Chapter Eleven

Energy: The Engine of Globalization

Low cost energy has made the rise of globalization possible. As people around the world buy gasoline or examine their electrical bills, and as factory and business owners study soaring energy-related costs, they might consider the pattern of conflicts presently driving up the price of energy, and inflating the prices of everything cheap energy has made possible. The causes for higher energy costs extend well beyond the basic issue of *peak oil.* Energy observers use *peak oil* to describe for us the arrival of long term global oil scarcity, that is, when oil discoveries no longer match the amounts of oil presently being consumed, we have started drawing down on the remaining world reserves of oil. The specter of a world with scarce oil sent fuel prices soaring as high as $147 a barrel around the world in summer 2008, and with it the prices of coal, natural gas, and other fuels. Oil at far higher prices has numerous consequences—a global wave of inflation in food and other prices, more innovation and investment in alternative forms of energy, and a worldwide scramble to see who will control the remaining oil presently seen as recoverable.

Threats to Oil Sources

Threats to oil sources take multiple forms. Back in late February of 2006 Al Qaeda militants attacked the massive Saudi Arabian oil processing plant at Abqaiq, where 7 million barrels a day of Saudi oil is processed for export to the world. Three separate fences encircle the depot, and motion sensors and over a thousand troops, with F-15 fighter planes and helicopters that circle the perimeter 24 hours a day. Despite these protections, Al Qaeda attacked this critically important oil source with two car bombs, both of which were exploded without doing any significant damage to oil facilities. Al Qaeda promised to continue to attack oil resources in the Middle East (Associated Press, 2006). Losing 7 mbd of Saudi oil would likely send a panic through global energy markets, and perhaps threaten the entire global economy (Tertzakian, 2006). The attack sent a shiver through oil prices in 2006 world markets, but nothing compared to the sharp rise in oil prices in 2008.

Meanwhile, on the same day in 2006, thousands of miles away in Nigeria, lightly armed revolutionaries from an army describing themselves as the Movement for the Emancipation of the Niger Delta (MEND) assaulted, took over, and threatened to destroy the production and distribution of the one million gallons a day of oil issuing from a facility run by Royal Dutch Shell. The self-described army of the poor kidnapped oil company employees, killed a dozen Nigerian troops, and demanded that oil profits from petroleum rich Nigeria be shared more with the poor (New York Times 2006). Troubles from mid-summer of 2006 continued in mid-summer 2008, with the Nigerian military still unable to secure Niger Delta oil against these attackers. The loss of Nigerian production contributed to higher global oil prices.

The *New York Times* adds that, "Indonesia, with extensive oil fields that made it a top target for Japanese conquest during World War II, became a net oil importer in 2004. Output from its aging fields has fallen almost 40 percent since 1995, and the country plans to withdraw from OPEC at the end of this year" (Bradsher, 2008).

In the multi-part puzzle of world energy, civil wars, government corruption, ancient ethnic and religious hatreds, limited refining capacity, and developing country debt all have caused interruptions in supply, raising the global price of oil. In poverty-stricken Chad, the World Bank stopped payments on loans funding the $4 billion pipeline that carries Chad's 240,000 daily barrels of oil to the Atlantic. The government of Chad reneged on a deal to share the oil wealth with its poor, putting its oil supplies in doubt. A five-year long civil war in Darfur in nearby Sudan threatened Sudanese oil supplies to China. This pattern of national and local troubles dramatically raising the cost of oil now has serious consequences for globalization. Manufacturers recognize that the new cost of shipping of parts to distant factories, and goods to distant markets may already be too expensive to continue. The price of shipping a 40-foot container from China to the U.S. had risen from $3,000 in 2,000 to $8,000 in 2008 (Rohter, 2008).

A Shift in Oil Wealth

National governments now control 82 percent of global oil, triggering a massive shift of wealth toward national oil sellers. In Venezuela the oil minister announced in 2006 that Venezuela would expropriate privately held oil production facilities and reserves. The Venezuelan government, led by its president, Hugo Chavez, would now require energy transnational corporations (TNC's) to sign partnership agreements sharing profits on a much larger scale with the Venezuelan government. Moreover, Venezuela's Chavez regime for the last two years has indicated intermittently that it might stop exporting oil to the United States altogether. The cause: Venezuela's claim that the U.S. had planned military action against the government of Venezuela. Given the history of U.S. involvement in covert actions against Central American and Latin American governments, Chavez may have had reason to bring public pressure to bear on the U.S. Venezuela is the source of 16 percent of the oil that the U.S. imports, and China has recently bid for Venezuela to sell this oil to Asian countries.

In the global picture the Middle East, Africa, and the Soviet Union account for 65 percent of global oil exports, while the U.S., the EU, and Japan buy 60 percent of oil exports (MBendi, 2008). Across Latin America more state control of energy is emerging, with Bolivia the most recent country to nationalize its energy industry via partnerships required of private energy companies. Ecuador is also increasing the state's share of energy profits. Amid windfall profits driven by the uncertainties of the global supply of oil and gas, nations are deciding to take a much greater share of profits otherwise headed for the coffers of transnational energy corporations. With major new finds of oil/gas dwindling, transnational energy corporations have little choice but to comply. These oil-producing nations follow the lead of Mexico, Iran, Russia, and Saudi Arabia, which long ago nationalized control of their energy resources (Mouawad, 2006a).

With the entire global energy picture shifting significantly, several new patterns appear underway:

1. As oil guru Daniel Yergin puts it, “We’ve seen a return to a 1970’s style of resource nationalism riding along the crest of high prices…[Deane: your choice of course, but APA puts spaces between the periods] During times of low prices, governments are keen to open up [to outside firms exploring and drilling]. But when prices are high, they have the high cards.” Substantial new evidence supports his observation that reserves are now more important than investment capital for new energy sources. Venezuela has increased oil taxes on foreign energy companies from 56.6 percent to 83 percent. Bolivia, Britain, Kazakhstan, and Nigeria have all raised their taxes on oil produced by private oil corporations. Such government control drives away private investment, yields less in profits, and leads to fewer new discoveries and less production, which in turn drives prices higher (Mouawad, 2006). Oil prices doubling in the last year bear out this analysis.

   Developing country governments also use fuel subsidies to keep prices low for domestic consumers and businesses, keeping domestic goods prices lower, and giving businesses a price advantage in their sales into the world market. China, for example, has recently raised its gasoline prices 17 percent , but still spends an estimated $40 billlion annually to keep gasoline and diesel prices below cost for cars and trucks. These subsidies have consequences for global oil prices. According to the *New York Times*, “The oil company BP, known for thorough statistical analysis of energy markets, estimates that countries with subsidies accounted for 96 percent of the world’s increase in oil use last year — growth that has helped drive prices to record levels” (Brasher, 2008).

2. The seven largest energy TNC’s (historically called the Seven Sisters) now control less than 5 percent of global energy reserves, and can invest freely in countries holding only 11 percent of reserves. With their profits at record highs, the major petroleum TNC’s can no longer rely on ready access to the reserves that keep their stock values high (Mouawad, 2006).

3. Iran, which exports 5 percent of the world’s oil, continues to issue threats that it might cut off oil exports unless the International Atomic Energy Agency (IAEA) stopped investigating its work on enriching uranium, a fuel that could be used both to produce nuclear energy and to develop nuclear weapons. While EU nations have attempted to broker a compromise, and the U.S. has threatened possible military intervention, oil-rich Iran is also negotiating to build a pipeline to provide natural gas to India. The United States opposes the pipeline in order to bring pressure on Iran to stop its enriched uranium processing. Sudden shifts to achieve energy security now mix with threats to use energy as a weapon or as a major bargaining tool in global geopolitics. For example, Russia has threatened to limit supplies of natural gas to former Soviet states interested in joining NATO. In negotiations over a cease-fire in George in August 2008 Russia also hinted

broadly that it was not above restricting its supplies of oil and natural gas to European nations as well.

4. As Hurricane Katrina demonstrated along the U.S. Gulf coast, damage to undersea infrastructure in Gulf of Mexico offshore oil sources left part of U.S. oil production unable to operate. Refineries also suffered damage, illustrating the potential for interruptions in oil supplies from storms perhaps linked to global climate change.

5. Add to the picture this dramatic information—according to over 2000 scientists in the United Nations Intergovernmental Panel on Climate Change (IPCC), rising global uses of fossil fuels are throwing the earth's natural systems seriously out of balance. Burning coal, oil, and gas in greater quantities to support global economic growth has triggered the beginnings of serious global warming—increasing desertification, depleting glaciers as fresh water sources, melting polar sea ice, altering ocean currents, and destroying crops and natural resources, all patterns which suggest that global warming may cause the global economy to falter or collapse. We are reaching uncharted territory in environmental damage, where assumptions about ever greater uses of fossil fuel energy must reverse quickly if we hope to preserve world economic order.

The Global Picture of Energy

The world used an average of 85.7 million barrels of oil per day in 2007, with oil costs averaging $70/bbl but rising to $117/bbl in 2008 (MBendi, 2008). Rising global demand for oil, and existing wells arriving at peak production together signal that demand threatens to move beyond supply, as huge price rises for petroleum products have recently demonstrated. Consequently, global economies have begun a worldwide competition to secure all forms of energy supplies—oil, natural gas, coal, biofuels, nuclear, and alternative renewable energy sources such as wind, solar, and waves.

To meet world needs, energy production and distribution traditionally have required capital, labor, technological breakthroughs, effective public policy, free trade agreements, low cost oil to ship petroleum and coal, and peace to keep supplies flowing. Energy analysts in the 21st century now seek answers to additional questions: Who controls cheap energy? Who has it available? Secure energy, and energy at lower prices are rapidly becoming much more important in influencing what goods will be produced, and in altering decisions about whether production must be moved closer to where sales occur. How transnational businesses answer this latter question will shape future trade from Asia to the EU and the U.S.

As they focus on domestic energy security and how it links to domestic employment and tax revenues, national governments are now refusing to permit the takeover attempts of their own country's energy companies by those from another nation. This is a reversal of globalization takeovers that is occurring in other industries. For example, British officials expressed opposition to the Russian government-controlled Gazprom trying to take over British gas concern Centrica. Also, the Spanish government blocked an attempted German purchase of a major electrical utility, and France declined to let the Italian energy business Enel acquire the French utility Suez Gaz du France (Timmons, 2006). In the western hemisphere the U.S. government signaled an unwillingness to allow China to acquire the American based oil/gas giant Unocal, a sale that eventually was permitted to Sinclair, an old American oil firm. This case offers an example of a country like China growing rich in foreign trade, creating its own sovereign wealth fund, and then trying to invest its foreign trade gains into the control of energy to assure its further growth.

Soaring oil prices have driven up prices of other energy fuels as well, with coal, natural gas, and palm oil, all suffering serious inflation. The energy price inflation has led nations such as China toward more experiments with clean, renewable energy such as hydroelectric, solar, and wind.

The Place of Energy in Global Wealth

While some 1.7 billion people around the world still live without electricity, cheap available energy makes wealth possible in industrial economies worldwide. On a global scale, factories, retail businesses, the service economy, all forms of shipping and transportation, electrical production, home and business heating and cooling, mining, fishing, farming and food production, health care, government operations, military forces, computers and the Internet, all depend heavily on secure supplies of energy. Economies with severe energy shortages face dire poverty and social chaos. Nigeria,

Crude Oil Prices Per Barrel 1949-Present

Note in the following table how long oil remained roughly static in price until OPEC formed in the mid 1970s. Global oil sales and reserves are denominated in dollars, leaving oil as a global meta-currency itself, establishing the value for the dollar via the global trade in oil, which produces some 1.5 million bbl/day of oil, has as high as 500,000 bbl/day of it stolen—a gargantuan criminal undertaking that marks Nigeria as a failed state. In the absence of the energy for fertilizer, farm equipment, food transport and distribution, and refrigeration, the world would not be able to feed 6.7 billion people, much less the 76 million new humans added to the global population each year. The global trade in food would shift significantly toward local and national markets, as recent limits on food exports have shown in the 2008 global food crisis. With only two significant interruptions in global oil availability in the past fifty years, and despite elaborate global energy supply systems, the entire global status of all energy faces a series of major changes, and with these changes the uncertainties that come with uncharted territory.

U.S. Average (in $/bbl.)

Table 11-1

Year	**Nominal**	**Inflation Adjusted 2007**
1946	$1.63	$17.66
1947	$2.16	$20.75
1948	$2.77	$24.76
1949	$2.71	$24.99
1950	$2.77	$24.74
1951	$2.77	$22.93
1952	$2.77	$22.41
1953	$2.92	$23.40
1954	$2.99	$23.92
1955	$2.93	$23.47
1956	$2.94	$23.25
1957	$3.14	$24.00
1958	$3.00	$22.33
1959	$3.00	$22.11
1960	$2.91	$21.16
1961	$2.85	$20.48
1962	$2.85	$20.24
1963	$2.91	$20.43
1964	$3.00	$20.78
1965	$3.01	$20.51
1966	$3.10	$20.52
1967	$3.12	$20.10
1968	$3.18	$19.61
1969	$3.32	$19.45
1970	$3.39	$18.77
1971	$3.60	$19.10
1971	$3.60	$19.10
1973	$4.75	$22.80
1974	$9.35	$40.67
1975	$12.21	$48.71
1976	$13.10	$49.46
1977	$14.40	$51.02
1978	$14.95	$49.27
1979	$25.10	$73.60
1980	$37.42	$97.68
1981	$35.75	$84.58
1982	$31.83	$70.91
1983	$29.08	$62.74

	Nom.	**Infl.Adj**
1984	$28.75	$59.47
1985	$26.92	$53.76
1986	$14.44]	$28.29
1987	$17.75	$33.56
1988	$14.87	$27.05
1989	$18.33	$31.75
1990	$23.19	$38.02
1991	$20.20	$31.86
1992	$19.25	$29.47
1993	$16.75	$24.92
1994	$15.66	$22.69
1995	$16.75	$23.62
1996	$20.46	$28.01
2000	$27.39	$34.16
2001	$23.00	$27.92
2002	$22.81	$27.22
2003	$27.69	$32.34
2004	$37.66	$42.80
2005	$50.04	$54.99
2006	$58.30	$62.11
2007	$64.20	$66.40
2008 Partial		
May-08	$117.40	$117.40
June -08	$133.38	$133.38

Source: Financial Trend Forecaster:
InformationData.com

For further research on oil and inflation in the U.S., we recommend that you visit:
http://mail.google.com/mail/?ui=2&ik=9671f1941d&view=lg&msg=11bafa830ea87d2e

As sources of energy grow scarce, once dominant global economies acknowledge new vulnerabilities. The world presently consumes over 31 billion barrels of oil per year. Trillions of dollars flow annually to oil selling nations from the U.S. the EU, China, Japan, and India. The U.S. imports $400 billion worth of oil annually, up 300 percent since 2002 (BNET, 2008). Moreover, around the world serious political and human rights controversies are multiplying in direct proportion to the inability of oil production to meet demand. For example, to assure some of its overseas oil supply, China has vetoed a U.N. resolution to intervene in the genocide in Darfur region of the Sudan, a strife-riven, oil rich area. In the larger global picture, the energy demands of economic growth carry consequences that threaten present forms of globalization.

1) Growing energy consumption is leading to the uses of energy as a diplomatic weapon, and to military attempts to secure distant energy supplies. Venezuela and Iran have recently threatened to cut oil exports. Moreover, the U.S. has established a military presence in Iraq and in 12 other energy-rich Middle Eastern countries, illustrating its reach for energy security.

2) Rising fossil fuel emissions threaten with global warming, climate change, sea level rise, ocean waters turning acidic, and rising damage to human health and life. These threats make it imperative that all economies move to greater energy efficiency, cuts in energy demands, and rapid development of clean forms of alternative renewable energy.

In what follows, please recognize that familiarity with the many numbers used to describe energy demand, reserves, supply, and other facets of the global energy picture is essential in understanding the increasingly problematic global energy outlook.

Global Energy Demand

Focusing on the demand side of the energy equation makes it a bit easier to understand the shifts in energy supplying the world economy. In 2003 a gross world product of some $56 trillion in goods and services consumed a total 28 billion barrels of oil a year (bbrl/yr). Demand in 2008 had risen to 31.4 bbrl/yr. As the human population of nearly 6.7 billion adds some 76 million more people annually, and as national economies grow, this demand for energy also grows by anywhere from 1 percent to 2.4 percent annually (Population Reference Bureau, 2006). The world's primary energy needs . . . are projected to grow by 55 percent between 2005, and 2030, at an average annual rate of 1.8 percent (World Energy Outlook 2007).

According to the *Wall Street Journal*, "The typical American consumes about eight metric tons of oil a year, or its equivalent in coal and other fuels. Japanese consume about half that sum. In China, per capita energy consumption now stands at just 1.2 metric tons" (Oster, 2006). Much of the new demand, then, comes from India and China, with significant growth in their rising middle class. With only 2.3 percent of global oil reserves, China has 20 percent of the world's population with GDP growing annually at over 9 percent. It now faces both energy shortages and extremely serious environmental damage from fossil fuel emissions. If China's rising demand for oil continues apace, China will more than double its present oil demand of 8 million barrels a day (mbd) to 16 mbd in roughly twelve years. Increased demand from other sources aside, this rising Chinese demand is putting pressure on oil producers, on other global oil consumers, and on prices. India adds significantly to new demand as well (World Energy Outlook 2007).

The situation might be even worse. For example, China's growth, running between 7 and 10.7 (or more) percent per year, means it is more than doubling in twelve years. *Time Magazine* indicated that China's demand for imported oil increased by a whooping 40 percent just in the first half of 2004. (See for further detail: http://www.time.com/time/magazine/article/0,9171,501041025-725174,00.html , and http://www.theoildrum.com/story/2006/12/7/1353/33507) "China's imports of diesel in the first quarter [2008] surged over 600 percent" (http://news.xinhuanet.com/english/2008-04/29/content_8075648.htm). And: China currently consumes only about 25 percent of the oil that the U.S. consumes, but "China will surpass the US as the world's largest energy consumer by 2023" (see: http://www.econbrowser.com/archives/2005/06/can_anything_sl.html). That means that China's energy consumption could increase by 400 percent, (not the 100 or 125 percent previously indicated) in 15 years, which is only three more years than the time-frame cited above. This scenario does not even consider the fact that in all probability, U.S. energy consumption will continue to grow.

World Oil Production

In the array of all global energy sources, 37 percent of the energy presently consumed comes from oil—presently some 86 million barrels a day (mbd) (MBendi, 2008). While new oil fields are coming into production, they do not appear capable of meeting the growing demand expected for oil over the next ten to twenty years, much less of supporting larger economies through 2050. Discoveries of new oil sources do not fulfill what oil producers call the replacement ratio—adding as many new barrels to oil reserves as were consumed from reserves in a given year. Meanwhile, although present production capacity remains a subject of controversy, a consensus of oil observers indicates that it is nearing or has already reached its limits, that is, oil producers have little elasticity of supply to meet increasing world demands for oil. The world's 14 largest oil fields produce 20 percent of what is presently consumed, but these fields average 54 years in age, a stage at which most fields are expected to diminish production (Sykes, 2005).

Aside from the urgent limits on fossil fuel uses that global warming now requires, world oil production depends on a number of variables. The easy oil has already been found. New oil in uncertain measure—as much as 4 mbd—is expected to come from the Caspian Sea region by 2010 if Islamic jihadis do not sabotage its production and transport. Russian oil sources recently reported that they may have three times their proven reserves of 60 billion barrels (MosNews, 2004). Algeria, Kuwait, Libya, and the United Arab Emirates (UAE) combined are expected to add 2 mbd, and West Africa's

Nigerian delta region is also expected to add 2 mbd in this time frame as well, but so far has not (*The Economist* , 2006). Canada's oil tar sands reserves rank second only to Saudi sources, some 300 billion barrels, but with significantly improved extraction techniques, hold perhaps as much as a trillion bbl (Kerner, 2004). Because extracting tar sand oil is far more expensive and resource intensive, these fields are projected to yield as much as 3 mbd in ten years (CNN, 3/19/06).

U.S. production is expected to decrease from 9.5 mbd to 8.5 mbd, and then begin to drop off steeply in the years after 2010. With a few notable exceptions, other world sources such as wells in Mexico are largely seen as unable to sustain present production rates. As a measure of how rapidly oil is acquired as it comes to market, the world's market inventory at any given time may stand at as little as four days worth of global oil demand, a figure of 328.3 million barrels (Mouawad, 2006).

Despite varying claims about *proven* versus *unproven* reserves, global petroleum analysts generally agree that the peak of global oil production (the amount that can be pumped at sustained rates) either is now arriving or will arrive within the next decade. While geologists disagree on the possibilities for discovering major new sources, early in the 21st century authoritative estimates indicate that the world has roughly 1250 to 1950 billion barrels of oil, that is, an average of 1600 billion barrels of combined proven and unproven oil reserves as yet untapped (Klare, 2001).

Meeting Oil Demand

On a demand scale, the United States, the world's largest oil consumer, presently consumes 21 million out of the 86 million barrels per day now produced, that is, 5 percent of the world's people use roughly 25 percent of the global oil supply. The U.S. harbors some 2.9 percent of global oil reserves, but is depleting its known stores so rapidly that it faces ever greater need for oil imports (Klare, 2001, pp. 54-5 and 85). For example, if the U.S. were to rely solely on pumping U.S. oil, at present rates of consumption the US would exhaust all of its oil in a stunningly short period of time—*about 4 years* (Kunstler, 2005). In contrast, the heavy concentration of oil reserves in the Middle Eastern countries with 673 billion barrels or 65 percent of proven global reserves in just nine countries, means that that region is presently producing approximately 31 percent of all of the world's oil.

Add another variable to the picture. The ability of a production system to operate reliably and efficiently at peak capacity over a long term is highly unlikely, as recently demonstrated by the significant losses from Hurricane Katrina to U.S. Gulf oil and gas production and the British Petroleum (BP) pipeline rupture in Alaska. The global oil supply system, from well to gas tank, operates presently at 97.5 percent of capacity, which means it is stretched to the limit and has no margin of error, a situation that imperils the entire oil-reliant world economy (Tertzakian, 2006). Against the multiple hazards of interruptions in supply—say another hurricane interrupting offshore oil production or a fire at a major refinery—the U.S. maintains a Strategic Petroleum Reserve of 700 mb, effectively 43 days worth of imported oil at present consumption rates.

Table 11-2 Major Oil Producing Countries By Percentage of Known Reserves.

Country	Percentage of Known Reserves
Saudi Arabia	25.0
Iraq	10.5
United Arab Emirates	9.3
Iran	8.5
Venezuela	6.9
Russia	4.6
Mexico	4.5
US	2.9
Libya	2.8
China	2.3
Nigeria	2.1
North Sea	1.5

Table 11-2 indicates the world's major known oil reserves. This total represents 90.1 percent of global oil reserves presently in production. Again, recent discoveries in the Caspian Sea area of Asia and in the coastal areas of West Africa (Chad, Nigeria) are supplying new reserves (International Energy Outlook, 2005).

Reserves aside, the actual production of oil reveals non-OPEC countries presently produce 48 million barrels a day, and OPEC produces about 38 mbd for a total of some 86 mbd. Projections based on demand indicate oil use rising by another 30 mbd by 2030 unless nations move quickly to alternative energy sources (World Energy Outlook 2007).

Just how this significant addition to production will occur remains a mystery. In calculating reserves, it warrants mention that oil wells in fact only deliver from 15 percent to 50 percent of the oil they harbor, and that as wells age, they also are subject to an annual drop of 5 percent or more in production. Reviewing existing wells, this drop multiplies exponentially to a loss of 148 mbd by 2020, 176 percent of present consumption—oil that either must be recovered from existing wells with new technologies, discovered and brought to market, or replaced by new non-fossil fuel technologies and fuels (Tertzakian, p.128).

With the exceptions of the Caspian Sea, offshore Brazil, West African fields, and the Canadian tar sands waiting on extraction discoveries, significant new discoveries of oil elsewhere have fallen, and many major oil producers such as those in the North Sea see their maturing wells as reaching or now extending beyond peak production capacity. Where much of the additional oil segment of this energy must come from is obvious, as aside from the discovery of some so-called “elephant” fields of 1 billion barrels or more off Brazil, Algeria, and Chad, the Middle Eastern countries hold two-thirds of the world’s known reserves. Nonetheless, as indicated above, Saudi Arabia, the largest of these sources, currently shows little interest in expanding rapidly to meet a greater share of rising demand by adding capacity or increasing its supply from existing wells and infrastructure. This tactic in part accounts for the rise of oil prices in mid-2008 to $147 a barrel.

Whatever the military investments and diplomatic hopes of the U.S. for regional Middle East energy hegemony, reliance on one region in turmoil to deliver more oil concentrates energy risks for the entire globe. Writer Michael Klare sums up the declining situation succinctly: ”we appear to be entering a permanent energy crisis” (Klare, 2001).

Natural Gas

Natural gas supplies roughly 23 percent of all global energy, with its use projected to grow by 2.3 percent annually, meaning the world will need 70 percent more natural gas by the year 2025 (International Energy Outlook 2005). Just where this much natural gas will come from poses an alarming mystery at this point. Natural gas uses produce significantly lower carbon dioxide emissions, and the gas is easily transported by pipeline. For example, the European Union (EU) and much of Eastern Europe imports major quantities of gas by pipeline from Russia. Problems arise where gas cannot be transferred by pipeline. It must be refrigerated to extremely low temperatures to liquefy it, shipped in double-hulled transport ships, then unloaded with extreme care because escaping super-cooled gas is known to hug the ground as it gasifies, then finds a spark and causes major explosions. Many ports refuse to accept ships carrying liquefied natural gas (LNG).

World Natural Gas Reserves

Proving subterranean reserves of natural gas remains a difficult business involving geology, politics, marketplace forces, and changing technologies. According to the U.S. Energy Information Administration, which draws on industry sources, global estimates of proven natural gas reserves are estimated at 5,210.8 Trillion Cubic Feet (Tcf). The Middle East holds 1,836.2 Tcf, or 34 percent of the world total, with Europe and the former U.S.S.R. with 2158.7, or 42 percent of reserves. The United States, with 3 percent of the world total natural gas reserves, ranks sixth among nations, with Nigeria, Algeria, and Venezuela following closely behind.

Table 11 - 3 Largest Natural Gas Reserves by Country

World’s Largest Natural Gas Reserves by Country 2005	
Country Rank	Proved Reserves (trillion cu ft)

1. Russia	1680.0
2. Iran	940.0
3. Qatar	910.0
4. Saudi Arabia	235.0
5. United Arab Emirates	211.1
6. United States	189.0
7. Nigeria	176.0
8. Algeria	160.5
9. Venezuela	151.0
10. Iraq	110.0

Source: Oil & Gas Journal, Vol. 102, No. 47 (Dec. 10, 2004). From: U.S. Energy Information Administration. http://www.eia.doe.gov/emeu/international/petroleu.htm

Coal

Of the remaining hydrocarbon energy sources, coal supplies 24 percent of global energy. At present demand rates coal reserves are abundant enough to last through the 21st century. According to the U.S. Energy Information Administration, coal demand will nearly double from 2003 to 2030, with non-OECD countries accounting for 81 percent of this increase. Coal prices doubled to as high as $120 a ton in 2008 before the global recession began to bring all commodity prices down. In the absence of urgent measures to move to clean renewable energy, coal's share of total world energy consumption is projected to increase from 24 percent to 27 percent in 2030. Over 80 percent of increased use is projected to come from China and India, which have abundant supplies (International Energy Outlook, 2006).

Coal causes major environmental damage during production, transport, and use, destroying landscapes, polluting waterways, and filling skies with toxic emissions ranging from lead to mercury to particulate matter that causes everything from heart disease to cancer. A 2007 World Bank Study in China indicated that air pollution was killing 750,000 Chinese people a year, a horrendous human loss. It was also costing /China 3.8 percent less in gross domestic product (World Bank, 2008). New technologies for cleaner burning of coal and the gasification of coal hold uncertain promise in limiting the significant emissions of sulphur, mercury, and other toxic substances. Unproven experiments are underway to store underground the CO2 from coal burning. To date, however, a study by MIT scientists indicates that present experiments have yet to prove measurable, reliable results for Carbon Capture and Sequestration (CCS). The report says that, "The volume of compressed carbon dioxide that will need to be captured and transported is similar in scale to the amount of oil consumed in the United States" (Bulls, 2007).

With cap and trade CO2 emissions requirements plus carbon taxes for fossil fuel use on the near horizon, investors now refuse to back further coal-burning plants in the U.S. In China the national government also wants coal-burning plant construction stopped, but the Province of Inner Mongolia was recently revealed to have built ten coal-burning electrical plants producing 8.4 gigawatts of electricity. The illegal plants in turn have increased China's demand for coal and "spawned thousands of illegal coal mines that have contributed to more than 4,000 coal-mining deaths in China this year"(Oster, 2006). According to government estimates, 20 percent of all power plants in China are illegal, demonstrating the struggle of China's central government to manage the energy demands of its rapid growth. Many of the thousands private coal mines serving these plants are also illegal, leaving China facing increasing damage to its environment and human health from coal-burning emissions (Oster, 2006).

Nuclear Power

Proposals for electrical power supplied by nuclear sources require close scrutiny. While France gets 80 percent of its electricity from nuclear sources (Mardell, 2008), investors in the U.S. have avoided supporting any new nuclear plants for four decades. Seven percent of global energy is supplied by nuclear reactors. Aside from their military and research uses, nuclear sources presently supply 16 percent of global electricity. Many nuclear reactors have now aged to the point where they face shut downs and costly decommissioning; seven new plants are being built and ten more are presently planned. Nuclear engineers claim that new designs for smaller reactors will make nuclear energy much safer. Disposal of nuclear wastes, however, remains a seriously troubled question, as the U.S. the Nuclear Regulatory Commission has failed to secure enough acceptable national sites for spent fuel storage. The U.S. has only two such sites available, and their capacities are nearly filled. Consequently, spent fuel remains stored in covered pools near reactors, vulnerable to disaster if pool cooling mechanisms fail, or if terrorists use explosives to release radiation (Clean Energy, 2008).

Nuclear energy requires government subsidies and strong, reliable regulatory oversight to control toxic radioactive byproducts. Because the wastes are deadly and last tens of thousands of years, these materials pose extreme hazards, including possible uses in atomic weapons by terrorists. Traces of wastes in environments near nuclear plants in the U.S. states of Washington and Colorado have led to legal suits based on claims that the wastes cause cancers. Also, Chernobyl remains as mute testimony to the risks of a nuclear meltdown at an electrical plant. Estimates project nuclear sources to produce 17 percent more electricity by 2025, the preponderance of it from new plants in China, India, and Korea, but given increases in energy demand, this amount of growth may then leave nuclear with a smaller percentage of the total energy picture. Developing enough safe nuclear plants to produce that much energy will test governments, scientists, investors, and international oversight officials from the International Atomic Energy Agency (IAEA).

Renewable Energy Sources

Renewable energy sources such as hydroelectric, biomass, wind, solar, wave, geothermal, and other sources supply the remaining 7 percent of world energy (International Energy Outlook 2005). With its solid Kyoto Treaty commitment to lowering CO_2 emissions, the European Union is leading the way in introducing wind energy as a major alternative to reliance on fossil fuels, with some 20 percent of energy in Germany and Denmark coming from wind. With only 6 gigawatts (GW) of wind energy at present, China plans to meet some of its rising demand with 100 GW of wind electricity by 2020 (Hudson, 2008). Add to this picture the massive Three Rivers Dam for hydroelectric power. In the U.S. plans are underway to build giant wind farms and transmission facilities in the state of Texas, enough to produce 20 percent of the energy demand in the U.S. (Pickens Plan, 2008). Similar plans are afoot in the deserts of California and Nevada to develop massive solar energy capacities (Woody, 2008).

Wind and solar sources have experienced over 30 percent global growth annually in recent years, with wind particularly competing favorably with fossil fuels on price. But, to become significant parts of global energy supply, both wind and solar must achieve scalability (i.e., improve their efficiencies and receive both massive government subsidies and incentives, massive private investment, and massive new production and distribution) all very soon. A breakthrough from MIT in the U.S. indicates that an inexpensive new technology will save solar energy as hydrogen, a major breakthrough that can lead to distributed energy generation. Biofuels such as biodiesel from agricultural sources such as algae, and ethanol made from corn, sugar cane, or green grass cuttings have also benefited from production breakthroughs and are rapidly becoming cost competitive and encouraged or even required by governments. Ethanol is now required as a 15 percent mix in gasoline in some parts of the United Sates, and Brazil relies heavily on it for automobile fuel. Unfortunately, in response to subsidies, the use of some 27 percent of U.S. corn for ethanol has helped to set off a sharp rise in global food prices.

Energy Demand

The International Energy Agency predicts major increases in the uses of electricity across the globe, with developing economies pushing overall global electrical use to more than double electrical demand by 2030 (World Energy Outlook 2007). Obviously meeting such demand will require huge new investments, more reliance on coal with its emissions problems, more oil/gas than presently appears available, and a huge growth in alternative renewable energy. It will also require new technologies and substantial conservation measures and incentives; more on these subjects appears later in this chapter. Finally, it will require multiple effective ways to limit greenhouse gases from exacerbating global warming.

The larger picture of global energy, then, is a jigsaw puzzle whose many pieces continue to change shape. Consequently the pieces have yet to fit together in a coherent new version of the larger picture. Moreover, as oil scarcity becomes more prevalent, continuing energy uncertainties will likely shape a troubled future for globalization.

To grasp just how fast energy demand is growing, it is useful to examine what growing economies will require if globalization continues its anticipated growth pattern. Then consider how rising demand will require shifts in where the energy for globalization will be found, who will control it, and how it will be distributed.

The U.S. Department of Energy predicts demand for oil rising from 86 mbl/pd to 119 or 125 mbl/pd in 2025, a rise of 45 percent to 50 percent, but just where that much oil will come from remains the central mystery on which the future of globalization centers (U.S. Energy Information Administration, 2008). Mature world economies are increasing their annual demands for energy by 1.1 percent, while in emerging economies the demand for more energy annually grows at the rate of 3.2 percent, with China's oil consumption leading the way with an annual growth of 5.8 percent. Already China has recently become the world's second largest consumer of oil behind the U.S., with both of these industrial powers relying ever more heavily on oil imports. The United States imports more that 60 percent of its oil, a percentage that grows annually as U.S. production exhausts its known reserves.

Eyeing the hard realities of global oil supply and demand, David O'Reilly, CEO of Chevron, a major global energy TNC, took out full-page ads in the *New York Times* in February 2006 saying: "One thing is clear, the era of easy oil is over" (Klare, , 2006). O'Reilly was emphasizing not only dwindling reserves, but the hard fact that the most accessible oil has already been found, and it will take progressively more energy to extract oil and gas. Tar sands and shale oil cost more to extract and refine, and new oil discoveries will come only from places where their extraction will also be difficult and costly. Gary McMurtry of the University of Hawaii put it another way in a March 2, 2006 speech entitled *The Future of Industrial Society at the End of Cheap Oil, or It's Only the End of the World as We Know It*. He stated,

> " The 'tipping point' will come when the global supply of fossil fuels begins to lag behind growing demand, at 'Hubbert's Peak,' not, as commonly believed, when all oil and natural gas are depleted. Hubbert's global peak is either upon us now, or may extend a few more years to 2010 or 2015 at the latest" (McMurty, 2006).

Numerous other observers add that a sense of entitlement to an abundant consumer way of life among people reliant on cheap oil has led these populations to use sophisticated forms of denial, what McMurtry describes as "a tragic point in the human experiment at industrial civilization."

Some Consequences of Fossil Fuel Limits

In the Lewis/Harrison scenario, however, all forms of fossil fuels—oil, gas, and coall—will by 2050 face serious limits, partly because of diminished oil reserves, but also because of the absolutely essential need to limit greenhouse gases to limit global warming. Rapidly rising CO2 emissions are collecting in both the atmosphere and the oceans, particularly in the mid-level depths of the oceans, trapping heat and advancing global warming. The last century saw a one-degree advance in global temperature, but now analysts continue to announce new projections of temperatures rising 50 percent more rapidly, anywhere from 3 to 11 degrees Fahrenheit (1.67-6.1 degrees Centigrade) in the 21st century. Increasingly, signs in nature around the globe—melting glaciers, changes in ocean currents, droughts, intensified hurricanes—support these estimations. As for hopes of carbon being held underground, coalmines, gas and oil fields, and other underground depositories lack the necessary capacity, and more, this kind of sequestration remains a technically unproven solution. The oceans offer no more capacity to absorb carbon emissions, as they are already turning acidic from CO2 emissions, threatening the marine life food chain (Harrison, 2006). Keeping atmospheric C02 at or below 350 parts per million, considered necessary to abate global warming, makes carbon-free power a necessity.

In light of a 10TW (terawatts) projected energy demand in 2050, the following energy sources might supply these amounts, according to Harrison, drawing on Lewis's research.

1) Biomass sources of 3 TW are possible but would require 600 million hectares of land, the use of which would seriously diminish food crops. As food is expected to be scarce as well in 2050, biomass has serious built-in limits and still produces greenhouse emissions.

2) Wind has a global potential for as much as 2TW, but it would require massive forms of storage for windless periods, and though growing rapidly in the early 21st century in northern Europe, it is not expected to produce 2TW in 2050. Amory Lovins says, however, that in North America wind energy in North and South Dakota could supply all of the energy needed for the entire continental United States. (For further discussion by Lovins see: http://www.rmi.org/images/PDFs/Energy/E03-05_20HydrogenMyths.pdf)

Wind energy can be saved by pumping water uphill during low energy demand periods, then using the falling water for hydroelectric power during windless times. Investments in wind in China and the U.S. will soon begin to rival those made in the EU, where several countries continue to ad wind capacity beyond 20 percent of their demand.

3) **Global geothermal** possibilities are minor, but hydroelectric power could generate as much as 3TW, unfortunately at a cost of stream flow and river fish propagation. The easy hydropower sources have already been tapped.

4) **Ocean Thermal Energy Conversion (OTEC**) might supply as much as 10 percent of what will be needed, but it has yet to receive investment in any serious measure and be proven as a technology. Wave energy is just emerging as a proven energy technology to support demands near coastlines.

5) Solar energy has a global potential of 600TW and practically holds the greatest promise for supplying a clean, renewable 10TW, or far more. Like other renewable clean sources, its cost up to now has made it less competitive on price, but breakthrough improvements in solar technologies now will make solar energy available for as little as 5 to 7 cents a kilowatt hour. That means solar is rapidly becoming cheaper and more efficient than fossil fuels, and consequently very attractive for investments. MIT's announcement in 2008 joins those of several other solar innovators, improving solar panels efficiencies beyond 30 percent, doubling solar capacity per photovoltaic panel (Science Daily, 2008). Solar can now be produced for under $1 a watt. Notably the Solar America Initiative in the U.S. includes roughly 1,000 private sector firms, electrical utilities, builder-developers, and local governments (Solar Energies Technology Program, 2008).

Some Consequences of Energy Scarcity

Energy scarcity has immediate consequences, some of them potentially devastating for energy-reliant economies such as that of the U.S. With 2008 world price rises in oil to the range of $117 to $147/bbl, the oil share of the U.S. balance of payments deficit increased in one year to $400 billion, a major flow of dollars that enrich foreign oil sources. Unfortunately these exports of dollars also exacerbate the balance of payments debt that threatens America's control of its economic future. As stock markets demonstrated in 2008, oil prices and threatened interruptions in oil supplies would lead to further swings in the price of oil and sudden shifts in the U.S. and global stock markets. It is worth noting that sales of oil worldwide are denominated in dollars, which also means that any significant drop in the value of the dollar could mean a corresponding rise in the price of oil.

What Globalization Will Require in Energy: Shifting Politics and a Shifting Set of Targets

Oil Requirements

Having enough oil to meet rapidly rising global demand will require a wide variety of things.

1) The obvious—discovering more oil in huge amounts for existing reserves are rapidly depleting as demand is rising. Global warming, however, will require substantial cuts in reliance on all forms of fossil fuels.

2) Creating major new and effective conservation measures that substantially cut demand, such as vehicles with far better mileage and replacements for reliance on fossil fuel. For example, the Indian vehicle manufacturer Tata Motors is producing a car that runs on compressed air and a battery. Solar energy can produce the compressed air.

3) Producing and supplying smart electrical grids and technologies to supply electric vehicles and to accept energy from them into the grid.

4) Subsidizing and lowering prices of alternative renewable energy, in part by cutting subsidies to oil to push its price up.

5) Assuring that transportation systems keep oil supply routes open in the face of terrorist sabotage of oil production fields, pipelines, terminals, and tankers.

6) Taxing carbon emissions.

7) Preventing major wars or serious diplomatic problems in oil producing regions, and between major oil producing and major oil consuming nations. Middle East regional threats of strife threaten global energy security, and with it the entire global economy, as is becoming obvious by the economic crises being suffered by major U.S. financial and insurance companies, and home-owning mortgage holders, at least partially caused by the hundreds of billions in expenses incurred by the U.S. for its war upon Iraq.

Global Oil and Gas Changes

A global oil/gas scarcity in the short term also may be expected to multiply and intensify disputes between nations over existing oil/gas sources. China and Japan have a long-running dispute about control of offshore oil and natural gas deposits in the East China Sea, an issue as yet unsettled. With its huge and rising energy demand, China is also investing in bringing natural gas in from Russia, investing in oil sources in Africa, and wooing Venezuela for oil otherwise now sold to the U.S, and buying Iranian oil. Such energy links among nations have the potential for strife as well as for peaceful collaboration among energy trading partners—wars or peaceful extensions of trade and cultural exchange. When gas supplies are cut off or suddenly limited, as with Russia's Gazprom cutting supplies to the Ukraine and Georgia in early 2006, the nations generating energy demand face serious economic damage via any one of a number of possible internationally triggered energy crises. Moreover, the EU has a difficult question to answer about its reliance on Russia's gas for 20 percent of its energy. [i]

Reviewing Global Energy Possibilities and Problems

A review of world energy sources and consumption patterns raises questions about the energy available for the continued growth of globalization. Energy scarcity and inflated energy prices can trigger a global economic downturn, an uncertainty global economies currently face. Or the reverse may occur, with a currency or credit collapse from other causes leading to a global recession, followed by drops in energy demand and energy prices. But the predicted growth of global economies is poised to increase energy demand steadily, and rapidly in places such as China and India. In the words of energy analyst Michael Klare, with oil and gas on the verge of not meeting rising demand, we face a long emergency.

Problems threatening oil and natural gas have multiplied around the world. In Myanmar oil/gas giant Unocal stood accused in a U.S. court of enslaving peasants during its collaboration with the Myanmar government in building a new pipeline. In February 2006 Russia played a card from its "oil-politics" deck, cutting natural gas to the Ukraine, Georgia, parts of Eastern Europe, and the EU. We described at the beginning of this chapter the attack of insurgents in Nigeria on oil production facilities there.

Meanwhile, in Afghanistan Islamic jihadis continue to threaten sabotage to a planned major natural gas pipeline, forcing U.N. troops to engage them in a guerrilla war. Corruption, war damage, and persistent sabotage by insurgents have cut Iraq's previous oil production of 4 million bbl per day of export oil to 2.43 mbbl/d (Graeber, 2008).

As a consequence of this pattern of oil interruptions, some of the leading global industrial powers can no longer count on the oil or natural gas they require. The intensity of global energy competition, foreign direct investment in energy, and energy commerce is increasing. Disputes among Caspian Sea area rebels and developers of oil and natural gas are leaving unanswered questions about the security of these rich new regional supplies. Meanwhile in the struggle to secure a steady flow of energy for its rising demand, China agreed to invest $100 billion to develop the Iranian Yadavarian oil field, which would then guarantee China 10 million tons of natural gas annually for the next 25 years (Honolulu Advertiser, 2006). As further evidence that the global race for energy sources is on, China has also invested $3 billion to develop oil in the Sudan (Friedman, 2005).

Across the Middle East, the rise of Islamic militants and insurgents who conduct guerrilla warfare attacks imperils pipelines. This turmoil in the Middle East has already interrupted and diminished expected oil supplies, particularly those from Iraq. It bears repeating that even the threat of oil scarcity puts the entire global economy at risk and sets in motion a complex series of international political and military maneuvers. It follows that energy security dominates the foreign policies of major oil producing and oil consuming nations, as well as the boardroom discussions of global energy TNCs. The U.S. presently maintains 13 bases in 9 different countries, from Qatar to Uzbekistan, and a fleet of ships patrolling from the Straits of Malacca and the Persian Gulf to a newly planned navy base in West Africa. U.S. taxpayers subsidize this service for the entire industrial world via their taxes. Ironically, some describe global deployments of the U.S. military as simply turning American troops into mercenaries who protect global oil TNCs.

The U.S. seeks a military presence wherever it can secure oil production or oil transportation. This extension of U.S. force creates a paradox—gratitude from some industrial/consumer nations for the safety of their oil supplies, but anxiety from other producer and intermediary pipeline nations who suspect that the U.S. will use its forces as it has in Iraq, invading in a pre-emptive war. Russia, for example, suspiciously eyes the U.S. air bases in Uzbekistan and Kyrgyzstan, two former Soviet Republics on its border that were assumed to be in Russia's sphere of influence. At the very least, the present global distribution of the U.S. military leads nations relying on these oil/gas sources—China and India included—to suspect the U.S. of seeking a global energy hegemony, an arrangement that erodes their regional influences and national sovereignties. As competition for oil rises, every industrial economy struggles to find new sources and new forms of energy security.

OPEC

The Organization of Petroleum Exporting Countries (OPEC) continues to meet and set oil production limits. With much higher oil prices, OPEC countries are presently enjoying a flood of profits. Their newly abundant sovereign wealth funds have begun investing in businesses in the EU and U.S. And with OPEC's maturing fields arriving at or near peak production, with Russia (a non-OPEC member) selling energy to Europe, with Indonesia no longer oil self-sufficient, and with recent discoveries in the Caspian Sea region and in West Africa putting new producing nations into the energy market, the fabric of the OPEC cartel may well be strained by rising competition.

Caspian Sea Oil/Gas Sources

Discoveries of substantial new oil sources in Azerbaijan, Kyrgyzstan, Georgia, and Kazahkstan—the so-called Caspian Sea countries—have led to major recent investments by global oil TNCs in production and pipeline transport. Caspian Sea regional production may reach 4 mbd in 2010, and as much as 6 mbd by 2020 (Klare, 2001). Regional gas reserves are estimated as equal to the combined reserves of Mexico, the U.S, and Canada (Klare, 2001 p.84). But intermittent wars, border conflicts, warlord struggles for control, and terrorist acts have clouded prospects for reliable new supplies of oil and gas from this region. Two new pipelines, one originating in Georgia and the other from Kazakhstan, lead to ports on the Black Sea. Another pipeline is planned to reach Turkey's Mediterranean coast, and another is planned through Afghanistan. The complexities that oil/gas scarcity brings to globalization are now unfolding in foreign policy struggles involving the U.S., Russia, the EU, the Caspian Sea and Middle-East countries, India, and China.

Environmental Threats and Responses

Given the serious threat of global warming, a new Intergovernmental Panel on Climate Change (IPCC) venture presently works to arrange a global carbon emissions treaty by 2009 in a meeting scheduled in Copenhagen. The speed of global warming links tightly to the amount of greenhouse gases emitted, which has direct links back to the fossil fuel demands that make production, transportation, and global commerce possible. A one-degree Fahrenheit rise in temperature in the 20th century has already led to serious global consequences. Scientists cite the rapid melting of glaciers in Greenland and major ice melts in Antarctica and the Arctic as evidence of dramatic global warming. As Simon Tett of the prestigious Hadley Climate Centre says, "People don't realize how dramatic these changes will be" (Morell, 2004). Sea level rise was estimated to be arriving twice as fast as previously believed; and higher temperatures from global warming have been associated with links to global storms and storm damage such as the 2008 disaster in Burma. Nations in Africa and parts of Asia are seeking international aid to change their crop variations to introduce either crops resistant to drought (Africa) or chronic flooding (Bangladesh).

Unrestricted fishing has contributed further to environmental distress with 17 of 19 major global fisheries being badly depleted (see Chapter Ten on food security), cities suffering from thick smog, water tables being overdrawn, and industry polluting rivers and shorelines. Further temperature rises caused by global warming will intensify all of these patterns and have a major impact on terrestrial and ocean ecosystems, species depletion, and human health. All of these dire consequences, then, threaten to throw the flow of globalization as we have known it off course. As history repeatedly demonstrates, civilizations inevitably face huge risks if environments are seriously damaged or collapse (Diamond, 2005).

Carbon Trading

A carbon trading market in the EU now registers and sets limits on greenhouse gas emissions. Past their prescribed CO2 limits, they must purchase carbon offsets in a marketplace with a limited number of offsets. The schemes aim at cutting overall emissions, and in the EU combine with national carbon taxes on fossil fuels. Similar plans are developing in the U.S., which still lacks a federal requirement for emissions trading. The proposed U.N. Framework emissions treaty will attempt to establish a worldwide cap and trade system to move energy users toward substantially less carbon burning. Thus far developing nations want the traditional industrial nations of the north to carry more of the burden, as up until recently they have done the most emitting. Low prices for carbon emissions rights show that the new markets probably have set emissions levels too high, allowing for too much CO2 to continue into the atmosphere. Opponents of the treaty point out a number of complications. For example, The Kyoto treaty, while a useful start, is too late with too little in encouraging too few cuts in emissions. Further, emissions trading still allows polluters to destroy air and water quality in ways that seriously damage nature and devastate human health. The world's seas absorb over half of the CO2 that is sequestered, with trees, crops, and other forms of foliage acting as the remaining natural storage reservoirs. Experimental attempts at pumping CO2 deep into oceans collided with recent science showing that deeper ocean waters already harbor twice the CO2 of surface waters, and that this amount of C02 changes ocean ph content, posing threats to marine life.

In summary, while the U.S. government estimates projected global energy demand to rise at approximately 2.2 percent annually, other variables in the energy security equation raise growing uncertainty about:

- the impact of peak oil production, and the resulting stability of energy prices; will energy availability and cost upset current criteria dictating comparative advantage in production?
- innovations in conservation and energy transmission;
- global warming, and storm and drought devastation through climate change;
- changing patterns in Atlantic Ocean currents possibly affecting industrialized Europe;
- sea level rise, and storms damaging heavily populated coastal areas;
- investments in alternative energy breakthroughs to improve price and availability of clean, renewable energy;
- the unwillingness of the United States thus far to join climate change agreements. China and the U.S. combined emit roughly half of global CO2. The world, and globalization, wait to see if all nations can agree on and enforce new, more stringent emissions levels.
- new global markets in carbon emissions trading;

- China struggling to substitute less polluting and clean, renewable energy in order to cut its coal-burning plant emissions;
- competition among industrial giants for secure access to energy, with resource wars and international friction interrupting oil and gas supplies.

The fate of globalization, indeed the fate of civilization itself, sits waiting for answers to critical energy questions. How will mankind meet its growing need for energy? How can globalization continue without causing the widespread environmental, social, health, and political damage that present energy uses cause?

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Endnotes to Chapter Eleven

[i] EU member countries are: Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, The Netherlands and United Kingdom.