, amount to less than 3 percent of the world's reserves, will never be more than a stopgap solution. Increased production from nonconventional petroleum sources like tar sands and oil shale would certainly add product to the market but they are not likely to be competitive with OPEC's production costs. As long as the petroleum standard dominates the global transportation sector, the oil cartel will be in the driver's seat of the world economy. Long-term security and prosperity require the development of sufficient, affordable, reliable, and sustainable petroleum alternatives that can compete against oil-derived transportation fuels at the pump. Getting to a point where alternative fuels comprise a significant portion of America's energy supply will take many years, substantial investment and strong political will. The latter is particularly necessary in light of the political clout of some of the industry groups that prefer to defend the status quo. For nearly three decades the auto industry effectively blocked efforts to increase fuel efficiency standards. This opposition was broken with the signing of the Energy Independence and Security Act of 2007, which required automakers to boost fleet-wide gas mileage to 35 miles per gallon by 2020, and in May 2009 the Obama administration introduced an even more stringent requirement of 35.5 miles per gallon by 2016. The oil industry enjoys billions of dollars worth of tax credits and is collecting a

45 cents-per-gallon federal subsidy for each gallon of ethanol it mixes with gas but its control over the fuel distribution system allows it to block any significant market penetration of petroleum alternatives.[25] The corn ethanol lobby also supports policies that undermine energy security. In the United States corn-derived alcohol is blended with gasoline and is on track to supply about 10 percent of America's fuel supply. The United States has 100 ethanol refineries that, in 2008, produced roughly 7 billion gallons a year from corn. Additionally, there are 76 plants under construction.[26] Yet, corn is not the best crop for ethanol production. Sugarcane is a far better. It has higher energy content and it is cheaper to grow. But the ethanol industry, through its champions in Congress, restricts imported sugar ethanol from entering the U.S. market through a 54-cent per gallon tariff. No such tariff is imposed on imported oil. Such protectionism is inconsistent with the intention to reduce oil dependence as billions of gallons of ethanol are kept away from the U.S. market this way.

The first thing the United States must do to bring choice and competition to its petroleum-dominated transportation sector is to ensure that the cars rolling on to its roads are platforms on which fuels can compete. For a cost of roughly $100 extra as compared to a gasoline-only vehicle, automakers can make virtually any car a flex-fuel vehicle, capable of running on any combination of gasoline and a variety of alcohols such as ethanol and methanol, made from a variety of feedstocks, including agricultural material, waste, coal, natural gas, and even carbon dioxide. Flex-fuel vehicles let consumers and the market choose the winning fuels and feedstocks based on economics. In Brazil, where ethanol is widely used, the share of flex-fuel vehicles in new car sales rose from 4 percent to 80 percent in under five years. These cars entail no size, power, or safety compromise by consumers, and ironically, they are manufactured by the same automakers that sell to the U.S. market. The U.S. alternative fuels market is dominated today by corn ethanol. But potential cellulosic biomass resources, from wood waste, food crop waste and dedicated crops, are as large in the United States as coal, and both would be an effective way to ramp up alcohol production. The U.S. Departments of Agriculture and Energy estimate that the United States could generate sufficient biomass to produce up to 4 mbd of oil-equivalent liquids.[27]

Despite the environmental issues associated with coal, it has a major role in energy security. The United States is home to a quarter of the world's coal reserves, and 50 percent of its electricity supply is already coal-based. Today coal plays almost no role in the transportation sector and hence is not perceived as a substitute for oil. This could change if coal-to-liquid (CTL) technologies become more competitive, allowing the production of diesel, gasoline and jet fuel via Fischer-Tropsch processes. No less promising are the technologies to produce the alcohol fuel methanol from coal. Coal-to-methanol technology is mature and economic and most of the alcohol supplying the Chinese market is produced this way. Technologies to convert carbon dioxide to methanol are currently in the development stage and could become an elegant solution for greenhouse gas emissions.[28]

Despite the potential of alcohol fuels as replacement to gasoline, there are still significant challenges to the nationwide deployment of alcohol fuels, including the

need for rail, waterway, and pipeline transport capacity, the need for distribution systems—less than 1 percent of U.S. gas stations have the ability to sell alcohol—and balancing food uses and water requirements. Opening the U.S. transportation fuel market to competition would require imports from developing countries where such fuels can be made cheaply and in large scale. Sugar, from which ethanol can be cheaply and efficiently produced, is now grown in 100 countries, many of which are poor and on the receiving end of U.S. development aid. Encouraging these countries to increase their output and become fuel suppliers, opening the U.S. fuel market to them by removing the protectionist 54 cent a gallon ethanol tariff, could have far-reaching implications for their economic development. By creating economic interdependence with biomass-producing countries in Africa, Asia, and the Western hemisphere, the United States can strengthen its position in the developing world and provide significant help in reducing poverty.

Electricity is another game changer. Since so little of U.S. electricity is generated from oil, using electricity as a transportation fuel enables the full spectrum of electricity sources to compete with petroleum. Plug-in hybrid electric vehicles (PHEVs) can reach oil economy levels of 100–150 miles per gallon of gasoline without compromising the size, safety, or power of a vehicle. If a PHEV is also a flexible-fuel vehicle powered by 85 percent alcohol and 15 percent gasoline, oil economy could reach over *500 miles per gallon* of gasoline (each gallon of gasoline is stretched with alcohol and electricity.) In addition, the United States is the world's biggest potential market for pure electric cars that can be sold as second or third family car. 38 percent of America's households own two cars and an additional 20 percent own three or more vehicles. That makes over 64 million households in the U.S. that own more than one vehicle and that can potentially replace one or more gasoline-only cars with a car powered with made-in-America electricity.[29]

Grid Concerns

Ideally, electric cars and plug-in hybrids would be charged at night in home or apartment garages, when electric utilities have significant reserve capacity. The Department of Energy estimates that over 80 percent of the U.S. vehicle market could shift to plug-in hybrids without needing to install additional base load electricity-generating capacity, assuming off-peak charging.[30] But to electrify America's transportation system the electric grid will have to be greatly bolstered, creating sufficient redundancies and storage capacity. This is true even without electric transportation, as domestic electricity needs are growing. At the moment, the physical and human elements that make a strong grid—generation and transmission capacity, distribution lines or control equipment and service personnel—are being stretched to the limit. Perhaps the most troubling is the shrinkage of generating capacity reserve margins, found in virtually every section of the country. Strict environmental regulations and not-in-my-back-yard (NIMBY) considerations currently limit the growth of electricity infrastructure, making siting of new facilities such as nuclear power stations, coal-fired power plants, LNG terminals, and even windmills a regulatory nightmare. Environmental activists like former

Vice President Al Gore, who in September 2008 called for civil disobedience to stop coal plants, take pride in the fact that 59 coal-fired plants were cancelled in 2007 alone and that nearly 50 more in 29 states are being contested.[31] For a nation of plasma screens, iPhones and computers, such resistance to expand the power sector means that sooner or later millions will be left in the dark. Back in 1982 a book by the Rocky Mountain Institute, *Brittle Power: Energy Strategy for National Security*, warned of the weakness of the grid, describing it as a disaster waiting to happen. "The United States has for decades been undermining the foundations of its own strength," it said. "It has gradually built up an energy system prone to sudden massive failures with catastrophic consequences."[32] To strengthen energy security the United States would need to increase its power-generating capacity significantly, in addition to investing a great deal to ensure sufficient redundancies and overall reliability. Notwithstanding concerns about safety, security, radioactive waste, and weapons proliferation, there is also likely to be an increased role for nuclear power. It is estimated that up to 17 new nuclear plants may be online by 2020, predominantly in the Southeast.[33] Wind, solar and geothermal power will also have an increased role. In the first ten months of 2008, wind power experienced a 38 percent growth from the year before. Solar and geothermal are poised to greatly expand their market share in the near future.[34] However, coal-fired power plants are projected to continue to be the dominant source of electricity generation through 2030. Coal's share in total electric generation is projected to increase from 49 percent to 54 percent.[35]

Other Energy Security Mechanisms

In addition to reducing the importance of oil to the transportation sector, and improving the domestic electricity system, America's energy supply will depend on the security and reliability of a wide network of critical energy infrastructure. In the United States itself oil flows through roughly 200,000 miles of pipelines and 130 refineries. 18 million tank-truck journeys a year move gasoline from refineries to gas stations. In addition, there are 1,300 natural gas drilling rigs, 300,000 miles of natural gas pipelines, and 10,000 power plants, including 104 nuclear reactors.[36] This vast network is vulnerable to disruption by either man or nature. The 2003 Northeast blackout was a reminder that an attack on America's electricity grid could cripple the U.S. economy. It also demonstrated the main problem of America's grid: the interdependency of the system's components and the dependency of the entire system on the weakest link in the chain. One failed transformer on a hot summer day (or cold winter day for that matter) becomes the epicenter of a catastrophic failure and the entire system collapses like a house of cards. This means that if a terrorist attack disables one or more elements in the generation or transmission system the ripple effect is certain. Such an attack could take place either physically or virtually. As former CIA Director James Woolsey warned, terrorists are smart enough to identify weaknesses in every system, including our electricity grid, "where the equivalent of flimsy cockpit doors might be found."[37]

Even if U.S. energy infrastructure were perfectly secure the United States would not be immune to supply disruptions caused by terrorists abroad. Energy security therefore depends also on the ability to protect critical facilities abroad. The United States, as the largest participant in the global energy system, has a stake in strengthening global energy security. This requires the United States to create multilateral, regional, and bilateral security arrangements and to provide oil-producing nations with counter-terrorism training and technology so they can better protect petroleum supplies. To increase supply and encourage competitiveness and investment the United States should also promote more favorable conditions for global energy trade and investment through multilateral and international institutions—including the World Trade Organization, G-8, Asia-Pacific Economic Cooperation (APEC), IEA, and the Joint Oil Data Initiative (JODI). Finally, if all fails and supply disruptions do occur the United States will need to fall back on its Strategic Petroleum Reserve (SPR). The energy security program designed to safeguard the U.S. economy from supply disruptions began collecting oil in 1977 and has the capacity to hold approximately 700 million barrels. This oil stockpile enables the federal government to release oil to the local market in time of emergency. According to the DOE, oil could be drawn from the SPR at a rate of 4 mbd for the first three months, falling progressively after for the next seven months until reaching zero. Alternatively, it could be drawn down at a rate of 1 mbd for a year and a half. At its current capacity, the SPR barely suffices to tide the U.S. economy over in case of a severe disruption of oil supplies, which is why, in his 2007 State of the Union address, President Bush announced his intention to almost double the SPR from its current capacity, 700 million barrels, to 1.5 billion barrels. But when oil prices soared in summer 2008 Congress decided to stall the expansion program.

Conclusion

There is no silver bullet solution to America's energy security predicament. If there is any realistic way to strengthen America's energy security it is in devising an energy policy that has a healthy balance among a variety of policies and technologies. Unfortunately few nations have the discipline and common foresight to address a collective problem a moment before they must do so. As President Barack Obama said in his first address on the issue: "Year after year, decade after decade, we've chosen delay over decisive action. Rigid ideology has overruled sound science. Special interests have overshadowed common sense. Rhetoric has not led to the hard work needed to achieve results. Our leaders raise their voices each time there's a spike in gas prices, only to grow quiet when the price falls at the pump."[38] Paradoxically enough, energy security can only be achieved through a common sense of insecurity. Without constant reminders of the vulnerability of the American way of life to energy supply disruptions and the heavy price in blood and treasury Americans pay each day to fuel their economy it is unlikely that the country will master the necessary political will and the huge investment necessary to embark on a major energy reform. Therefore, the terrorists who blow up facilities

in the Persian Gulf and the hurricanes crashing against U.S. shores are likely to be the most important drivers of America's energy policy in the years to come.

Notes

1. Energy Information Administration, *Annual Energy Outlook 2007 with Projections to 2030*, http://tonto.eia.doe.gov/ftproot/forecasting/0383(2007).pdf.
2. Ibid.
3. Ibid.
4. "Energy is the Albatross of U.S. National Security, Lugar Says," Press Release, Senator Richard Lugar, March 13, 2006, http://www.brookings.edu/comm/events/20060313lugar.pdf.
5. Condoleezza Rice, Testimony before the Senate Foreign Relations Committee, April 5, 2006, quoted in Steven Mufson, "As China, U.S. Vie for More Oil, Diplomatic Friction May Follow," *Washington Post*, April 15, 2006, http://www.washingtonpost.com/wp-dyn/content/article/2006/04/14/AR2006041401682.html.
6. While the United States does not import oil from Iran it is affected geopolitically by Iran's strong standing in the global oil market. Oil is a fungible commodity so even if the United States imported all of its oil from friendly and stable sources it would still be beholden to the growing power of those who control the lion's share of the world's reserves.
7. Jimmy Carter, televised speech on July 15, 1979, http://www.pbs.org/wgbh/amex/carter/filmmore/ps_crisis.html.
8. Amory Lovins and Hunter Lovins, "Mobilizing Energy Solutions," *The American Prospect*, January 28, 2002.
9. George W. Bush, "State of the Union Address by the President," January 31, 2006, www.whitehouse.gov/stateoftheunion/2006; Remarks by President Obama on Jobs, Energy Independence, and Climate Change East Room of the White House, January 26, 2009, http://www.whitehouse.gov/blog_post/Fromperiltoprogress/.
10. Irwin M. Stelzer, "Can We do Without Saudi Oil?" *The Weekly Standard*, November 19, 2001.
11. Michael Klare, "The Futile Pursuit of 'Energy Security' by Military Force," *The Brown Journal of World Affairs* (Spring/Summer 2007).
12. Institute for the Analysis of Global Security, Iraq Pipeline Watch, http://www.iags.org/iraqpipelinewatch.htm.
13. Energy Information Administration, Mexico Country Brief, http://www.eia.doe.gov/cabs/Mexico/Background.html
14. "Mexico: Pemex Oil Field Declining," *New York Times*, February 8, 2007.
15. "Chavez starts OPEC Summit with 200-dollar Oil Warning," *AFP News Agency*, November 17, 2007.
16. *Report of the National Energy Policy Development Group*, The White House, http://www.whitehouse.gov/energy/2001/index.html.
17. Glenn Kessler, "Oil Wealth Colors the U.S. Push for Democracy," *Washington Post*, May 14, 2006.
18. Maurizio d'Orlando, "Need for Oil Draws China Close to Saudis and Iranians," *Asia News*, April 13, 2004, http://www.asianews.it/index.php?l=en&art=615.
19. *Development of America's Strategic Unconventional Fuels Resources*, Task Force on Strategic Unconventional Fuels, Report to Congress, September 2006, http://www.fossil.energy.gov/programs/reserves/npr/publications/sec369h_report_epact.pdf.

20. "Analysis of Crude Oil Production in the Arctic National Wildlife Refuge," EIA Report #: SR-OIAF/2008-03, May 2008, http://www.eia.doe.gov/oiaf/servicerpt/anwr/results.html.
21. Ibid.
22. National Petroleum Council (NPC), *Facing the Hard Truths About Energy*, (Washington. D.C.: NPC, July 18, 2007), http://www.npchardtruthsreport.org.
23. *National Security Consequences of U.S. Oil Dependency*, Council on Foreign Relations Task Force Report, 4, http://www.cfr.org/content/publications/attachments/EnergyTFR.pdf.
24. James Woolsey and Anne Korin, Turning Oil into Salt, *National Review*, September 25, 2007, http://article.nationalreview.com/?q=OTlmMjFjYWRjOWI3ZGI0MzUxZDJjYTBlMmUzOTc2Mzc=.
25. David Kiley, "Big Oil's Stall on Ethanol," *BusinessWeek*, October 1, 2007.
26. Renewable Fuel Association, Industry Statistics, http://www.ethanolrfa.org/industry/statistics/.
27. The "Billion Ton Study"—*Biomass as a Feedstock for a Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Annual Supply*, USDA and USDOE, April 2005, http://www.osti.gov/bridge.
28. George Olah, Alain Goeppert, and G.K. Surya Prakash, *Beyond Oil and Gas: The Methanol Economy* (Weinheim, Germany: Wiley, 2006); See also Robert Zubrin, *Energy Victory: Winning the War on Terror by Breaking Free of Oil* (Amherst, NY: Prometheus, 2007).
29. *Pocket Guide to Transportation 2008*, Bureau of Transportation Statistics, U.S. Department of Transportation, http://www.bts.gov/publications/pocket_guide_to_transportation/2008/.
30. According to the DOE's Pacific Northwest Lab report there is sufficient off-peak reserve capacity in the electricity grid to power up to 84 percent of today's vehicles before new power plants of any kind need to be built. See: Jennifer Kho and Brian Caulfield, "US Could Plug in Most Cars," *Red Hering*, December 10, 2006, http://www.redherring.com/Home/20179.
31. Mark Mills, "Brownout," *Forbes*, June 30, 2008, http://www.forbes.com/forbes/2008/0630/038.html.
32. Amory Lovins and Hunter Lovins, *Brittle Power: Energy Strategy for National Security* (Andover, MA: Brick House: 1982).
33. Goldman Sachs Power Survey: Outlook for Nuclear Development, August 2007.
34. Energy Information Administration, Renewable Energy Production and Consumption by Source, http://www.eia.doe.gov/emeu/mer/pdf/pages/sec10_3.pdf.
35. *Annual Energy Outlook 2008 with Projections to 2030*, Energy Information Administration, http://www.eia.doe.gov/oiaf/aeo/pdf/0383(2008).pdf.
36. *Siting Critical Energy Infrastructure: An Overview of Needs and Challenges*, National Commission on Energy Policy, June 2006, http://energycommission.org/files/contentFiles/Siting%20Critical%20Energy%20Infrastructure_448851db5fa7d.pdf.
37. R. James Woolsey, "The War on Terrorism," The Pitcairn Trust Lecture on World Affairs, Foreign Policy Research Institute, http://www.fpri.org/enotes/20021010.woolsey.waronterrorism.html.
38. Remarks by President Barack Obama on Jobs, Energy Independence, and Climate Change East Room of the White House January 26, 2009, http://www.whitehouse.gov/blog_post/Fromperiltoprogress/.