Geopolitical Threats to World Energy Markets

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According to best estimates, the energy mix of the world will change only slowly over the next several decades. Oil, natural gas and coal will continue as the primary energy commodities of world commerce, so they will remain the main focus of the geopolitics of energy. Within this context, the article analyzes the implications of energy geopolitics for energy markets. The rise of national oil companies (NOCs) and the expansion of bilateral contracts between energy producing and energy importing countries threaten to diminish world energy markets. Pipelines and sea lanes are critical for international energy commerce, both with dramatic importance for energy finance. The quickly maturing liquid natural gas (LNG) infrastructure and the huge promise of shale gas will raise the importance of natural gas in world energy consumption and increase the independence of some countries with potentially large significance for energy finance. The article includes a brief consideration of the changing role of nuclear energy after the 2011 tsunami in Japan and the disaster at the Fukushima-Daiichi nuclear plant, and it concludes with a consideration of climate change and the future environmental impacts of the world's changing energy consumption patterns.

Key Words: Energy; Geopolitics; Energy markets; Oil; Natural gas; Coal; Nuclear energy; Climate change; National oil companies (NOCs); Bilateral contracts; Shale gas; Liquid natural gas (LNG); Tsunami; Fukushima-Daiichi; Pipelines; Sea lanes.

In early 2011, the price of crude oil rose by 62 percent in a single month, rocketing from $75 to $120 per barrel as protests and revolts shook an arc of Arab countries. The price of crude jumped six percent on a single day, February 21, in response to sudden and dramatic unrest in Libya. This strong price reaction occurred even though Libya only accounts for about two percent of annual world oil production. The large influence of troubles in this relatively minor

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producer stemmed from two main sources. First, already occurring unrest across the oil-producing countries of the Middle East, accompanied by fears that other nations would soon be inflamed, raised market doubts about the ability of other producers to surge their production to compensate for the withdrawal of Libyan oil from the market. Second, Libya produces a light sweet (low sulfur) crude that is particularly suited to certain refineries and is especially valued in some market segments. Saudi Arabia, the main supplier thought to be capable of a surge in production, pumps a heavier more sour (higher sulfur) crude. With many refineries in Europe and Asia being poorly equipped to handle higher sulfur crude, an expansion of Saudi production could not adequately substitute for the missing Libyan contribution.

Energy prices have always been subject to shocks from events that occur in single countries, and this will remain true as long as major sources of energy are concentrated in relatively few countries. However, looking back as well as forward, larger geopolitical considerations go beyond the impact of any single nation, and those transnational and more enduring factors are the focus of this chapter.

Energy Geopolitics for the Next Generations: Demand, Mix, and International Movements

The overall contours of energy geopolitics are rather straightforward and understood by most people at least at a casual level. First, there are several basic types of energy sources: fossil fuels (including coal, oil, and natural gas), nuclear energy, and renewables (including hydroelectric power, wind energy, biomass, waste products, and solar). Each of these resources is best suited to particular uses. For example, hydroelectric power can generate electricity quite well, but it would be a poor choice for a transportation fuel.

Further, these various energy resources are distributed across the world in a way that does not match the point of most likely or beneficial consumption. The response to this situation is twofold. First, one can adapt a geographically convenient energy source to a use for which it is less well-suited. For example, near the end of World War II, the almost-defeated axis powers were driven to near-

desperate expedients. Oil-starved Japan converted some automobiles to burn wood as fuel. After failing to capture oil fields in Rumania and in the Caucasus, Germany, having developed the world's first jet-propelled aircraft, used oxen to tow planes onto the runway in order to conserve jet fuel[2].

As a second approach, one can move a fuel from its source to where it will be used. The contemporary world economy, built on fossil fuel, has developed and elaborated this model for almost a century, starting with the conversion of the British navy from coal to oil in the first decades of the twentieth century.[3] The mismatch between the geographical location of energy resources and their points of consumption drives the geopolitics of oil. If oil must be transported from the nations where it originates to the countries where it will be consumed, the energy must transit national boundaries, international waters, and sometimes-contested borderlands as well.

Three more general factors complete the geopolitical stage setting. First, virtually all experts expect worldwide energy demand to increase markedly over the next generation or so, focusing on a horizon out to 2030-2050. Energy demand will grow faster in some regions (most notably China and India according to most expectations) while demand in others may stagnate or expand at a much slower rate (North America and the Eurozone). On balance, the world will demand sharply increasing energy supplies. Second, the energy mix – the proportion of fossil fuels, nuclear, and renewables – will change only slowly. Thus, the energy mix of today is essentially the energy mix of 2030-2050. Third, the largest energy consuming regions of the next generation will gather an increasing portion of

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[2] Daniel Yergin, "Energy Security and Markets," in Jan H. Kalicki and David L. Goldwyn, *Energy and Security: Toward a New Foreign Policy Strategy*, Baltimore: The Johns Hopkins University Press, 2005, p. 60.

[3] See Erik J. Dahl, "Naval Innovation: From Coal to Oil," *Joint Forces Quarterly*, Winter 2000-01, 50-56; and F. William Engdahl, "Oil and the Origins of the 'War to Make the World Safe for Democracy'," June 22, 2007, available at http://www.engdahl.oilgeopolitics.net/

their energy from outside their own borders. We consider each of these main features in turn.

Table 1 ExxonMobil's Analysis of World Energy by Type (Quadrillions of BTUs)

	2000	2010	2030	% Chg. 2000 to 2030	% Chg. 2010 to 2030
Oil	156	173	204	30.77	17.92
Gas	89	112	164	84.27	46.43
Coal	90	128	134	48.89	4.69
Nuclear	27	28	50	85.19	78.57
Biomass/Waste	41	47	48	17.07	2.13
Hydroelectric	9	11	16	77.78	45.45
Renewables	3	7	20	566.67	185.71
Total	**414**	**506**	**636**	**53.62**	**25.69**

Source: ExxonMobil, "The Outlook for Energy: A View to 2030," 2010, p. 53. A North American household consumes approximately 400,000 BTUs per day.

Table 1 shows ExxonMobil's analysis of energy consumption in the recent past, the present, along with the anticipated situation in 2030, with total energy demand being broken into six categories. Every category shows substantial growth, except for coal and biomass. Measured from 2000 to 2030, ExxonMobil anticipates that energy consumption will surge by more than 50 percent, and from 2010 to 2030 by more than 25 percent. BP presents a similar analysis in "BP Energy Outlook 2030," key elements of which appear in Table 2.[4] From 2000-2030 BP forecasts total growth in energy consumption of 80 percent and for the 2010-2030 sub-period a growth of 41 percent in consumption. In its analysis covering 2001-2030, Deloitte also foresees rapidly increasing demand for energy, with total use increasing by two-thirds.[5] If these analyses are even approximately

[4] "BP Energy Outlook 2030," January 2011, London.

[5] Deloitte, "Globalization and Energy Supply: Strategic Risk in the 21st Century,"

correct, we will witness a tremendous increase in worldwide energy consumption in the next twenty years.

Table 2 BP's Analysis of World Energy Consumption by Type (Million Metric Tons of Oil or Equivalent)

	2000	2010	2030	% Chg. 2000 to 2030	% Chg. 2010 to 2030
Fossil Fuel Liquids	3562.1	3943.3	4671.1	31.1	18.5
Natural Gas	2175.5	2828.3	4312.4	98.2	52.5
Coal	2337.6	3496.1	4411.9	88.7	26.2
Nuclear Energy	584.3	613.9	1096.8	87.7	78.7
Hydroelectricity	600.1	772.8	1144.0	90.6	48.0
Renewables	658.9	985.2	2174.9	230.1	120.8
Totals	**9918.5**	**12639.7**	**17811.1**	**79.6**	**40.9**

Source: BP, "BP Energy Outlook 2030," January 2011, London. Data are available at: www.bp.com. Accessed April 16, 2011. Fossil fuel liquids includes oil, gas-to-liquids and coal-to-liquids.

Table 3 also draws on estimates for 2030 by ExxonMobil and BP and shows the percentage of each type of energy source exploited in 2010 and the distribution these energy firms expect to hold in 2030. Interestingly, the two firms differ in their assessment of the situation that prevailed in 2010. Some of the disagreements stem from slight differences in energy classifications, but others appear to be more substantial. For example, the two assessments of the proportion of energy deriving from hydroelectric generation differ by a factor of about 100 percent. Even with some important differences, the two forecasts are in broad agreement, especially regarding the categories that are likely to be most important from a geopolitical perspective. They both agree that oil will provide 25-30 percent of all energy in 2030 and that natural gas will contribute about 25 percent, with fossil fuels, all considered (coal, oil, and natural gas) together, accounting for 75-80 percent of all energy the world will consume in 2030.

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Table 3 Percentage of Consumption by Fuel Types, Estimates of ExxonMobil and BP

	Exxon		BP	
	2010	**2030**	**2010**	**2030**
Oil and Derivatives	34.19	32.08	31.20	26.23
Natural Gas	22.13	25.79	22.38	24.21
Coal	25.30	21.07	27.66	24.77
Nuclear Energy	5.53	7.86	4.86	6.16
Hydroelectricity	2.17	2.52	6.11	6.42
Renewables	10.67	10.69	7.79	12.21
Totals	**100.00**	**100.00**	**100.00**	**100.00**
Oil + Gas + Coal	81.62	78.93	81.23	75.21

Source: BP, "BP Energy Outlook 2030," January 2011, London. Data are available at: www.bp.com. Accessed April 16, 2011 and ExxonMobil, "The Outlook for Energy: A View to 2030," 2010, p. 53. Categories were adjusted slightly to make them congruent. Note that ExxonMobil has a category "Biomass/Waste," which BP does not. This table combines "Biomass/Waste" as a part of "Renewables." Included here in "Oil and Derivatives" for BP are their sub-categories gas-to-liquid and coal-to-liquid.

Of the six categories of energy shown in Table 3, some types are consumed where they originate, while large portions of other types of energy are shipped great distances. Hydroelectricity, energy produced from renewables, and nuclear energy have virtually no shipping or transmission across national boundaries.[6] Not only has this been true historically, but it is projected to remain true for the next generation. Thus, the principal energy sources that are shipped trans-regionally are all fossil fuels – oil, natural gas, and coal – as Table 4 shows. Of

[6] BP, "BP Energy Outlook 2030," January 2011, London.

Table 4 Fossil Fuel Demanded for Import and Available for Export, 2010 and 2030, Projected

		Percentage of Consumption Demanded for Import (Negative values indicate proportion of consumption available for export.)		Millions of Metric Tons of Oil or Equivalent Demanded for Import (Negative values indicate tons available for export.)	
		2010	2030	2010	2030
Oil	North America	37.53	30.55	387	291
	Asia Pacific	68.37	82.88	854	1475
	Europe & Eurasia	6.07	6.84	55	59
	Middle East	-235.51	-229.58	-829	-1153
	Africa	-226.58	-166.71	-333	-345
	S & C America	-37.77	-29.29	-97	-105
		2010	2030	2010	2030
Natural Gas	North America	2.19	1.53	17	13
	Asia Pacific	14.19	19.56	70	204
	Europe & Eurasia	7.20	11.76	72	145
	Middle East	-22.98	-13.28	-80	-98
	Africa	-102.94	-141.52	-97	-263
	S & C America	-9.63	-8.17	-13	-20
		2010	2030	2010	2030
Coal	North America	-4.62	-11.39	-26	-52
	Asia Pacific	1.72	2.36	40	79
	Europe & Eurasia	9.04	-1.38	43	-6
	Middle East	89.64	85.18	8	8
	Africa	-35.81	-29.66	-38	-48
	S & C America	-116.60	-105.15	-29	-37

Source: BP, "BP Energy Outlook 2030," January 2011, London. Data are available at: www.bp.com. Accessed April 16, 2011.

these, all three are not shipped equally. For example, in 2010 North America, the Asia Pacific, and Europe and Eurasia imported 1,296 million metric tons of oil, but total world imports of coal in 2010 totaled only 91 million tons. This difference is perhaps not surprising for three reasons: Oil has much more value per unit of weight, oil is easier to ship, and coal deposits are more widely distributed than oil, so that coal is consumed near its point of production. BP, as also shown in Table 4, expects trans-regional shipments of oil to increase by about 50 percent by 2030, with those of coal remaining essentially unchanged.

Natural gas occupies a middle ground between oil and coal in terms of shipments. Traditionally, natural gas moved only through pipelines, with an almost negligible shipment of gas in the form of liquefied natural gas (LNG). However, shipments of LNG have become more cost competitive with other energy transportation methods recently, and LNG shipments have accelerated rapidly in recent years.

To ship LNG requires that natural gas be liquified by cooling the gas to -260 degrees Fahrenheit. In this process, natural gas is first transported by pipeline to a liquefaction facility, typically located at or near a port or railhead. After liquefaction, the LNG is pumped onto a ship or into railroad tank cars, which then carry the LNG to its destination, a facility at which it can be re-liquified and shipped on via a natural gas pipeline. Obviously this transmission cycle requires the development of an elaborate infrastructure, which has been developing quite rapidly.[7] The growth of LNG is one of the reasons that consumption of natural gas is expected to grow more rapidly than

[7] For assessments of the importance of LNG, see: Baker Institute, "The Geopolitics of Natural Gas," March 2005; Baker Institute, "Natural Gas in North America: Markets and Security," January 2008; Cindy Hurst, "Liquefied Natural Gas: The Next Prize?," in Gail Luft and Anne Korin (eds.), *Energy Security Challenges for the 21st Century: A Reference Handbook*, Santa Barbara, CA: ABC-Clio, 2009, pp. 271-281; and Donald A. Juckett and Michelle Michot Foss, "Can a 'Global' Natural Gas Market Be Achieved?" in Jan H. Kalicki and David L. Goldwyn, *Energy and Security: Toward a New Foreign Policy Strategy*, Baltimore: The Johns Hopkins University Press, 2005, pp. 531-552.

either coal or oil (See Tables 1 and 2). In addition, natural gas is increasingly popular as a fuel for electrical generation, due in no small measure to its lower emission of greenhouse gases.[8]

With the advance of LNG as a method for shipping natural gas, one might expect the long-term result to be a world in which both oil and natural gas in the form of LNG have a similar pattern of international shipment. Previously, with no way to transport natural gas across great ocean distances, much of it was "stranded." With the development of a robust LNG infrastructure, natural gas seems poised to fully enter the world energy market.

Natural gas may one day be traded around the world with a facility matching that of oil. However, a potentially extremely important development for the availability and geopolitical significance of natural gas lies in the future of shale gas – gas trapped in deep sedimentary layers of shale that has been unrecoverable in a commercially viable manner until quite recently. Massive shale gas deposits around the world, including the United States, promise to make natural gas much more abundant near the point of ultimate consumption. Thus, the future of shale gas can dramatically affect the future geopolitical significance of natural gas and even have a dramatic effect on markets for other forms of energy. These issues are addressed specifically in a later section of this chapter.

The argument of this chapter thus far lays a foundation for the critical importance of oil and natural gas. Even setting aside the emerging importance of shale gas, oil and natural gas are the two forms of the world's energy that dominate international energy shipments. As a result, the geopolitical implications of energy turn on the acquisition of oil and natural gas from abroad and the shipment of oil and gas around the world. Thus, the balance of this article focuses

[8] See Baker Institute Policy Report, "The G8, Energy Security, and Global Climate Issues," Number 37, July 2008; International Energy Agency, "World Energy Outlook 2010: Fact Sheet," 2010; and Robert A. Hefner III, "The Age of Energy Gases: The Importance of Natural Gas in Energy Policy," in Kurt M. Campbell and Jonathon Price, *The Global Politics of Energy*, Washington, DC: The Aspen Institute, 2008, pp. 149-182.

primarily on these two forms of energy and their geopolitical implications for energy finance.[9]

Table 5 OPEC and the Future of the World's Supply of Oil

	2010	**2015**	**2020**	**2025**	**2030**
World oil demand	85.5	91	96.2	100.9	105.5
Non-OPEC supply	51.9	53.9	55.7	56.6	57.5
OPEC crude supply	29.3	30.8	33.2	36	38.7
Percentage supplied by OPEC	34.27	33.85	34.51	35.68	36.68

Source: Adapted from OPEC, "World Oil Outlook," 2010. See p. 10.

The World Market for Energy

Oil today trades in a mature worldwide market, which has developed from a longstanding and mostly successful U.S. policy.[10]

[9] Contrary to the thrust of this chapter, some offer a radically different vision. The National Intelligence Council, in "Global Trends 2025: A Transformed World," November 2008, foresees a technological breakthrough in the energy field by 2025 "…that will provide an alternative to oil and natural gas." However, even this radically different vision of the world's energy future maintains that "…implementation will lag because of the necessary infrastructure costs and need for longer replacement time." See pp. 45-51, especially p. 46.

[10] For the foreign policy dimension of the international energy market, see: John Deutch, James R. Schlesinger, and David G. Victor, "National Security Consequences of U.S. Oil Dependency," Council on Foreign Relations, Independent Task Force Report No. 58; Donald A. Juckett, and Michelle Michot Foss, "Can a 'Global' Natural Gas Market Be Achieved?" in Jan H. Kalicki and David L. Goldwyn, *Energy and Security: Toward a New Foreign Policy Strategy*, Baltimore: The Johns Hopkins University Press, 2005, pp. 531-552; Loyola de Palacio, "Reforming the Gas Market," in Jan H. Kalicki and David L. Goldwyn, *Energy and Security: Toward a New Foreign Policy Strategy*, Baltimore: The Johns

Metaphorically at least, recent decades have seen the "financialization" of oil. With the operation of this worldwide market, oil has become essentially fungible, with oil in one location being readily convertible into oil in another. Of course, not all oil is the same. This chapter already noted the importance of Libyan oil and sweet versus sour types of crude oil, so oil may be largely fungible, but different kinds of oil are not quite as fungible as cash.

Nonetheless, to a large extent, the old accounting saw of "all sources support all uses" has become true of oil in the world market, and the promise of LNG may soon make the same true of natural gas. This is an extremely important geopolitical dimension of the world energy market. Speaking of the diversity of supply, Winston Churchill noted almost 100 years ago that: "Safety and certainty in oil lie in variety and variety alone,"[11] and the same remains true today. That variety of supply depends on robust world energy markets. Further, it seems evident that talk of "energy independence" for the United States is a fanciful notion, in spite of longstanding claims by a succession of presidents that we are working toward such energy autarky. As Table 4 makes clear, the location of supply and demand for energy makes evident the future of an interdependent world of energy.[12] For the United States, the best outcome is for energy to be

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Hopkins University Press, 2005, pp. 175-194; and Daniel Yergin, "Energy Security and Markets," in Jan H. Kalicki and David L. Goldwyn, *Energy and Security: Toward a New Foreign Policy Strategy*, Baltimore: The Johns Hopkins University Press, 2005, pp. 51-64.

[11] Parliamentary Debates, Commons, July 17, 1913, 1474-77, quoted in Daniel Yergin, *Energy Security and Markets*, in Jan H. Kalicki and David L. Goldwyn, *Energy and Security: Toward a New Foreign Policy Strategy*, Baltimore: The Johns Hopkins University Press, 2005, pp. 51-64. See p. 52.

[12] For the unlikelihood of energy independence for the United States, see: John Deutch, James R. Schlesinger, and David G. Victor, "National Security Consequences of U.S. Oil Dependency," Council on Foreign Relations, Independent Task Force Report No. 58; Peter M. Jackson, "The Future of Global Oil Supply: Understanding the Building Blocks," Cambridge Energy Research Associates, November 2009; Clifford Krauss, "Can We Do Without the Mideast?" New York Times, March 30, 2011; and Philip K. Verleger, Jr., "Forty Years of

traded in a free worldwide market, with the hope that new technologies can lessen dependence on foreign energy sources.

OPEC and the Future Role of a Cartel

While the preceding section described the development of a world energy market, it is hardly a free market or one that is likely to remain free of noncompetitive influences and disruptions to the current market structure. The creation, survival, and effectiveness of the Organization of Petroleum Exporting Countries (OPEC) have long demonstrated the market power of key suppliers of crude oil. According to OPEC's own estimates, shown in Table 5, the cartel currently supplies slightly over one-third of the world's oil, a proportion anticipated to remain essentially stable over the next twenty years, even as world demand increases. BP sees an even more dominant role for OPEC, saying: "The importance of OPEC is expected to grow. On our projections, OPEC's share of global production would increase from 40% in 2010 to 46% in 2030 (a level not reached since 1977)."[13]

Over its history of almost half a century, OPEC has been one of the most effective cartels in any major market in the world. Although OPEC has had periods when oil price sank despite its efforts, notably after the Asian financial crisis of the late 1990s, it has enjoyed spectacular successes. OPEC first brought the world the oil shock, price spike, and long gas lines of the 1970s, and today OPEC appears to be meeting with great success as crude oil is currently priced well above $100 per barrel. Edward Morse and Amy Jaffe summarize the situation as follows: "OPEC has been one of the most remarkable success stories and also one of the most extraordinary anomalies in the global economy for over forty years. It is a success story because, despite persistent forecasts that it is doomed to fail, it has not simply managed to survive but can be credited with succeeding in its basic objectives: defending and supporting the income and revenue aims of

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Folly: The Failure of U.S. Energy Policy," *International Economy*, Winter 2011, 49-66 passim.

[13] See "BP Energy Outlook 2030," January 2011, London, p. 37.

Table 6 Major Oil Companies of the World

Supermajors, the "Big Five" or International Oil Companies (IOCs)	
BP	United Kingdom
ChevronTexaco	United States
Conoco Phillips	United States
ExxonMobil	United States
Royal Dutch Shell	Netherlands and United Kingdom
Key National Oil Companies (NOCs) (Includes nationally-owned firms focused mainly on natural gas.)	
Abu Dhabi	Abu Dhabi National Oil Company
Algeria	Sonatrach
Brazil	Petrobras
China	China National Offshore Oil Company (CNOOC)
China	China National Petroleum Corporation (CNPC)
China	Sinopec
Iran	National Iranian Oil Company (NIOC);
Iraq	Oil Ministry
India	ONGC
Indonesia	Pertamina
Kazakhstan	Kazmunaigaz
Kuwait	Kuwait Petroleum Company
Libya	Libya National Oil Company
Malaysia	Petronas
Mexico	Pemex
Nigeria	Nigerian National Petroleum Corporation (NNPC)
Norway	Statoil
Qatar	Qatar General Petroleum Corporation
Russia	Gasprom
Russia	Rosneft
Saudi Arabia	Saudi Aramco
Venezuela	Petroleos de Venezuela, S. A. (PDVSA)

its members, and forcing any burden of adjustment to higher oil prices on other countries."[14]

OPEC manages supply to manage price – OPEC has not fundamentally increased its supply capacity in any meaningful way for more than a decade.[15] Not surprisingly, restricting capacity aids OPEC members in respecting its self-imposed production targets. In addition, OPEC sometimes cuts production to support higher prices, such as in 2006 and 2007.[16]

There can be no doubt that OPEC adjusts its productive capacity as a function of its efforts to control prices and in response to prices. Any business will respond to a market environment with lower prices by adjusting its production schedule. But a cartel does not merely respond to external market developments. It is not a price taker, but rather functions to control prices. OPEC effectively acknowledges this by speaking of its concern with *security of demand*: "Recent behaviour has shown that oil prices continue to matter for supply. The low prices witnessed at the end of 2008 led to a revision in investment plans; and if prices had remained that low, the implications for supply moving forward, both in OPEC and non-OPEC countries, could have been substantial. This, in turn, is a reflection of the lesson that low oil prices can sow the seeds of higher ones, and that security of supply is improved by security of demand."[17] Thus, OPEC would like high and stable demand and a high and stable price, but this gives rise to a tension between price maintenance and expanding production. Amy Jaffe makes the point: "OPEC's joint desires to garner maximum

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[14] Edward L Morse and Amy Myers Jaffe, "OPEC in Confrontation with Globalization," in Jan H. Kalicki and David L. Goldwyn, *Energy and Security: Toward a New Foreign Policy Strategy*, Baltimore: The Johns Hopkins University Press, 2005, pp. 65-95. See p. 68.

[15] See, for instance, Amy Myers Jaffe, "OPEC: An Anatomy of A Cartel," in Gail Luft and Anne Korin (eds.), *Energy Security Challenges for the 21st Century: A Reference Handbook*, Santa Barbara, CA: ABC-Clio, 2009, pp. 78-90, especially p. 83.

[16] See Christof Rühl, "Global Energy After the Crisis," *Foreign Affairs*, March/April 2010.

[17] OPEC, *World Oil Outlook, 2010*, pp. 125-126.

revenues for its oil and its long term aim to attain energy security of demand are at odds with each other."[18] And Abdalla el-Badri, the secretary general of OPEC said in 2007: "If we (OPEC) are unable to see security of demand… we may revisit investment in the long term."[19]

Most predictions see expanding demand for oil over the next decades, with OPEC's share of the market remaining fairly steady. Indeed, this is the official position of OPEC, as Table 5 shows. This relatively steady state envisioned by most observers implies a stable role for OPEC in the oil market going forward. As John Deutch, James Schlesinger, and David Victor note, "The potential market power of OPEC will not decline in future years, partly because the market share of oil production by OPEC is not expected to decline."[20]

Contrary to the narrative developed in this section, there is the prospect of a market disruption that might substantially weaken the role of OPEC and curb its market power. If shale gas develops as fully as some believe, and if LNG becomes as robust a transport mechanism as many hope, these developments could curb the demand for OPEC's oil significantly. This possibility is covered in a later section, as is the recent effort of some natural gas suppliers to develop a natural gas cartel.

The Rise of National Oil Companies and Bilateral Contracts

From the end of World War II and into the late 1970s, the seven largest international oil companies – the so-called "Seven Sisters" – collectively controlled 85 percent of known world oil reserves.[21] In

[18] Amy Myers Jaffe, "OPEC: An Anatomy of A Cartel," in Gail Luft and Anne Korin (eds.), *Energy Security Challenges for the 21st Century: A Reference Handbook*, Santa Barbara, CA: ABC-Clio, 2009, pp. 78-90. See p. 86.

[19] Quoted in Amy Myers Jaffe and Ronald Soligo, "Militarization of Energy: Geopolitical Threats to the Global Energy System," Baker Institute for Public Policy, May 2008, p. 8.

[20] John Deutch, James R. Schlesinger, and David G. Victor, "National Security Consequences of U.S. Oil Dependency," Council on Foreign Relations, Independent Task Force Report No. 58, 2006, p. 16.

[21] *Time*, "The Seven Sisters Still Rule," September 11, 1978. Available at: http://www.time.com/time/magazine/article/0,9171,946053,00.html. Accessed

more recent years, the "Seven Sisters" have given way to the "Big Five" international oil companies (IOCs) of Table 6. Over this same period, many of the largest petroleum producing nations have cast off their colonial encumbrances and gained control of their own oil resources.[22] Today, nationally owned oil companies (NOCs) control over 90 percent of world oil reserves. Excluding production of the OPEC nations, the countries formerly constituting the Soviet Union account for 25 percent of the balance, and the Big Five produce 20 percent, with the next 20 largest U.S. firms accounting for only four percent of non-OPEC production. Chinese firms contribute 8 percent and Mexico's Pemex 7 percent.[23] The pursuit of wealth, rather than geopolitical advantage, primarily motivates OPEC's NOCs. However, to many, the ascendance of Russian and Chinese NOCs carries ominous geopolitical overtones. Some fear that these powerful and populous nations may use their state-owned enterprises as instruments of foreign policy.

For its part, Russia appears to be concerned mostly with maintaining (or regaining) influence over its "near abroad," those nations that were formerly part of the Soviet Union. It seeks this control or influence largely by managing its pipeline connections with these countries, drawing oil and gas into Russia before shipping it on via pipeline to western Europe. By occupying the key nodal points in this vast pipeline network, Russia has been able to exercise considerable influence over these now-independent nations. A later section addresses the geopolitical aspects of pipelines explicitly.

Chinese NOCs have recently garnered a great deal of attention,

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April 20, 2011. The "Seven Sisters" were: Standard Oil of New Jersey, Standard Oil Company of New York, Standard Oil of California, Gulf Oil, Texaco, Royal Dutch Shell, and Anglo-Persian Oil Company. A succession of name changes and mergers has led largely to the "Big Five" of Table 6.

[22] For an account of the transition from oil dominance by IOCs to control by NOCs, see Daniel Yergin, *The Prize: The Epic Quest for Oil, Money and Power,* New York: Free Press, 1991, especially Chapter 28, "The Hinge Years: Countries Versus Companies."

[23] Amy Myers Jaffe and Ronald Soligo, "The International Oil Companies," Baker Institute for Public Policy, November 2007. See p. 12.

much of it unwelcome. The three Chinese NOCs: China National Petroleum Corporation (CNPC); China Petroleum and Chemical Corporation (Sinopec); and China National Offshore Oil Corporation (CNOOC), all emerged from Chinese government ministries. CNPC is China's largest oil producer; Sinopec is the largest refiner; and CNOOC owns the most service stations. These NOCs also hold controlling shares in Chinese petroleum companies listed on stock exchanges.[24] The national government and Communist part of China exert control over these NOCs through the power "…to appoint, dismiss, and promote the companies' general managers."[25] The Chinese government has directed all three companies to become fully vertically-integrated oil companies. In 1998, to facilitate this expansion, the Chinese government directed CNPC to grant oilfields to Sinopec in exchange for Sinopec's refineries.[26]

In 2005, CNOOC brought these Chinese NOCs to wider public attention when it attempted to acquire the U.S. firm UNOCAL for $18.5 billion, with a portion of the financing being derived from the Chinese government.[27] This merger attempt stimulated widespread fear in the United States that Chinese would be gaining control of U.S. energy assets and transferring the product of those assets to China. In the face of strong public and Congressional opposition, CNOOC abandoned its overtures. Part of this outrage may have been due to the $7 billion in financing that the Chinese government

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[24] CNPC holds 86.3% of PetroChina; Sinopec owns 75.8% of Sinopec Corp; and CNOOC controls 66.4% of CNOOC Ltd. See Erica S. Downs, "Who's Afraid of China's Oil Companies?" in Carlos Pascual and Jonathan Elkind (eds.), *Energy Security: Economics, Politics, Strategies, and Implications*, Washington, DC: Brookings Institution Press, 2010, pp. 73-102.

[25] Erica S. Downs, "Who's Afraid of China's Oil Companies?" in Carlos Pascual and Jonathan Elkind (eds.), *Energy Security: Economics, Politics, Strategies, and Implications*, Washington, DC: Brookings Institution Press, 2010, pp. 73-102. See p. 75.

[26] Steven W. Lewis, "Chinese NOCs and World Energy Markets: CNPC, Sinopec, and CNOOC," Baker Institute, March 2007. See pp. 3-4.

[27] Erica S. Downs, "The Fact and Fiction of Sino-African Energy Relations," China Security, Summer 2007, 3:3, 42-68. See p. 55.

provided to CNOOC to facilitate the merger, whereas U.S.-based Chevron, which also sought to capture UNOCAL, had no supporting government financing. Concern over Chinese NOCs perhaps reflects the general anxiety of the West regarding the rapid economic and political development of China.

Faced with the imperative to develop into fully vertically-integrated oil companies, China's three NOCs all need to acquire upstream resources. However, China's oil in place is extremely limited. As a result, China's NOCs have been extremely active in securing resources not only in China but in a variety of other countries. For example, CNPC has acquired oil and gas assets in at least 23 countries, including Sudan, Algeria, Ecuador, Nigeria, Chad and Kazakhstan. For its part, Sinopec acquired a stake in Iran's Yadavaran oil field. CNOOC purchased a significant stake in the Akpo field in the Niger Delta. All in all, the Middle East yields about 50 percent of China's imports, and Africa contributes 25 percent.[28] Taking China's three NOCs together, they operate in at least 31 countries, with equity oil holdings concentrated in Kazakhstan, Sudan, Venezuela, and Angola. Also, these NOCs are participating in transnational pipeline projects to bring oil and gas from North, Central, and Southeast Asia to China.[29]

For IOCs and NOCs, the holy grail of oil investment has been the direct or equity ownership of upstream oil assets. Before the oil producing nations gained greater sway over their own resources and developed their NOCs, IOCs enjoyed considerable equity stakes around the world. Now, most nations restrict equity participation to their own NOCs. However, a number of African countries make exceptions to this general rule, and the chance for equity participation is one of the factors that have made Africa particularly attractive to Chinese NOCs. Most of the equity oil holdings of CNPC, Sinopec and

[28] Steven W. Lewis, "Chinese NOCs and World Energy Markets: CNPC, Sinopec, and CNOOC," Baker Institute, March 2007. See pp. 22-23.

[29] Julie Jiang and Jonathan Sinton, "Overseas Investments by Chinese National Oil Companies: Assessing the Drivers and Impacts," International Energy Agency, February 2011. See pp. 9-10.

CNOOC in Africa are concentrated in Sudan, but these firms are currently diversifying into Angola and Nigeria.[30]

To sustain their thrust into Africa, China's NOCs have broadened their relationship with host countries to extend far beyond narrow oil interests by investing in oil infrastructure and non-energy development projects. For instance, in the Sudan, China invested more than $8 billion in Sudan's oil industry. Included in this investment was the construction of a 900-mile pipeline from Sudan's oil field to the Red Sea.[31] Beyond Sudan, China has participated in infrastructure projects in Angola, Nigeria, Congo, and Gabon, in tandem with advancing its oil interests.[32]

The thrust of China's NOCs into Africa has raised both fears and criticisms. First, there is the concern that the NOCs' acquisition of equity oil in Africa will sew up supplies and make the oil of these nations unavailable to the wider market. Thus, some fear that these bilateral arrangements between China on the one hand and various African nations on the other will both subvert the world market and divert Africa's oil directly to China. A second major concern is China's apparently happy acquiescence in bonding with some regimes that the west regards as the most oppressive and illegitimate, giving rise to the view that China's friendship with these regimes undermines efforts to make them comply with western ideals. As Henry Lee and Dan Shalmon say trenchantly:

> From the political perspective, Western nongovernmental organizations have accused China of using its investments to support some of the more abusive, corrupt, and violent governments in the world. The poster child for this argument has been China's support for the Sudanese government and its unwillingness to condemn publicly the genocidal practices of the janjaweed militias operating in

[30] Erica S. Downs, "The Fact and Fiction of Sino-African Energy Relations," *China Security,* Summer 2007, 3:3, 42-68. See p. 44.

[31] Steven W. Lewis, "Chinese NOCs and World Energy Markets: CNPC, Sinopec, and CNOOC," Baker Institute, March 2007. See p. 20.

[32] Serge Michael and Michel Beuret, *China Safari: On the Trail of Beijing's Expansion in Africa*, New York: Nation Books, 2009.

> Darfur. China's repeated contention that it does not get involved in domestic politics and that its relationships with African governments is strictly commercial is perceived by many as hollow. Critics argue that without China's investments and tacit support, African governments, such as the Sudan's, would be forced to amend their behavior.[33]

Sudan provides China with the second most oil of any foreign country, and CNPC holds a 40 percent stake in the Greater Nile Petroleum Operating Company there.[34]

Aside from undermining international efforts to bring human rights pressure on governments such as Sudan's, China seems to be aiming at creating multidimensional relationships with oil-supplying nations. The general strategy seems to be that China seeks equity interests in oil where possible and establishes bilateral contracts to gain secure supplies of oil that it regards as more secure than merely acquiring oil in the open market. In addition, by helping oil-supplying nations entrench their governments and improve their infrastructure, China seeks to solidify its influence over these nations in the service of its broader geopolitical interests. While most observers deny that China's NOCs are directly controlled by the Chinese government, there can be no doubt that their business strategies are more coordinated with overall Chinese foreign policy than is the case for the IOCs and their respective host nations.[35]

The fear that China's efforts to secure equity oil and to establish

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[33] Henry Lee and Dan Shalmon, "Searching for Oil: China's Oil Strategy in Africa," in Robert I. Rotberg, *China Into Africa: Trade, Aid, and Influence*, Washington, D.C.: Brookings Institution Press, 2008, 109-136. See p. 109.

[34] Jeffrey A. Bader, "Rising China and Rising Oil Demand: Real and Imagined Problems for the International System," in Kurt M. Campbell and Jonathon Price, *The Global Politics of Energy*, Washington, DC: The Aspen Institute, 2008, pp. 97-113. See p. 107.

[35] For the range of economic contacts and between Chinese and their African hosts, along with the tensions these developments have engendered, see: *The Economist*, "The Chinese in Africa: Trying to Pull Together," and "Africa and China: Rumble in the Jungle," April 20, 2011.

bilateral supply contracts is at the expense of the world oil market is presently unfounded. China has come to the African continent in search of oil long after IOCs secured the best tracts, and the proportion of African oil that is under contract with China is actually quite small. Further, some of the oil that China acquires in Africa under these equity and bilateral arrangements winds up in the world market through Chinese sales.[36] Further, oil that China helps to develop in Africa under equity or bilateral agreements actually expands the world's supply of oil, thereby strengthening the present oil market structure. If the world oil market really operates within a context in which "all sources fund all uses," then China's development of African oil actually increases world supply.

Contrary to the optimistic outlook just considered, it is possible to imagine a situation in which burgeoning Chinese control of oil could actually diminish the supply to the world market. Consider a situation in which a market disruption significantly reduces the world supply. This situation could arise from OPEC holding oil off the market, or from disruptions to major energy infrastructure, such as the pipeline network, or through a disruption of oil market commerce over various sea lanes. Such a development would almost instantly diminish the total world supply of oil. In such a context, China's effective control over the output of particular nations could alleviate its own supply concerns while exacerbating those of other nations. In sum, as long as the size of the world market is robust relative to demand, China's foray into Africa holds little threat, but that could change if world supplies become smaller relative to demand, and such a supply-demand imbalance could occur through natural growth in demand relative to supply or from reduction of the size of the world market through some untoward events such as embargoes, terrorist attacks, or interruptions of the physical distribution system.

Pipelines

The world's network of transnational oil and gas pipelines is

[36] Julie Jiang and Jonathan Sinton, "Overseas Investments by Chinese National Oil Companies: Assessing the Drivers and Impacts," International Energy Agency, February 2011. See p. 17.

already vast, yet it is expanding rapidly. The construction and routing of pipelines is fraught with geopolitical implications. Once established, a pipeline is too expensive to reroute or duplicate, so any transnational pipeline route establishes clear and enduring geopolitical costs and benefits.[37]

The pipeline network established over the decades of the Soviet Union provides the clearest example of the geopolitical dimensions of pipeline routings. The Russian system is currently the world's largest and is operated by the Russian NOC, Gazprom.[38] The Caucasus and Caspian regions consist of newly-independent countries that were former Soviet republics: Turkmenistan, Kazakhstan, Azerbaijan, Georgia, Armenia, Tajikistan, Kyrgyzstan, and Uzbekistan. The Soviet-era pipeline system links all of these new nations as providers and consumers of energy. The Soviet-era pipeline network was designed to run from these central Asian regions into Russia. From there, the pipeline network connected with Russia's own huge supply sources and then fanned westward toward other eastern European Soviet republics and on to nations of western Europe. Eighty percent of Russian natural gas transits Ukraine. In this pipeline web, Russia continues to occupy the key central nodes.

This arrangement redounds to Russian advantage. Because most of these central Asian nations are landlocked and have no other means of distribution, all or most of their international sales must transit Russia via the pipeline network, leaving these nations somewhat under the control of a single customer. Similarly, European nations to the west of Russia, whether former Soviet republics (Ukraine, Moldavia, Byelorussia, Latvia, Estonia, and Lithuania), or countries that were always outside the Soviet bloc (e.g., Germany, France, and Italy), rely on the Russian-controlled pipeline for a

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[37] Gal Luft, "The Pipeline Paradox: Why Is the United States Helping Iran Sell Natural Gas?" *Foreign Policy*, April 12, 2011, discusses the unintended consequences of American foreign policy regarding Iran in this context.

[38] Michael T. Klare, *Rising Powers, Shrinking Planet*, New York: Henry Hold and Company, LLC, 2008. See p. 91.

substantial portion of their natural gas supplies.[39]

For years since the demise of the Soviet Union, Russia has maintained geopolitical sway over its former republics to the west by providing gas at below-market prices. However, in a price dispute, Russia cut off Ukraine's supply of natural gas on January 1, 2006. This could have been extremely serious to Ukraine, as Michael Klare notes: "Ukraine would have been plunged into an immediate (and possibly lethal) energy crisis except for one thing – Gazprom's main gas pipeline to Western Europe ran through its territory, and the Ukrainians promptly responded to the Russian cutoff by siphoning off gas meant for Europe to satisfy their own requirements."[40]

Both supplying and consuming nations on the Gazprom pipeline network would like to escape the Russian embrace. The United States, of course, also supports initiatives to reduce Russian energy influence. Accordingly, there is widespread interest in the development of new pipelines that evade Russian control. For example, the recently-constructed Baku-Tbilisi-Ceyhan (BTC) pipeline runs from Baku, Azerbaijan, to Tbilisi, Georgia, and on to Ceyhan, Turkey on the Mediterranean, thereby providing Azerbaijan

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[39] For various perspectives on the pipelines of the Soviet-era, see: Mehdi Parvizi Amineh and Henk Houweling, "Global Energy Security and Its Geopolitical Impediments – The Case of the Caspian Region," *Perspectives on Global Development and Technology*, 2007, 6, 365-388; Gawdat Bahgat, "The Geopolitics of Energy in Central Asia and the Caucasus," *The Journal of Social, Political, and Economic Studies*, Summer 2009, 34:2, 139-153; Baker Institute Policy Report, "Russia and the Caspian States in the Global Energy Balance," May 2009; Daniel Freifeld, "The Great Pipeline Opera," *Foreign Policy*, September/October 2009, 120-127; Pinar Ipek, "Azerbaijan's Foreign Policy and Challenges for Energy Security," *Middle East Journal*, Spring 2009, 63:2, 227-239; Jeff Smith and Ilan Berman, "Central Asia's Energy Bazaar," *Real Clear World*, January 27, 2011;

http://www.realclearworld.com/articles/2011/01/27/central_asias_energy_bazaar_99372.html; and Marat Terterov, John Van Pool, and Sergiy Nagornyy, "Russian Geopolitical Power in the Black and Caspian Seas Region: Implications for Turkey and the World," *Insight Turkey*, 2010, 12:3, 191-203.

[40] Michael T. Klare, *Rising Powers, Shrinking Planet*, New York: Henry Holt and Company, LLC, 2008. See p. 109.

with an outlet to the west. Planners dubbed another contemplated pipeline "Nabucco" after some pipeline planners happened to see a Viennese performance of the Verdi opera in 2002.[41] Nabucco is planned to originate in Baku on the Caspian Sea and run to Tbilisi on the route of the BTC pipeline and then to continue across Turkey, transit from Asia to Europe across the Bosporus, and terminate in Vienna after crossing Bulgaria, Rumania, and Hungary. This pipeline remains merely contemplated, in part because it is not free of its own geopolitical limitations, as it crosses some countries that may not be reliably stable.

The energy producing nations of central Asia also seek Russia-free outlets to the east, and these have their own geopolitical complications. For instance, there is a planned pipeline to run from Turkmenistan through Afghanistan, across Pakistan, and into India, the TAPI pipeline. While such a route would help Turkmenistan escape Russian energy control, it is difficult to imagine a more geopolitically hostile and unstable set of countries to traverse.[42]

Geopolitical contention also arises from competitors for a given supply. Russia would like to develop alternative markets to its European outlets. To that end, Russia is developing a pipeline to link Siberian oil to East Asian outlets, notably China and Japan. This Eastern Siberia-Pacific Ocean (ESPO) pipeline originates in Taishet, in Russia's far eastern regions, and should eventually reach the Pacific coast at Perevoznaya Bay. *En route* to the Pacific, the pipeline passes within thirty miles of the Chinese-Russian border. From there a spur already runs to Daqing, China, and deliveries to China along this spur started in early 2011. Japan would be a primary customer for oil that

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[41] Daniel Freifeld, "The Great Pipeline Opera," *Foreign Policy*, September/October 2009, 120-127. See p. 123.

[42] John Foster, "Afghanistan, the TAPI Pipeline, and Energy Geopolitics," March, 23, 2010. Available at: tp://www.ensec.org/. The four participating nations recently reached agreement to build the pipeline. See *Pipelines International*, "Agreement Paves Way for TAPI Pipeline,"

http://pipelinesinternational.com/news/agreement_paves_way_for_tapi_pipeline/053838/

Accessed April 23, 2011.

reaches the Pacific, and some oil will flow to the Pacific via rail pending completion of the last portion of the pipeline. Russia plans a similar route for a natural gas pipeline. Thus, China and Japan are placed in possible contention for supply of eastward-bound energy, in addition to competing with Europe as well.[43]

Building a pipeline establishes a permanent route with a dual geopolitical potential. The pipeline may contribute to geopolitical stability by increasing the supply of globally available energy, or it may exclude portions of the world's supply from general accessibility. Further, the establishment of new transnational pipelines and the routes they follow will almost always be a geopolitical issue. In a certain sense, pipelines with an origination and termination point resemble a bilateral contract between an energy surplus and an energy deficit state. They have the potential to both expand market supply, but also the capacity to shunt a portion of the world's energy supply to a particular nation and away from the general price-driven market as the result of a relationship that is both economic and geopolitical.

Sea Lanes

In contrast to uni-dimensional pipelines or bilateral contracts, the open sea offers a fully two-dimensional sphere of maneuver in which ships can chart a course to connect any two points. In this respect, the United States benefits from the sourcing of its oil imports. Almost 58 percent of U.S. oil imports are drawn from North and South America, with Canada and Mexico together accounting for more than one-third of all U.S. imported oil. The next largest regional source is the west coast of Africa, from Nigeria, Algeria, and Angola, with transport lanes across the expanses of the Atlantic Ocean. The U.S. draws only 20 percent of its oil imports from the Persian Gulf region (Saudi

[43] Regarding the ESPO pipeline particularly, see: Steven W. Lewis, "Chinese NOCs and World Energy Markets: CNPC, Sinopec, and CNOOC," Baker Institute, March 2007; Robert Morley, "How Russia Is About to Dramatically Change the World," Trumpet.com, January 5, 2010; and Richard Weitz, "Chinese Pipe Dreams," *The Diplomat*, January 3, 2011.

Arabia, Iraq, and Kuwait.)[44] This distribution of supplies makes it relatively easy for the U.S. navy to defend its vital oil import sea lanes. In peace, this distribution is less important, as normal energy markets constitute an environment in which "all sources support all uses." The real problem with any distribution of energy imports arises when normal world markets are threatened in some way, or when transport avenues are disturbed or closed.

In contrast with the wide-open Atlantic from the west coast of Africa to the east coast of the United States, much of the sea is not open. Instead, the distribution of the land interacts with the sea to create a number of critical chokepoints, which are distributed in a manner that seemingly purposefully complicates the geopolitical dimension of energy markets. Three of the most critical chokepoints lie near the mother lode of the world's oil supply in the Middle East. They are the Straits of Hormuz (controlling the opening of the Persian Gulf into the Indian Ocean), the Straits of Bab-el-Mandab (lying at the junction of the Red Sea and its juncture with the Gulf of Aden and on to the Indian Ocean), and the Suez Canal (connecting the Mediterranean and the Red Sea). The Straits of Hormuz witnesses the passage of almost 20 million barrels of oil per day, which is about two-thirds of all ship-borne oil and about 20 percent of the world's total daily consumption.[45] Further, most of the world's surge capacity of oil must transit the Straits of Hormuz as well.

The Straits of Bab-el-Mandab are somewhat less strategically important, even though about four million barrels a day of crude oil transit this passage, which runs along the shores of Yemen, one of the world's least stable countries. Further, interdiction of shipments in the Bab-el-Mandab would also choke off the Suez canal from the south.

[44] U.S. Energy Information Administration, "Crude Oil and Total Petroleum Imports Top 15 Countries," March 30, 2011.

http://www.eia.doe.gov/pub/oil_gas/petroleum/data_publications/company_level_imports/current/import.html

[45] Baker Institute Policy Report, "The G8, Energy Security, and Global Climate Issues," Baker Institute Policy Report, Number 37, July 2008. See p. 9. See also Daniel Brumberg, Jareer Elass, Amy Myers Jaffe, and Kenneth B. Medlock, III, "Iran, Energy, and Geopolitics," Baker Institute for Public Policy, May 2008.

The Suez Canal carries about two million barrels per day, even though it is too small to accommodate Very Large Crude Carriers (VLCCs). The associated Suez-Mediterranean (SUMED) pipeline runs from the western shore of the Red Sea across Egypt to the Mediterranean west of Alexandria and has a capacity of 2.3 million barrels per day. Blockage of the Red Sea passageway would require ships from the Persian Gulf to sail an additional 6,000 miles around the Cape of Good Hope to reach Europe and the Mediterranean, disrupting supplies and increasing costs. These chokepoints almost literally lie under the guns of regimes that are clearly hostile to western interests, even though the economic lifeblood of those hostile powers depends largely on sales to western nations.

The Straits of Malacca, lying just along the western shore of Malaysia, down to Singapore and running north of Indonesia, is the most critical constricted passageway in the Indian Ocean. At one point the Phillips Channel is only 1.7 miles wide, yet more than 60,000 ships transit these straits annually.[46] Japan and China are the large energy consumers that are most vulnerable to problems in the Straits of Malacca. Interdiction of the Straits would require a journey around the southern coast of Indonesia before heading north toward the South China Sea through the Lombok or Sunda Straits. Somewhat less critical are additional sea lane chokepoints in the Bosporus, the Panama Canal, and the Danish Straits.

Interruption of tanker traffic through any of these passages could cause severe disruption of the world's oil markets, with sudden shifts in the quantity and distribution of supply. Perhaps not surprisingly, then, the Persian Gulf has long been regarded as an "American Lake," with the U.S. Sixth Fleet being based athwart the Persian Gulf in Bahrain. Nonetheless, some of these chokepoints are subject to

[46] Energy Information Administration, "World Oil Transit Chokepoints," February 2011. See p. 3. This document provides an excellent general discussion of these chokepoints. See also: Michael T. Klare, *Rising Powers, Shrinking Planet*, New York: Henry Holt and Company, LLC, 2008, and Daniel Brumberg, Jareer Elass, Amy Myers Jaffe, and Kenneth B. Medlock, III, "Iran, Energy, and Geopolitics," Baker Institute for Public Policy, May 2008.

closure through the threat of asymmetric warfare, such as swarming speedboats or missile attacks, perhaps being launched from Iran.[47] While the effect of such disruptions on world energy markets would certainly be large, it is difficult to estimate their magnitude without some indication as to the thoroughness or persistence of the interruption in traffic.

For China, the most vital energy sea lanes follow an arc from eastern Africa along the northern coast of the Indian Ocean, past Iran, Pakistan, and India, and on through the Straits of Malacca, and into the South China Sea. Much of this route is within a short distance from land, making it fairly easy for land-based powers along the route to project power southward across these sea lanes that are so vital to Chinese energy supply.

Perhaps more than anyone else, Robert D. Kaplan has emphasized the increasing geopolitical consequence of the Indian Ocean, most notably in his book, *Monsoon,* as well as in his other publications.[48] While the Indian Ocean is important for much of the world's trade, it is critically important for energy. Further, the importance of the Indian Ocean for energy shipments has been heightened by the emergence of China as a key participant in world trade. Much of China's oil comes from the Persian Gulf and the east coast of Africa, from where it must make the long journey past the southern shores of many nations that range from the unruly to hostile. From this point of view, China's sourcing leaves it in a particularly vulnerable position, because its key oil imports come from East Africa and the Persian Gulf region. Further, this critical route of China's energy supply is subject to the naval might of the United States.

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[47] Daniel Brumberg, Jareer Elass, Amy Myers Jaffe, and Kenneth B. Medlock, III, "Iran, Energy, and Geopolitics," Baker Institute for Public Policy, May 2008. See p. 14.

[48] Robert D. Kaplan, *Monsoon: The Indian Ocean and the Future of American Power*, New York: Random House, 2010. See also three other works by Robert D. Kaplan: "Center Stage for the 21st Century: Power Plays in the Indian Ocean," *Foreign Affairs*, March/April 2009; "The Geography of Chinese Power," *Foreign Affairs*, May/June 2010, 22-41; and "Lost at Sea," *The New York Times*, September 21, 2007.

As Kaplan emphasizes, China is working assiduously to strengthen its ability to secure its path of energy supplies through the Indian Ocean and also to thwart U.S. naval dominance in this region. As military dominance depends on capacity and need not require the exercise of might, the United States has enjoyed unparalleled command of the sea since the end of World War II, due to the size and sophistication of its naval resources, most particularly a large "blue-water" navy led by a suite of nuclear aircraft carriers. According to some, China is pursuing a "sea denial" strategy to counterbalance U.S. naval dominance in traditional resources. For example, rather than trying to match the United States in developing a fleet of nuclear-powered aircraft carriers, China appears to be developing antiship missiles capable of sinking ships, or at least keeping them far out to sea far away from China's vital sea lanes.[49]

Partially in response to their naval vulnerability, many see the Chinese as developing a "string of pearls" strategy of securing access to bases and harbors where Chinese ships can resupply and refit. For example, China is working with Pakistan to build a port facility in Gwadar, Pakistan, and it is helping establish a fueling station in Sri Lanka. Other potential "pearls" include Hainan Island, Woody Island in the Paracel archipelago, a container port in Chittagong, Bangladesh, and a deep water port in Sittwe, Myanmar. While the idea of this string of pearls has garnered considerable attention, there is a persistent debate about whether China itself has conceived these moves as developing a necklace of pearls to wreath the south Asian littoral. Nonetheless, the establishment of numerous naval "places and bases" of resupply along the route from the oil-rich regions of Africa and the Middle East would give China the means to project power over that route in order to protect its own peaceful acquisition of supplies or to dominate the route upon which other nations, most

[49] See: Andrew S. Erickson and David D. Yang, "Using the Land to Control the Sea? Chinese Analysis Consider the Antiship Ballistic Missile," *Naval War College Review*, Autumn 2009, 62:4, 53-86; Michael T. Klare, "The New Geopolitics of Energy," *The Nation*, May 1, 2008; and Robert D. Kaplan, "Lost at Sea," *New York Times*, September 21, 2007.

notably Japan, must rely.[50]

Beyond establishing a network of facilities for ships, China appears to be concentrating on developing other means to secure its access to oil resources in the region. For example, China in cooperation with other nations is exploring the establishment of pipelines to link the Bay of Bengal with Yunnan, a canal across the Isthmus of Kra in Thailand, as well as rail links to bring oil overland from the coast of the Indian Ocean directly into China, thus avoiding some sea lane chokepoints.

While U.S. naval might has long been instrumental in keeping the sea lanes open for energy shipments and other forms of commerce, a strong Chinese naval power would have the potential to either secure or obstruct these sea lanes. Both alternatives have dramatic implications for energy markets over the next several decades. The United States has long demonstrated its resolve to maintain open seas, and China may well be expected to have similar interests, at least in normal circumstances. Thus, the presence of two guarantors of

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[50] This metaphor of a string of pearls apparently derives from a Pentagon report developed in 2004 and leaked to the press in early 2005. For an extended geopolitical treatment, see Robert D. Kaplan, *Monsoon: The Indian Ocean and Future of American Power*, New York: Random House, 2010. Christopher J Pehrson, "String of Pearls: Meeting the Challenge of China's Rising Power Across the Asian Littoral," Strategic Studies Institute, July 2006, provides a more technical military assessment. Of those concerned with this issue, some take the string of pearls strategy as a clear part of conscious Chinese policy. Others are less sure. Intellibrief, "China: 'String of Pearls' Strategy," April 1, 2007 sums up the situation quite nicely: "The development of the "String of Pearls" may not, in fact, be a strategy explicitly guided by China's central government. Rather, it may be a convenient label applied by some in the United States to describe an element of China's foreign policy." See also, Andrew S. Erickson and David D. Yang, "Using the Land to Control the Sea? Chinese Analysis Consider the Antiship Ballistic Missile," *Naval War College Review*, Autumn 2009, 62:4, 53-86; Michael T. Klare, "The New Geopolitics of Energy," *The Nation*, May 1, 2008; Robert D. Kaplan, "Lost at Sea," *New York Times*, September 21, 2007; Robert D. Kaplan, "Center Stage for the 21st Century: Power Plays in the Indian Ocean," March/April 2009, *Foreign Affairs*; and Daniel J. Kostecka, "Places and Bases: The Chinese Navy's Emerging Support Network in the Indian Ocean," *Naval War College Review*, Winter 2011, 64:1, 59-78.

open seas may help to stabilize energy markets. However, with a still strong United States and a strengthening China, any confrontation between the two powers could imply a very significant disruption to the transport of energy across the seas. In some year not too distant, one can easily imagine a situation in which the United States and China are both strong and have conflicting interests in sustaining or in impeding energy shipments to other nations. In such an event, both nations may have the power to interdict normal shipments of oil from the Middle East, and any such disruption would generate cataclysmic price increases and price volatility in energy markets.

The New World of Natural Gas

Recent technological innovations for transporting and developing natural gas threaten a technological disruption that may radically alter the world's energy landscape in the next two decades. A previous section of this chapter briefly alluded to the emergence of economically feasible LNG systems, which by itself has large implications for energy geopolitics. However, as soon as the importance of LNG started to become clear, shale gas began to become a force. In fact, shale gas has the potential to swamp the already large importance of LNG. This section focuses on the interplay of LNG and shale gas and the vast potential that shale gas holds for changing world energy markets.

Without liquefaction, natural gas was essentially transportable only via pipeline. When liquified, natural gas can move by train or ship. Thus, the advent of LNG gives natural gas a transport and market potential much more like crude oil. Even without shale gas, LNG transportability has been anticipated to drive an expansion of natural gas in the world's energy mix. In the EU, for example, predictions suggested in 2005 that natural gas consumption would grow by 67 percent in thirty years, even in the face of declining EU production. That increase was to be fed in large part by LNG imports.[51] Similarly, Exxon's "Energy Outlook to 2030" showed an

[51] Loyola de Palacio, "Reforming the Gas Market," in Jan H. Kalicki and David L. Goldwyn, *Energy and Security: Toward a New Foreign Policy Strategy*, Baltimore: The Johns Hopkins University Press, 2005, pp. 175-194. See p. 176.

increase in natural gas consumption of 60 percent from 2005 to 2030 as shown in Table 1, and BP's estimates show that natural gas should provide as much of the world's energy as oil by the same time, as Table 2 shows.

Because LNG technology transforms natural gas into an energy commodity similar to crude oil, one can expect natural gas to come to have the same strengths and weaknesses as the market for crude oil. As recently as 2005, LNG accounted for only one-third of worldwide gas shipments, with two-thirds moving by pipeline.[52] But the further maturation of LNG infrastructure promises to change those proportions. For example, South Korea, Taiwan, and Japan have virtually no natural gas resources and together accounted for two-thirds of global LNG demand in 2003. As LNG matures, such nations can meet an increasing portion of their energy needs by natural gas imported as LNG. Further, as LNG technology continues to improve, such nations can diversify their supplies of LNG more fully than at present.

However, just as the worldwide market for crude oil, with major supplies concentrated in just a few countries, eventually gave rise to OPEC, there is the fear that worldwide use of LNG could lead to a cartel in natural gas (ignoring for a moment the promise of shale gas, which is explored below.) Fifteen natural gas exporting nations have already banded together to form the Gas Exporting Countries Forum (GECF), which many regard as an incipient cartel. Iran and Russia are clear leaders in this movement.[53]

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[52] Donald A. Juckett, and Michelle Michot Foss, "Can a 'Global' Natural Gas Market Be Achieved?" in Jan H. Kalicki and David L. Goldwyn, *Energy and Security: Toward a New Foreign Policy Strategy*, Baltimore: The Johns Hopkins University Press, 2005, pp. 531-552. See p. 534.

[53] For discussion of the possibilities of a cartel in natural gas, see: Gawdat Bahgat, "The Geopolitics of Energy in Central Asia and the Caucasus," *The Journal of Social, Political, and Economic Studies*, Summer 2009, 34:2, 139-153; Baker Institute Policy Report, "Russia and the Caspian States in the Global Energy Balance," May 2009; Cindy Hurst, "Liquefied Natural Gas: The Next Prize?," in Gail Luft and Anne Korin (eds.), *Energy Security Challenges for the 21st Century: A Reference Handbook*, Santa Barbara, CA: ABC-Clio, 2009, pp. 271-281; Amy Myers Jaffe, "Shale Gas Will Rock

In contrast to crude oil, however, natural gas is much more widely distributed across the world, and much of the world's resources of natural gas occur in the form of shale gas. Previously not exploitable because of inadequate technology and high costs, shale gas promises to vastly increase the world's resources of usable natural gas, with a geographical distribution that will help to frustrate the formation of any cartel. For example, North America may have as much as one quadrillion cubic feet of shale gas, while Europe may have almost 200 trillion cubic feet.[54] (One barrel of oil is equivalent to about 6,000 cubic feet of natural gas.) The Energy Information Association puts the importance of shale gas into perspective: "Thus, adding the identified shale gas resources to other gas resources increases total world technically recoverable gas resources by over 40 percent to 22,600 trillion cubic feet."[55]

The geographical distribution of these shale basins that hold so much natural gas is extremely important for the future of the world's energy market. Major shale gas formations lie in North America, southern South America, South Africa, Europe, Central Asia, and throughout the Maghreb. For the United States, with its already well-developed and extensive gas pipeline network, the advent of shale gas promises to move the United States markedly closer to the elusive goal of energy independence. Over the next decades, the United States should be self-sufficient in natural gas production. This, at least temporary abundance of natural gas may retard the necessity for ever-increasing oil imports if natural gas is used to generate electricity, and electricity becomes a more important energy source of the transportation fleet.

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the World," *Wall Street Journal*, May 10, 2010; and Donald A. Juckett, and Michelle Michot Foss, "Can a 'Global' Natural Gas Market Be Achieved?" in Jan H. Kalicki and David L. Goldwyn, *Energy and Security: Toward a New Foreign Policy Strategy*, Baltimore: The Johns Hopkins University Press, 2005, pp. 531-552.

[54] Amy Myers Jaffe, "Shale Gas Will Rock the World," *Wall Street Journal*, May 10, 2010.

[55] U.S. Energy Information Administration, "World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the United States," April 2011. See p. 3.

While the shale gas resources of Europe are not as well-explored as those in the United States, it is now clear that Europe possesses substantial shale gas resources. From a geopolitical point of view, the development of European shale gas can reduce reliance on natural gas imports from Russia, with all of the geopolitical leverage that might provide. China's shale gas lies mainly in its western regions, but there are apparently large shale gas basins in the northeast which have yet to be assessed.[56] Pipelines from these regions may prove to make an important contribution to China's ever-growing energy budget. Key countries in the global economy of East Asia – Japan, Taiwan, Singapore, South Korea – have not yielded any new discoveries of shale gas, so they are left with no improvement in their own resources. However, they are quite likely to benefit indirectly. With the prospect of much more natural gas production, these nations stand to benefit from a greater diversity of LNG suppliers and, perhaps, costs that are lower than they otherwise would be.

While shale gas has great promise, it is not free of serious risks and concerns. Shale gas is produced by forcing a mixture of water and chemicals into the shale formation to create small fissures in the rock – the process of hydraulic fracturing or "fracking." These cracks allow the gas to flow up through the rock to be collected. The shale deposits are typically quite deep, lying well below aquifers. The great fear is that fracking may lead to contamination of the aquifers, thereby destroying a considerable portion of the water supply for wide geographical regions.

The potential dangers of fracking are entering the public consciousness: The documentary film *Gasland* was nominated for an Academy Award in 2011 and features water from a kitchen sink that bursts into flames. Similarly, the ProPublica.org web site has published an account of Louis Meeks's problems with his water supply in "Hydrofracked? One Man's Mystery Leads to a Backlash Against

[56] For an assessment of world resources, see U.S. Energy Information Administration, "World Shale Gas Resources: An Initial Assessment of 14 Regions Outside the United States," April 2011, and especially the map on page 1-7.

Natural Gas Drilling."[57] Beyond destruction of an aquifer, the fracking process also creates wastewater that is laced with the chemicals added to the hydraulic fracturing mix. This second potential environmental hazard is probably not as serious as the possibility of destroying an aquifer. One of the earliest and perhaps largest shale formations that has been exploited is the Barnett Shale, which lies across 5,000 square miles and at least 17 Texas counties, including the city of Fort Worth. Major aquifer damage in such a heavily populated region has truly dramatic potential.

To date, hydraulic fracturing operations have been largely unregulated. Different drillers use different proprietary mixtures of chemicals to add to the water forced into the shale, and the composition of the various chemical mixtures is not public information. It is clear that hydraulic fracturing will be subject to increased regulation. France is contemplating a ban on even the exploration for shale gas that would use hydraulic fracturing.[58] In addition to its sudden and unexpected abundance, one big advantage for natural gas is that it is cleaner than alternatives, especially coal. However, some are questioning whether natural gas produced by fracking is really so clean. Some accounts even suggest that it could generate more greenhouse gas emissions than coal.[59] Already some states are moving to strengthen their regulatory control over hydraulic fracturing and the environmental threats it may pose.[60] While shale

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[57] Abrahm Lustgarten, "Hydrofracked? One Man's Mystery Leads to a Backlash Against Natural Gas Drilling," ProPublica.org, February 25, 2011. Available at:

http://www.propublica.org/article/hydrofracked-one-mans-mystery-leads-to-a-backlash-against-natural-gas-drill. Accessed April 27, 2011. This short account is also available as a free publication on Kindle.

[58] Max Colchester and Geraldine Amiel, "France Mills Banning Shale Exploration," *Wall Street Journal*, April 19, 2011.

[59] Abrahm Lustgarten, "More Reasons to Question Whether Gas Is Cleaner than Coal," ProPublica.org, April 12, 2011. Available at:

http://www.propublica.org/article/more-reasons-to-question-whether-gas-is-cleaner-than-coal

Accessed April 27, 2011.

[60] Pennsylvania is already moving to regulate the disposal of wastewater from

gas has the potential to enlarge the world's energy supply and increase the diversity of sources, the ultimate future of shale gas remains unclear due to uncertainty over its environmental impacts.

Nuclear Power

Nuclear power has been and will continue to be generated and consumed entirely within the borders of the producing country. As such, conventional thinking has held that nuclear power presents few geopolitical issues. However, the March 2011 earthquake-tsunami-nuclear disaster in Japan has already highlighted potential international consequences of nuclear power to great public consciousness. Shortly after the disruption at the Fukushima-Daiichi nuclear power plant, elevated radiation levels were detected in California and in milk produced in nearby regions near the plant. The United States banned milk, vegetables, and fruits from affected regions of Japan in the aftermath of the disaster.[61] While the dispersion of nuclear material from the Fukushima-Daiichi plant was relatively small, it suggests the possible consequences of a much more extensive radiation emission more proximate to other nations and their population centers. For example, France relies extensively on nuclear power generation and a major radiation emission from France would certainly have large geopolitical implications.

At the very least, the Fukushima-Daiichi disaster clouds the future of nuclear power. It has already caused the cancellation of some plans for building new nuclear capacity.[62] If nuclear power is a smaller portion of the energy mix in the future, it will affect the resulting allocation of demand for other sources of energy. This shifting demand will have its own geopolitical, price, and market volatility consequences.

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hydraulic fracturing. See: Robbie Brown, "Gas Drillers Asked to Change Method of Waste Disposal," *New York Times*, April 19, 2011.

[61] ABC News, "FDA Bans Milk, Vegetable, Fruits From Nuclear Plant Crisis-Affected Areas in Japan," March 22, 2011.

[62] Rebecca Smith, "NRG Drops Plan for Texas Reactors," *Wall Street Journal*, April 20, 2011.

Climate Change and Environmental Considerations

The acquisition of energy in any form imposes some environmental burden. The overriding problem for energy and the environment is whether a growing world population with intensifying energy use can acquire sufficient energy to sustain an enriched way of life at an acceptable environmental cost. One of the greatest issues in this domain is the question of climate change. But we have seen that even such optimistic plans as the development of shale gas and the enlargement of nuclear power generation are subject to changing assessments of their environmental impact.

This chapter has barely touched on environmental considerations, perhaps the largest and most dramatic of these being a fear of anthropogenic destruction of the environment through the emission of greenhouse gases. To date, much of the world has made no serious efforts to change energy consumption to constrain greenhouse gases. Nonetheless, the future of world energy will continue to be affected by environmental concerns. But those issues lie beyond the scope of this chapter and deserve their own thorough treatment.

The Future of Energy Geopolitics and Energy Finance

From the development of a worldwide network of coaling stations to service the British fleet, to the beginning of the age of oil, and through the present day, the story of energy has been intertwined with international politics, all with dramatic effect on energy markets. The aftermath of World War II led to a bipolar world dominated by the Soviet Union and the United States, which briefly gave way to a unipolar world with the demise of the Soviet Union. Today, a multipolar world appears to be developing. This world of many significant powers and increasing energy demand will necessarily engender geopolitical tensions, and these potential conflicts will continue to have a dramatic effect on energy markets.

For energy finance, geopolitical understanding is necessary. We have seen that the effect of an oil supply disruption that affects only a single small country can be quite large. The world nexus of energy supply draws many nations into simultaneous interaction. This requires participants in energy finance to be students of energy

geopolitics, because the future of world energy is as likely to be as determined by the interaction of nations as by the fluctuations in world supply of and demand for energy.

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