

Energy and Resources: *Ample or Scarce?*

In the coming years, energy and resource issues will continue to shape international security. In the most likely case, worldwide supplies will be ample, with no shortages that could trigger a global conflict over their control. Sufficient energy, metal, and mineral supplies are expected for various reasons: rapid technological change is making available previously uneconomical reserves; more countries are welcoming foreign investment; and, the demand for a greater supply may be limited if slower world economic growth occurs. Yet, this adequacy of aggregate resources may be accompanied by crises over specific issues.

Energy and resource issues will continue to be a factor in U.S. security policy and defense planning. Most likely, the United States will not be required to employ military forces in order to secure access to resources. However, U.S. forces may be required for broader purposes, as was the case in the Persian Gulf War, 1990–91. Some specific energy and resource problems could exacerbate regional political tensions, potentially causing military conflicts in key areas, such as the Persian Gulf. In the coming years, 40 to 65 percent of the world's oil will come from the Persian Gulf, a region infected by political instability and anti-Western attitudes.

U.S. forces might be used to ensure adequate supplies for Western democracies. This would include securing lines of communication to key oil and gas fields or protecting vulnerable countries with large resource reserves from attack. U.S. forces might also be used to counter rogue governments with sufficient oil revenues to acquire weapons of mass destruction. Help from allies and partners will be important in guaranteeing energy security and deterring regional conflicts.

Energy and resources pose another challenge: they must be developed in ways that reduce pollution, especially greenhouse gases that contribute to global warming. Higher production levels increase the potential for environmental problems. While the overall future of energy and resources appears encouraging, it is mixed and uncertain.

Key Trends

Globalization is the key trend affecting energy, resources, and the environment. Global market forces are determining the supply and demand for energy, minerals, and other resources. This is beyond the ability of any government or regional bloc to control. For example, the increasing number of countries exporting oil



AP/Wide World Photos

Oil rigs on the shore of the Caspian Sea in Baku, Azerbaijan

has eroded the power of the Organization of Petroleum Exporting Countries (OPEC). Market forces, rather than command economies, are driving production decisions in the former Eastern bloc. Western governments have reduced the regulatory web that once tightly bound the energy business.

Energy, Resources, and Security Affairs

Prior to World War II, resource security was exemplified by the British Empire's system, in which control over territory was seen as essential to ensuring resource supplies. A more recent concept was that serious energy and resource shortages would pit countries against each other, with survival or starvation at stake. Neither concept is applicable in today's international environment. First, global market forces are making access to supplies more reliable. Second, supplies are generally ample to meet the demand. Yet, the

relationship between resources and security remains subtle but profound, and capable of producing disintegrative effects. Four types of worrisome interactions are of special concern to the United States:

- Key energy and resource producers lacking powerful military forces or entrenched governments may be vulnerable to aggression. Rogue regimes may be tempted to steal from resource-rich neighbors through blackmail, raids, or territorial conquest. The Gulf Cooperation Council (GCC) countries are obvious candidates.
- Energy and resource reserves may be located in unstable areas or accessible only through hostile territory. This could lead to conflicts over production facilities and transportation routes, or at least extortion of revenues. The Caspian basin is an example. Shortages could exacerbate underlying political differences and serve as a catalyst for regional conflicts. Water disputes, such as between Turkey and Syria, are a possibility.

Strait of Hormuz

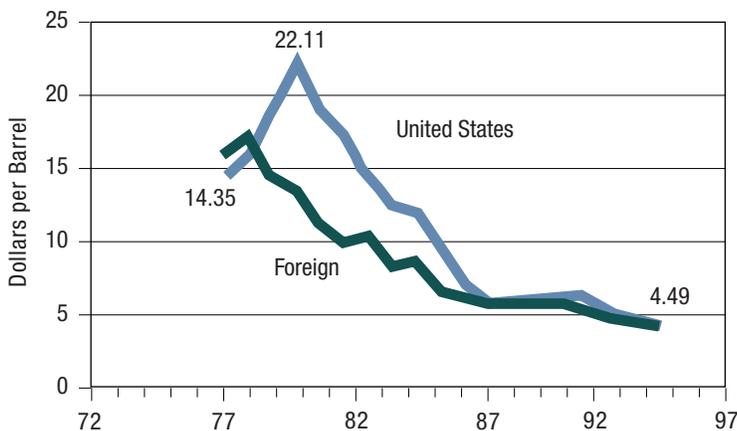
The United States seeks to sustain confidence in the free flow of oil through the Strait of Hormuz. Lying between Oman and Iran, the Strait is about 25 miles wide. Oil tankers prefer to use the deeper water channels, which are less than one-half that wide and lie near the Omani side of the Strait. As tankers proceed up the Persian Gulf after the Strait, they pass through narrower channels lying on both sides of the islands of Abu Musa and Tunbs, which are occupied by Iranians, but claimed by the United Arab Emirates. The in-bound channel is between the islands and the Iranian mainland.

The Strait of Hormuz is important because it is heavily used by commercial shipping. In 1994, 19,850 ships transited the strait, carrying 1.71 billion deadweight tons. It also provides access to ports useful for surging military personnel and materiel into the region during a crisis. If the Strait were blocked, time-phased force delivery plans could be delayed, providing an aggressor with a window of opportunity. However, a 1997 study by the Office of Naval Intelligence stated that alternative ports outside the Strait have the capacity to receive forces deploying to the GCC countries. Jeddah on the Red Sea could handle 1 million 20-foot-equivalent-units (TEU) a year, and three ports on the Gulf of Oman Sea—Khor Fakkan and Fujairah in the UAE and Mina Qaboos in Oman—could handle 2.7 million TEU containers, a total capacity of 3.7 million TEU, compared to 4.3 million TEU actually landed within the Persian Gulf in 1996.

Besides its military importance, the Strait has taken on a symbolic significance for world oil markets. One-fifth of the world's oil transits the Strait. However, in a crisis, alternative routes would allow much of the Gulf oil to reach world markets. Two large pipelines cross Saudi Arabia to the Red Sea, one of which was built for Iraq. Chemical additives could reduce friction in the pipelines and speed the flow. Gulf oil exports could quickly reach two-thirds their current level without use of the Strait. Additionally, the volume of exports could be restored to near normal levels by adding additional horsepower to pumping stations along those pipelines and by laying a short new pipeline from UAE oilfields to outside the Strait. The cost for such measures could equate to about \$1 per barrel, according to a 1997 study for the Baker Institute for Public Policy at Rice University.

The country most dependent on the Strait is Iran. It has no realistic alternatives to the Strait. It would be hard pressed to divert even one-third of its imports to routes outside the Strait. By contrast, the Gulf country least affected would be Iraq. It could readily trade through Turkey and Jordan, the main trading routes since *Desert Storm*.

Cost of Finding Oil and Gas Reserves



Source: Department of Energy, Energy Information Administration, from data reported in Form EIA-28, "Financial Reporting System."

Note: Costs are calculated as the ratio of total exploration and development expenditures to total oil and gas reserve additions (barrels of oil equivalent) for the major energy producers reporting to the Energy Information Administration. All costs are expressed in 1996 dollars, excluding the purchases and sales of reserves, and are 3-year weighted averages centering on the year shown.

- If anti-Western regimes can disrupt supplies and threaten economic pain, they might try to coerce the West into supporting their agendas. A cartel controlling Gulf oil might try to pressure the West into abandoning Israel, for example.

- Major powers dependent on imports, especially from unstable regions, might independently attempt to ensure access to resources rather than participate in a cooperative security effort. Such independence could take the form of policies that work against cooperative security efforts. A potential example would be Chinese military cooperation with Gulf rogues.

Plentiful Oil

The world oil market continues to have ample supply and, therefore, low prices. Crude oil prices fell in late 1997 and stabilized in early 1998 at little more than 1986 levels. The average price for other goods rose by about 30 percent from 1986 to 1998, meaning the real price of oil fell significantly over that period. Furthermore, the price of oil in 1986 was only about one-third its 1980 price. Adjusting for inflation using 1997 dollars, the price of a barrel of crude oil fell from \$66 in 1980, to \$14 in 1998. Had the 1998 price been the same as 1980, U.S. consumers would have paid \$340 billion more for oil, plus more for natural gas and coal. At this price, 1980 oil imports alone would have cost \$180 billion more.

Nuclear Power

Nuclear power provided 6.3 percent of total world energy consumption in 1995. Department of Energy (DOE) forecasts that the absolute amount of nuclear power produced will decline between 1995 and 2020. By then, nuclear power's share will be only 3.3 percent of total world energy consumption. The only region where nuclear power will retain its role is in developing Asia, primarily China and India. Even there, nuclear power will constitute only 1.7 percent of total energy supply. The decline in nuclear power will be sharpest in North America, which will reduce its reliance on nuclear power from 7.7 percent of total energy in 1995 to 3.3 percent in 2020. The area most reliant on nuclear power in 1995, Western Europe, is forecast to reduce its nuclear power from 12.6 percent of total energy in 1995 to 7.0 percent in 2020. For both North America and Western Europe, DOE forecasts a decline in the absolute amount of energy from nuclear power between 1995 and 2020, because of the high cost of addressing environmental concerns about radiation. The environmental paradox is that nuclear power has the least global-warming impact of any energy source.

The primary reason for lower oil prices is lower oil production costs. The cost of finding oil and gas reserves in the United States dropped from \$22.11 per barrel in 1982 to \$4.49 in 1996. The cost abroad dropped from \$14.35 in 1979 to \$4.49 in 1996. The information revolution has reduced modeling and sensor costs, and a higher proportion of the wells drilled are hitting oil. Additionally, 40 to 50 percent of the oil reserves in a field can be recovered, instead of 30 percent as in the past.

As costs drop, previously unattractive oil fields, e.g., deep offshore fields in the Gulf of Mexico, can be made profitable. After a long slide, U.S. oil production in 1998 was higher than in 1997. The U.S. Department of Energy forecasts that U.S. oil output will remain constant for another decade.

The outlook for increased global production is excellent. More countries are welcoming foreign investment in the oil industry, with fewer protectionist restrictions. Foreign investors committed themselves to a program that would increase Venezuelan oil output capacity from 3.5 million barrels per day (mbd) to 6 mbd within a decade, assuming there is a market for the oil. Other countries, besides OPEC members like Venezuela, are also increasing production.

Between 1990 and 2000, countries outside OPEC and the former Soviet Union (FSU) will increase oil production by 9 mbd; this is significant, because the total increase in world oil production will be 10 mbd. The OPEC 5 mbd

increase will be offset by the 4 mbd decline in the FSU. In 2000, countries outside OPEC and the FSU will produce half the world's oil. This includes more than 25 countries, some exporting oil on a substantial scale. For example, Norway is the world's third-largest oil exporter.

The Persian Gulf will remain vital to world energy supplies. This is a concern, because the Gulf has many security problems. The GCC monarchies face serious domestic problems, including anti-Western radical Islamists. Historically, rogue regimes in the region have been inclined to act aggressively toward their neighbors. Growing oil revenues may enable rogue regimes to build weapons of mass destruction and conventional capabilities.

Persian Gulf countries have increased their output sharply in the last decade and may do so in the next. Their ample reserves can sustain a considerable increase in output. Although currently producing about 9 mbd, Saudi Arabia is pursuing a program to raise its capacity from 11 mbd to 14 mbd within the next few years. The U.S. Department of Energy (DOE) estimates its capacity in 2020 as 18.2 mbd. The other GCC states—Kuwait, Bahrain, Qatar, UAE, and Oman—are increasing their capacity from 7 mbd to 10 mbd or more.

Iraq has tremendous production potential, which may be realized as UN restrictions on its oil industry are relaxed. A February 1998 Security Council resolution authorized production of 2.8 mbd at current prices. Iraqi production could rise to 6 mbd within 3 to 5 years after sanctions end. A more cautious DOE forecast is that Iraqi production capacity could reach 6.9 mbd by 2020.

Iran is welcoming foreign investment to expand its capacity. The United States has eased its threat of secondary boycotts against foreign firms investing in Iranian oil and gas, although U.S. firms are still banned from such investment. DOE estimates Iranian production capacity at 6.3 mbd in 2020.

If demand rises quickly, then the Persian Gulf share in world oil exports could rise, from the historic low of 36 percent in 1985 to 65 percent by 2020, according to DOE forecasts. This would put the Persian Gulf share back to where it was in the early 1970s, when the Gulf cartel was able to drive oil prices up sharply. But, if demand grows slowly, the Middle East's share in output could stabilize at its current level, according to private-sector forecasters.

DOE forecasts that Persian Gulf production will go increasingly to East Asia. It predicts that,

in 2020, 57 percent of Persian Gulf oil will go to the Pacific Rim countries (including northeast Asia). Only 7 percent will go to the United States and 9 percent to Europe. South Asia will receive a big part of the remaining 26 percent. This trend will raise important questions about the role of Asian countries in Gulf security.

Where Gulf oil is sold is irrelevant. Disruption of Gulf oil would require speedy reallocations and raise oil prices for all consumers around the world. Additionally, the United States is committed to pooling its oil with other industrial democracies. Thus, such a disruption would hit the America hard, even if all U.S. oil comes from the Western Hemisphere.

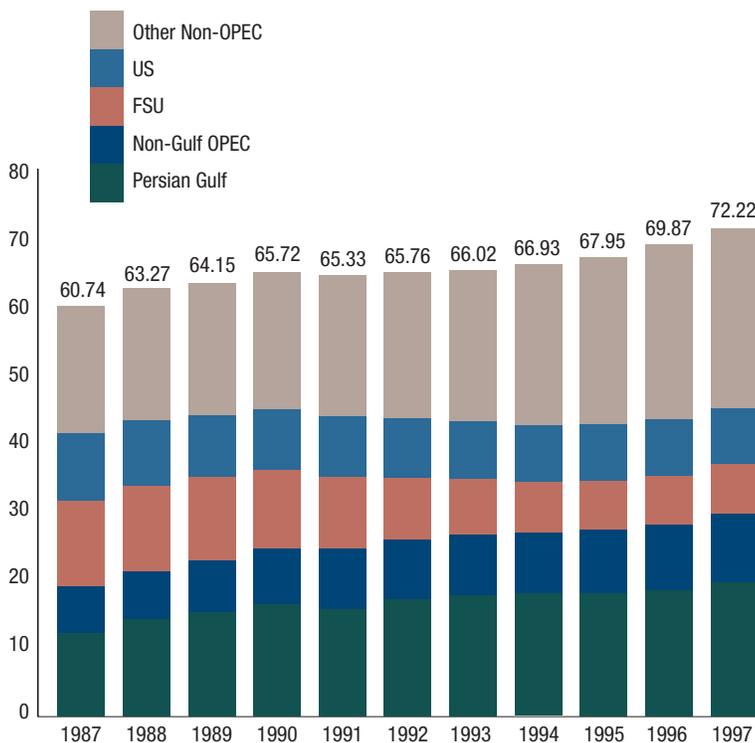
While the role of market forces in the oil and gas industry is increasing, one area where geopolitics predominates is the Caspian basin. Azerbaijan, Kazakhstan, and Turkmenistan could have 5 percent of the world's oil reserves. By 2008, they could produce 5 mbd, primarily from Azeri offshore fields in the Caspian Sea and the Kazakh Tenghiz field northeast of the Caspian. The Caspian basin is a world-class oil area but not an alternative to the Persian Gulf.

While the Caspian basin may not actually be important to the world oil picture, it is of great interest to world oil companies. It is one of the most attractive areas available to them. Their role in the Persian Gulf is severely limited by government monopolies, unattractive terms, and political problems, including UN sanctions on Iraq.

U.S. firms are committed to investing billions of dollars, primarily in the Azeri offshore and Kazakh Tenghiz fields. The problem is how to get the oil and gas to market through Caspian countries. Some pipelines are already under construction or renovation. They include a 1.2 mbd oil pipeline from Kazakhstan via Russia to the Black Sea, two .2 mbd pipelines from Azerbaijan to the Black Sea (one via Russia and one via Georgia), and short gas pipelines to connect the Iranian gas network between Turkmenistan and Iran. The Kazakh pipeline will carry most of that country's projected oil capacity. Additional pipelines will be needed for Azeri oil and Turkmen gas. All projected routes have problems, making the following choices difficult:

- Existing pipelines via Russia. Adding more capacity to those pipelines raises fears of excessive dependence on Russia. Also, this oil would probably be moved to Black Sea ports for transport by ship. This could create problems in the increasingly crowded Bosphorus Straits.
- Transport via Iran faces political problems. The United States would likely oppose this. Azerbaijan would be suspicious of Iranian irredentism. Also, the Iranians are offering poor terms and have a reputation for price gouging.
- Pipelines to the Mediterranean. Turkey is lobbying for pipelines across its territory. However, such a pipeline would have to go through a second country before reaching oil producing countries. Additionally, optimum routes lie in unstable Kurdish areas.
- Other alternative routes. Routes to India via Afghanistan and Pakistan would be politically difficult. Routes to China would be economically challenging.

Oil Output in Million Barrels per Day



Source: *Statistical Review of World Energy 1998* (British Petroleum).

Energy Demand

DOE forecasts that world energy consumption will grow 2.3 percent annually, the same rate since 1970. At this rate, world consumption in 2020 will be three times that of 1970. Of all energies, natural gas consumption is growing the fastest. Its share of world energy consumption rose from 17.5 percent in 1970 to 21.4 percent in 1995. It is projected to be 27.2 percent in 2020. Eighty percent of natural gas consumption occurs in producing countries, especially the United States and Russia.

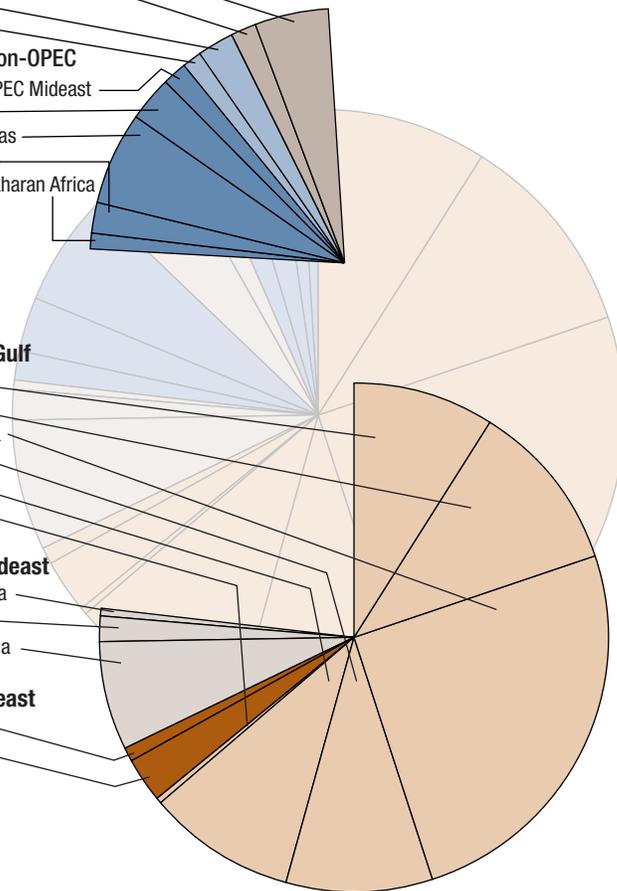
Oil Reserves in Million Barrels, 1997

NON-OPEC

- Former Soviet Union
 - Russia
 - Other
- Asia-Pacific
 - China
 - Other
- Other Non-OPEC
 - Non-OPEC Mideast
 - U.S.
 - Americas
 - Europe
 - Sub-Saharan Africa

OPEC

- Persian Gulf
 - Iran
 - Iraq
 - S. Arabia
 - Kuwait
 - UAE
 - Qatar
- Other Mideast
 - Indonesia
 - Nigeria
 - Venezuela
- Non Mideast
 - Algeria
 - Libya



Source: *Statistical Review of World Energy 1998* (British Petroleum), 4.

In 1995, 25 percent of the world's energy came from coal, most of which was consumed by the United States and China. Another 14.6 percent came from nuclear energy, hydropower, and renewable energy sources.

Oil will remain the most important fuel and the principal fuel for energy-poor countries. It constituted 47.3 percent of world energy in 1970 and 39 percent in 1995. It is projected to be 37.1 percent in 2020.

The United States remains the world's largest energy consumer, and this consumption is rising. U.S. energy consumption grew 1.2 percent annually from 1970 to 1995 and is projected to grow at the same rate to 2020. However, the U.S. share of

global energy is declining: it was 33 percent in 1970 and 25 percent in 1995, and DOE forecasts it to be 19 percent in 2020.

Energy consumption is growing rapidly in developing Asia. In 1970, it consumed 70 percent less energy than did the United States. Developing Asia went from consuming 9 percent of the world's energy in 1970 to 20 percent in 1995 and is projected to consume 31 percent in 2020. Developing Asia accounted for a one-third increase in world consumption from 1970 to 1995 and is expected to retain that share to 2020. By 2020, developing Asia will consume 70 percent more energy than does the United States.

Most of Asia's increase in energy demand will be from China and India. This will be satisfied mostly by domestically produced coal. Nevertheless, the region's demand for oil will increase rapidly. Rising income will lead to more demand for transportation of goods and people. Developing Asia's consumption of oil for transportation is expected to rise from about 4.5 mbd in 1995 to 12.5 mbd in 2020, accounting for most of Asia's increasing oil demand, which will go from 11.3 mbd in 1995 to 28.6 mbd in 2020.

Asia will eventually consume most of the Persian Gulf oil. DOE forecasts that in 2020, Asia will consume 38.4 mbd, including 9.8 mbd in Japan and Australasia. Of this, Asia will produce about 20 percent and import more than 75 percent from the Persian Gulf.

By contrast, the United States will depend less on Persian Gulf oil. Of the 9.9 mbd that the United States imported in 1997, Canada and Latin America (including Mexico) provided 5.5 mbd, while the Persian Gulf only provided 1.8 mbd. Persian Gulf oil was only 10.0 percent of U.S. oil consumption in 1997.

For the United States, imports will become more important. DOE forecasts that U.S. domestic production will satisfy only 35 percent of consumption in 2020. Increased imports will not come from the Gulf. The Gulf share of the U.S. oil market will decline to 8 percent in 2020, according to the DOE. Others forecast a smaller Gulf share. Some industry sources suggest that the Western Hemisphere will become oil independent. Latin American oil output will increase fast enough to meet U.S. oil import needs.

Europe is more dependent on Gulf oil than the United States; however, that is not its main source of oil. In 1997, Western Europe produced 6.9 mbd (87 percent in Norway and the United

Kingdom). It imported 9.4 mbd, of which 4.6 mbd came from the FSU and Africa, and 3.8 mbd from the Gulf. DOE forecasts that Western European oil imports will rise little by 2020, and the Gulf's share will stay constant. Many industry sources forecast a declining Gulf share, with more coming from the FSU and Africa. Like the United States, Europe's direct energy needs are not and will not be closely tied to the Gulf. One reason is that European governments are disinclined to take a strong role in sharing responsibility for Gulf security.

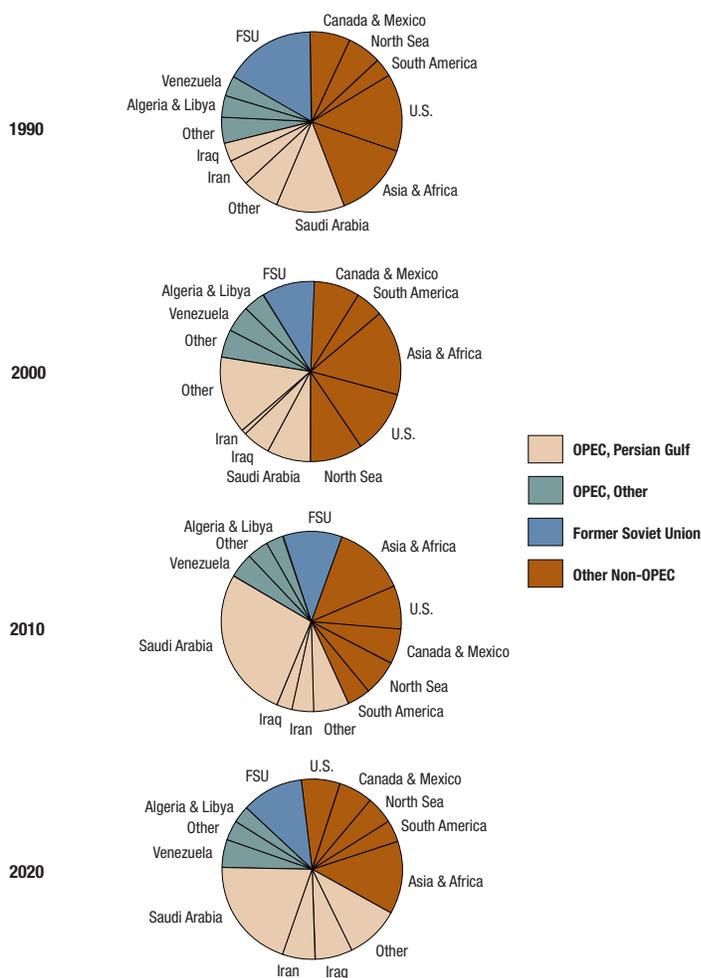
Forecasts for energy demand are sensitive to two major uncertainties: future economic growth rates and trends in energy intensity of output. If the 1998 Asian crisis were to spread and last longer, world energy demand could decline substantially, especially because much of the increased demand is attributed to Asia. According

to DOE scenarios, energy growth could be cut in half compared to normal conditions.

Energy intensity is also a major variable. The historic trend is toward less energy per unit of output in the economy. In the United States, energy consumption per dollar of gross domestic product (GDP) (inflation-adjusted) dropped from 20 million British thermal units (BTUs) in 1972, to 13 million BTUs in 1997. One reason is the shift toward industries that use less energy. The information technology companies use less energy to produce a dollar of output than do the auto or steel industries.

Another reason is greater energy efficiency. For example, the average fuel consumption per mile for U.S. vehicles continues to drop. In 1996, the average American vehicle was driven 17 percent more miles than in 1973, but used 18 percent less fuel. Additionally, environmental considerations, especially over global warming, may contribute to even greater efficiency. All this is likely to mean that the trend toward less energy per unit of output will continue. This is true not only in the United States, but globally. For example, China's energy consumption since 1980 has increased at about half the rate that real GDP has grown. That ratio is expected to continue.

World Oil Production Capacity (mbd)



Ample Commodity Supplies

Previously, reliance on imported materials was a national security concern. America is highly dependent on some imported metals that are used extensively in military systems. Imports are estimated to provide the United States with 100 percent of its manganese, 99 percent of its bauxite, 87 percent of its tungsten, 84 percent of its tin, 79 percent of its cobalt, and 78 percent of its chromium.

Today, import dependence is less of a concern because of globalization. Governments have limited ability to disrupt most raw material markets, especially over the long term. Temporary disruptions may occur with one or two producers of minerals. National security planners have to be concerned about commodities that come mostly from countries far from the United States (for example, manganese), which comes primarily from Ukraine, China, and South Africa. The Government has established strategic reserves and created incentives for private stockpiling. This is the most cost-effective means of reducing risk. The Strategic Petroleum Reserve is an example. The U.S. Defense Logistics Agency also

Source: *International Energy Outlook 1998* (Washington: Department of Energy).

The Karkamis Dam, Turkey's fifth dam on the Euphrates River, just 3 miles from Syria



AP/Wide World Photos

maintains a year's supply of manganese, bauxite, cobalt, and chromium, among other metals and minerals.

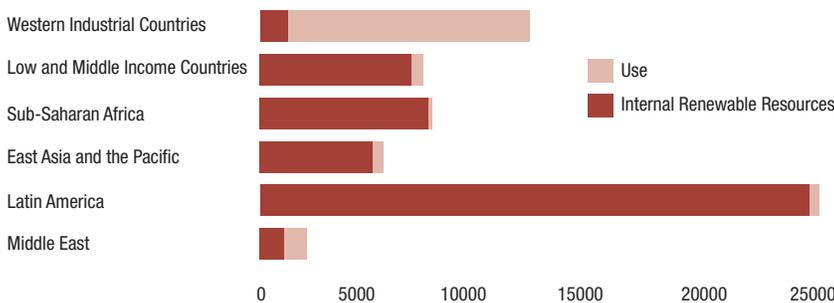
In the 1970s, many argued that increasing resource shortages could lead to rising prices, social tensions, and potential conflicts. However, the price of resource-based commodities declined to 1950s and 1960s levels and below. Since 1985, supplies for many raw materials have been ample and prices have been historically low.

There has even been an unused capacity in many agricultural, metal, and mineral products.

One explanation for this price stability is the effect of technology on production costs. Technology has enabled the use of what previously might have been discarded as waste. It has also allowed the development of previously uneconomical reserves. Additionally, higher prices for a raw material create an incentive to use it less and find substitutes. The global situation can be viewed as a race between technology and demand; for the last 200 years, technology has been winning.

Water Availability

(cubic meters per person per year in the early 1990s)



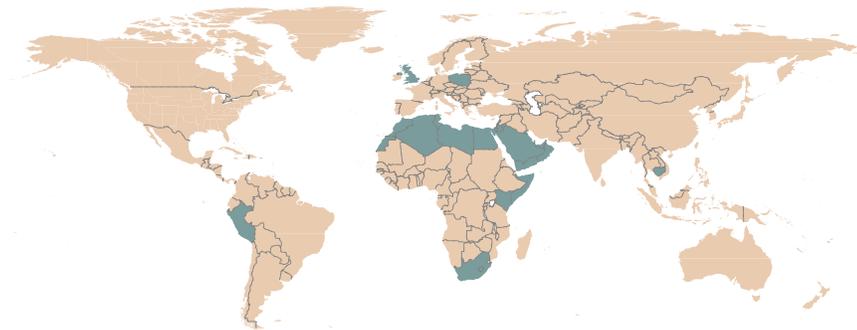
Increasingly Scarce Water Supplies

Problems with renewable resources, especially water, have been greater than expected. Water supplies are becoming a significant concern in many parts of the world, as populations increase and per capita water use rises with income. The Middle East, the region with the least amount of water per person, has the highest use per person. This explains why it is the region with the greatest tensions over water. The Persian Gulf

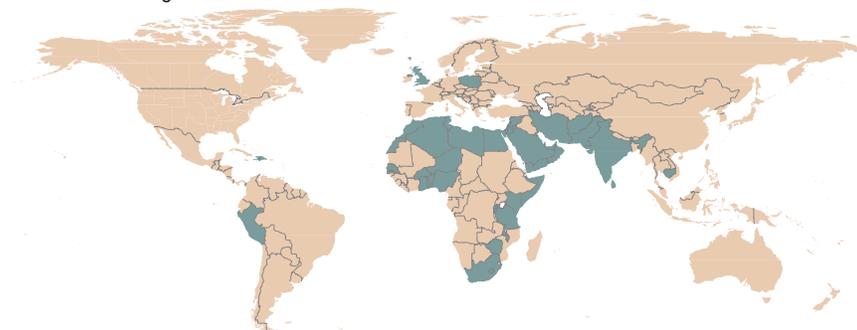
Source: *World Development Report 1992* (Washington: World Bank), 197.

Water: A Scarce Commodity

1999 450 million people in 31 countries currently face serious shortages of fresh water.



2025 2.8 billion people in 48 countries (one-third of the world's population) are expected to face water shortages.



Sources: World Commission on Water for the 21st Century; U.N., World Bank, Population Action International; *The Washington Post*.

states meet the demand by desalinating sea water. However, few other countries are prepared to pay this high cost. Many countries are unwilling to raise water prices to a level that would encourage conservation and shifts away from water-intensive crops. Globally, agriculture accounts for 69 percent of water consumption, compared to 22 percent for industry and 9 percent for household and other use. For many, the preferred solution is to make greater use of rivers.

About 200 river basins are shared by two or more countries. Thirteen are shared by five or more countries, and four basins are shared by nine or more countries. Shared watersheds comprise about 47 percent of the global land area and more than 60 percent of the area on the continents of Africa, Asia, and South America. Water conflicts exist on every continent, with the most acute in the Middle East, primarily in the Euphrates, Nile, and Jordan river basins.

The Euphrates River basin covers parts of Turkey, Syria, and Iraq. Tensions have been acute since Turkey began its \$40 billion Southeastern Anatolian Project in the 1960s. This is a vast irrigation and hydroelectric project that uses water from the Tigris River. In 1992, the project's centerpiece, the Atatürk Dam, began producing electricity. In 1994, the Anliurfa irrigation channel began carrying 30 cubic meters a second to Turkey's Harran Plain. Turkey has rejected Syrian and Iraqi complaints over the project. Turkey maintains that it is adhering to its 1987 pledge to provide 500 cubic meters a second to Syria. Anger over the project may have been a deciding factor for Syrian aid to the Turkish Kurdish terrorist organization, the PKK.

The Nile River basin encompasses 10 countries with a population of 250 million. For centuries, Egypt has regarded safeguarding its Nile water supply as the central national security issue. A 1959 bilateral accord with Sudan allows Egypt to use 55.5 billion cubic meters a year and Sudan 18.5 billion. In 1997, Egypt began construction of the \$2 billion New Valley pipeline and desert reclamation project. Eventually the pipeline and project will use 5.5 billion cubic meters of water annually. This will push consumption to the bilateral limit or over, unless Egypt succeeds with planned water-conservation for farms. Ethiopia is also planning several small dams along the Blue Nile, which is the source of most of the Nile's waters. This could reduce the flow into Sudan below the level agreed to in the Sudan-Egypt treaty. Sensitivities over water have contributed to tensions among these three countries, as well as the civil war in southern Sudan.

The Jordan River basin includes parts of Israel, Palestinian areas, Jordan, and Syria. The Jordanian-Israeli peace treaty includes a provision governing division of waters between them. However, a three-way dispute still exists among them, and Syria has blocked the long-planned construction of a dam on the tributary Yarmuk River between Jordan and Syria. Also, the Palestinians complain bitterly about the division of water with Israel.

Resolving water disputes is not easy. International law provides two opposing doctrines relating to international waters. The doctrine of "unlimited territorial sovereignty" states that a country has exclusive rights to its use of waters in its territory. Under this doctrine, a country depleting or contaminating shared waters has no incentive to mitigate the impact on other countries. The contrasting doctrine of "unlimited territorial integrity" states that one country cannot

alter the quantity and quality of water available to another. Under this doctrine the upstream country is required to mitigate all impacts regardless of costs.

In practice, international water disputes have moved away from these two doctrines and toward a doctrine of “equitable and reasonable use.” However, this has come to mean that the strongest, most clever, and best-positioned countries can claim resources without great concern for the impact on others.

Measures governing water use often originated in an era when this resource was not regarded as scarce. Cultural and religious groups may view water use as too important or sacred to

be governed by impersonal markets or agreements with neighboring countries. Market forces tend to ensure the peaceful provision of resources among countries. However, this is hard to apply to water. It is seldom subject to clear property rights and its use can have extensive impact.

Globalization of Environmental Problems

How to address growing environmental problems may cause considerable disagreement among countries. Disagreements are likely to occur with a “free rider” state—a country that recognizes that a problem exists, but chooses not to do its fair share toward a solution, because it believes that other countries will satisfactorily solve the problem. Such problems are not likely to be resolved militarily but addressed by means of international agreements.

The ozone problem shows what can be done through international conventions. Chlorofluorocarbons (CFCs) are chemical compounds with wide application as aerosol propellants, coolants in refrigeration and air conditioning, foam blowing agents, and solvents for cleaning electrical compounds. In the 1970s, scientific evidence indicated that CFCs could deplete the stratospheric ozone layer that shields the earth from damaging ultraviolet radiation. In 1987, the Montreal Protocol on Substances that Deplete the Ozone Layer was signed by 24 countries. Some problems have arisen, such as India’s unwillingness to cooperate. However, this case serves as a model for resolving global environmental problems, because:

- Damages were identified and generally regarded as serious by the scientific community. The effects would negatively impact all countries.
- The cost of resolving the problem by phasing out CFCs, while substantial, was not prohibitive.
- Firms producing offending products were able to develop alternatives that allowed them to maintain profits.

The global warming problem, believed to be caused by carbon buildup in the atmosphere, is similar to the ozone problem. However, a solution is less readily available. The scientific evidence has not been accepted by all of the important political actors. Also, some countries may benefit from global warming, though it is not clear how much. The costs of mitigating carbon buildup in the atmosphere may be high. Finally, the firms most affected have few obvious alternatives.

Environmental Security

Environmental factors rarely have been the principal factor leading directly to armed conflict, either state to state or internal. That said, environmental activists emphasize the indirect contribution of environmental factors to conflict and argue that the environment is coming under greater stress, such that environmental factors may be a more direct cause of violence in the future.

The environment can be linked to security in three other ways, which reflect differing concepts of security:

- *Security of the environment.* It could be argued that one of the most vital human concerns should be protection of the global environment (e.g., from global warming.) However, it is by no means clear whether it is useful to describe security of the environment by the same term, “national security,” that has been used for military and geopolitical matters.

- *Human security* (e.g. from famine, disease, and weather). Environmental change directly threatens human security in a variety of ways. For instance, global warming may lead to flooding in coastal areas and to more destructive storms. Providing security from natural and manmade disasters is an important governmental function—one in which the military is often called to assist—but it is quite distinct from the kinds of national security threats that lead countries to consider going to war.

- *National security.* While there is vigorous debate about how the environment affects national security, it is clear that national security can affect the environment, most obviously through the environmental impact of military operations. The U.S. military is spending over a billion dollars a year on reducing the environmental impact of its operations. As another example of how national security affects the environment, consider how the problems in Afghanistan and between India and Pakistan prevent the use of Central Asian natural gas in India. Using that gas, instead of coal, would noticeably cut global carbon emissions and thereby reduce global warming.

Environmental problems lend themselves to cooperative solutions rather than to conflict. Involving the military in environmental problems could make those problems harder to solve, because the military’s role could create suspicions and inflame nationalist passions.

Environmental issues can provide a useful source of confidence and security building measures (CSBMs), as well as an issue around which military-to-military contacts may develop among countries that are not particularly friendly. For instance, along the demilitarized zone between the two Koreas, an agreement established regular contacts to manage the zone as a refuge for migrating birds.



AP/Wide World Photos

Fighting over scarce supplies of kerosene in petroleum-rich Nigeria

As a result, controversy exists over how to respond to global warming. The 1992 Framework Convention on Climate Change was vague and not implemented. The December 11, 1997 Kyoto Protocol involving industrial countries, Eastern Europe, and the FSU pledged to reduce greenhouse gas emissions relative to the 1990 levels by 5 percent on average. Countries can use a variety of means to achieve these goals, including natural absorption of carbon (e.g., planting trees). Countries that could not meet their goals without high costs to buy emission rights from another country that would not use them. Such a system could substantially reduce costs of complying with the Kyoto Protocol.

The Kyoto Protocol has been controversial, and its underlying scientific conclusions have been debated. Some argue that reducing energy consumption will not have much effect on the amount of carbon in the atmosphere. Others argue that energy-related carbon emissions do negatively affect the atmosphere.

Another difficult issue has been the carbon emissions in developing countries. Between 1990 and 2010, China alone will increase its emissions by more than the entire Kyoto Protocol reduction. During this period, developing countries will increase carbon emissions by 2,034 million tons, compared to the Kyoto Protocol reduction of 721 million tons, primarily because of their heavy reliance on coal. By 2020, they will consume over twice as much coal as the industrial nations. The developing countries resist any carbon emissions limits, pointing to their lower emissions per capita. In 2020, their projected emission of 0.8 tons per person will be one-fourth of the industrialized countries 1990 emissions of 3.2 tons per person. The U.S. level was 5.2 tons.

The Kyoto Protocol will heavily impact energy consumption. In the United States, 84 percent of greenhouse gas emissions come from energy-related activities. Meeting the U.S. goal set by the Kyoto Protocol will be difficult. It will require marked changes in energy use and could include reducing energy consumption and using alternative fuels, like shifting from coal to natural gas. The impact on the global energy market is less clear. Most of the projected increase in energy demand will occur in countries that have not pledged to reduce carbon emissions.

U.S. Interests

Energy and resource issues will not cause global war in the foreseeable future. However, they may create local crises and require military deployments. U.S. forces may intervene in future crises and wars in the Persian Gulf. Energy dynamics will dictate that U.S. forces play a major role in Persian Gulf security. They will also continue to help secure sea lines of communication from the Persian Gulf, especially to East Asia. Other contingencies are more speculative. In the event of a conflict between Turkey and its Middle Eastern neighbors over water, U.S. forces could be called on under NATO Article V provisions. Caspian security is also a concern. This may require U.S. political-military involvement, but not a substantial U.S. force commitment.

Fisheries

Resource constraints have become a problem for a few commodities, especially sea-caught fish. Overfishing has become a serious environmental problem.

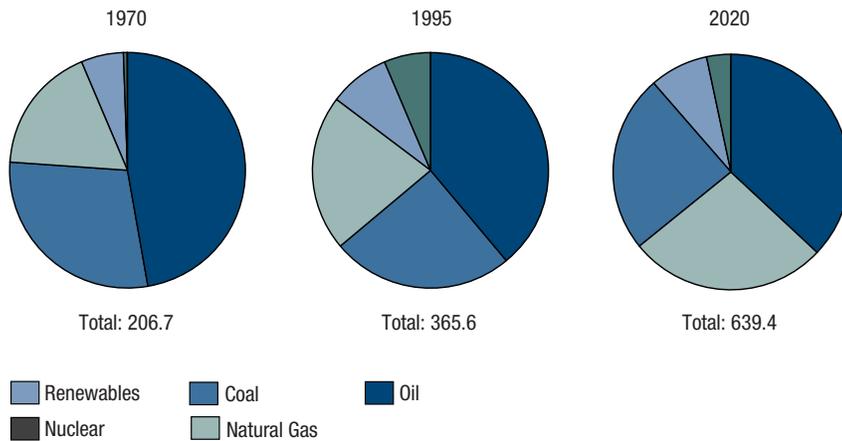
Only after some difficulty have international agreements been reached. They stop such destructive practices as the use of fishing nets that are miles long and sweep an area clean of all fish, even though many species and small fish are discarded. It is, however, difficult to police those agreements. While overfishing is a serious environmental concern, its economic effects can be offset by shifting to fish farms; these could include raising species like salmon, previously available in the wild.



AP/Wide World Photos

Fishing boat in the Gulf of Maine, where once-plentiful supplies of cod fish are experiencing significant declines

World Energy Consumption by Fuel Type
(Quadrillion BTU)



Source: *International Energy Outlook 1998* (Washington: Department of Energy).

Assuring Energy Security

The industrial democracies have a vital interest in maintaining ready access to stable and reasonably priced energy supplies. The United States seeks the following conditions regarding energy security:

- A variety of energy alternatives available from a number of sources
- Market forces, rather than political factors, determining energy availability.

Such conditions offer the best prospect for market stability. The availability of energy alternatives and sources would minimize the impact of disruption to any one supplier. Markets would also be able to make price adjustments that would encourage conservation, shifts to alternative fuels, and improvements to oil output capacity. Western countries cannot rely entirely on energy from within, because low-cost Middle Eastern oil is vital to holding down transportation costs.

To assure energy security, the U.S. Government has to do more than promote the role of market forces regarding energy. It must also provide a security guarantee for the Persian Gulf, the world's key energy region. Securing the free flow of Middle Eastern oil is complicated. Middle Eastern countries want to export their oil. However, the aggressive behavior of rogue regimes must be curtailed. Rogues could pressure other oil-producing countries to reduce exports so as to increase their revenues. Limiting oil exports of rogue regimes, such as the UN sanctions on Iraq, may be appropriate.

Avoiding Water Conflicts

The United States has reason to be concerned about two Middle East water conflicts. First, the dispute over the Jordan River basin could complicate the Arab-Israeli peace process on which the United States has staked so much prestige. Second, the Euphrates River conflict is of immediate concern to the American military. This conflict pits a NATO member, Turkey, against two rogue states, Iraq and Syria. A Syrian-Iraqi strike against a Turkish dam, which is a remote possibility, could seriously challenge NATO solidarity. While Washington would likely side with Turkey, some in NATO might be reluctant to meet their obligations under NATO Article V. Greece would resist, and some European countries may not want to see NATO forces deployed that far from Central Europe.

Protecting the Environment

Air, drinking water, arable land, and oceans were once considered readily available "free" goods. They now face increasing contamination. Large-scale ecosystem damage has been caused by industrial pollution, deforestation, loss of biodiversity, ozone depletion, and ultimately climate change. This could threaten the well-being of people the world over. Environmental problems could lead to manmade disasters or exacerbate natural catastrophes. If disasters spread or become more frequent, military forces are likely to be used in response.

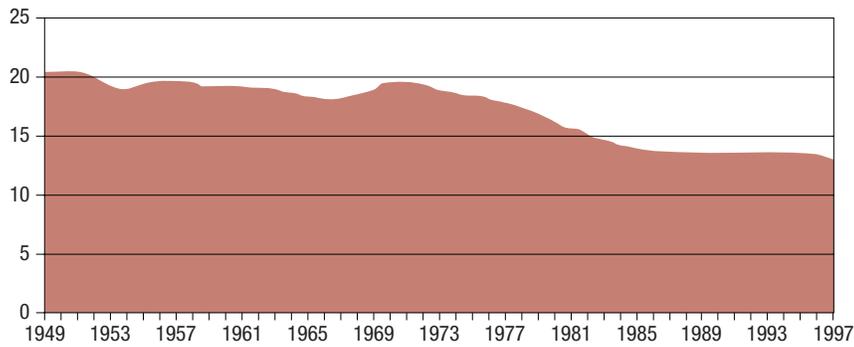
Successful environmental policies are ones that when implemented today help prevent problems tomorrow. However, some threats may not emerge for years, their magnitude unknown until then. The challenge is to achieve international consensus on how to respond to problems that are not readily apparent. The problem is, many believe that, if a threat is not readily apparent or does not transpire, the associated policies are not needed.

Strategies for environmental problems require cooperation among countries, between business and government, and between scientists and policymakers.

Consequences for U.S. Policy

Several energy, resource, and environment policy issues will be of particular concern to the defense community.

Energy Consumption per Dollar of GDP (Thousands of BTU per 1992 dollar)



Source: Energy Information Administration Annual Review (Washington: Department of Energy) 1997

Sustaining the Consensus for Secure Markets

Global market dynamics will not operate freely and openly, if the underlying security system is not stable. If major powers were to return to the 19th century approach of guaranteeing access to raw material supplies, namely securing political control over such supplies and ultimately developing monopolies, the world economy would suffer and world politics would become more tense. As China's economy develops, it will become more dependent on imported raw materials. Integrating China into the world's raw material market will be critical to a stable and relaxed security environment for energy and resources.

Persuading Allies and Partners to Contribute to Gulf Security

At present, the United States is principally responsible for defending the Persian Gulf and Western access to oil; other industrial democracies have as much interest as America in the free flow of reasonably priced oil. As a group, the other Organization for Economic Cooperation and Development (OECD) countries import 50 percent more oil than does the United States. They also produce 50 percent more oil than America. They have reasonable cause to contribute to a common energy security framework that includes the defense of the Persian Gulf.

A common understanding with allies on energy security will be achieved with the resolution of four basic issues:

- *"Free Riders."* Allies and partners have little incentive to contribute if they believe that the United States will provide the security on its own.

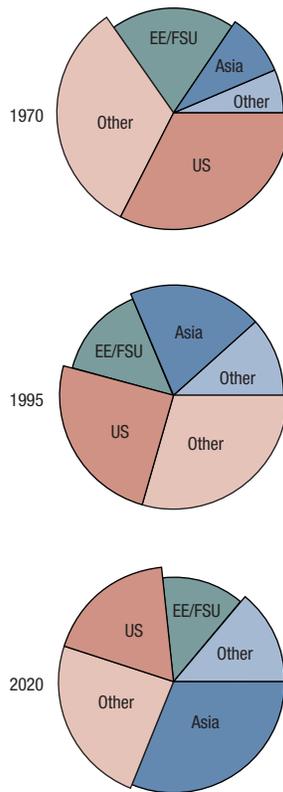
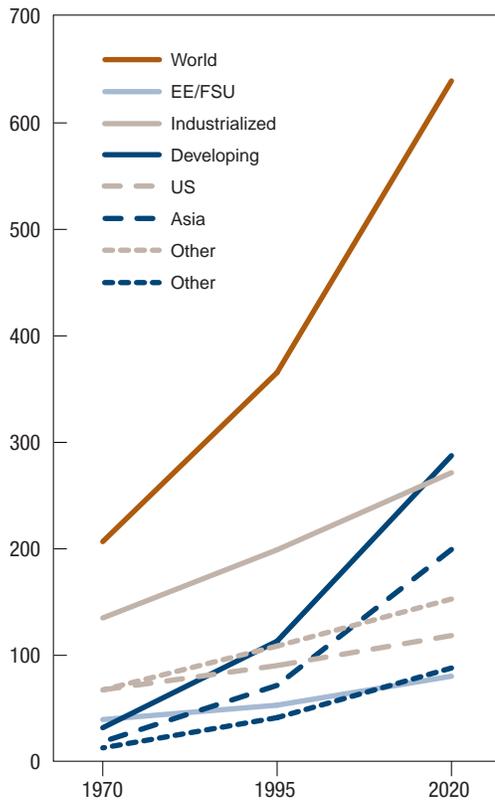
- *Division of Labor in Gulf Security.* This issue centers on the relationship of responsibility sharing to import shares. That is, to what extent should the responsibility for Gulf security fall on those who import their oil from the Persian Gulf? Economists argue strongly that it is immaterial how much U.S. oil comes from the Gulf. Any shortfall from the Gulf would affect all oil consumers equally. However, this view does not necessarily impress U.S. politicians, who find it difficult to explain why U.S. forces should assume the majority of the Gulf's security burden when most Gulf oil goes to Asia. Saudi leadership also worries that the U.S. public may not be willing to sustain this security burden. The issue to be resolved is, to what extent should responsibility for Gulf Security fall on those who import oil from the Gulf?

- *Achieving Consensus on Gulf Security Issues.* If allies play a greater role in Gulf security, they may want a larger say in this common effort. The United States has not agreed with its European allies or Arab partners on some Gulf security issues. America may be reluctant to accommodate some European and Arab concerns. The United States also is not likely to share decisionmaking with major importers such as China and India, unless its overall relationship with them improves.

- *Sufficiency of Forces.* It is by no means clear that European nations have sufficient forces that are equipped and trained for rapid deployment to a distant theater; this includes forces for regular exercises and a sustained deterrent presence in theater. Asian energy-consuming nations clearly lack such forces. Arab partners do not have many forces capable of operating on a modern battlefield with U.S. forces. As the revolution in military affairs (RMA) impacts U.S. forces, disparities will grow. The United States can take the lead on providing the forces, while other countries assume much of the financial burden, as was done in *Desert Storm*. This approach, however, is politically problematic. Coalitions are more likely to work if based on a more equitable commitment of forces.

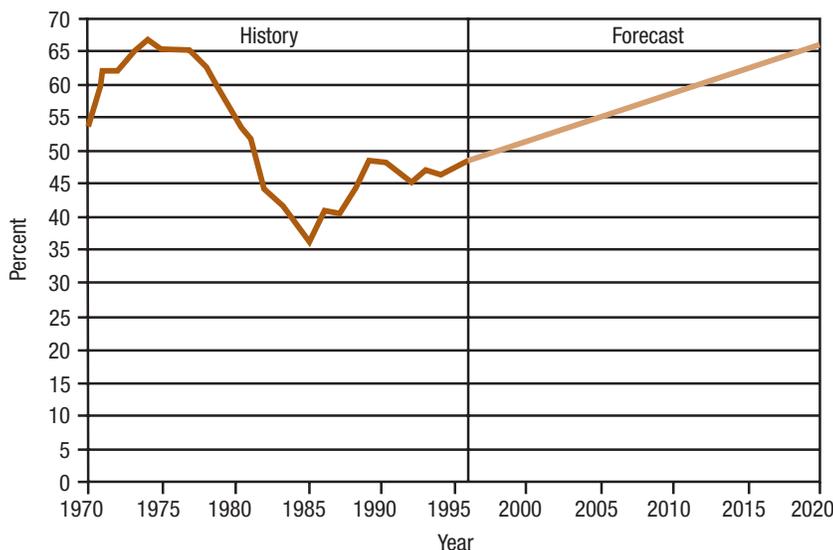
Energy security issues are likely to become more complicated. For example, what would happen if China decided that it had to play a more active role in the security of the sea lines of communication to and from the Gulf? In principle, such a role would be compatible with the U.S. desire for a broader sharing of the responsibility for energy security. The problem is

World Energy Consumption
(Quadrillion BTU)



Source: *International Energy Outlook 1998* (Washington: Department of Energy)

Persian Gulf Share of World Oil Exports, 1970–2020



Source: *International Energy Outlook 1998* (Washington: Department of Energy).

that tensions in Southeast Asia and the South China Sea could be exacerbated by a larger Chinese naval presence in blue waters. Moreover, could the United States and China agree on Gulf policy?

Hedging Against an Oil Supply Shock

Military planning is based on two implicit assumptions regarding any oil supply shock: first, any shortfall will be alleviated through increased output elsewhere, substitution of other fuels, or conservation. The second assumption is that military forces will respond fast enough to enable production to be restored before the Strategic Petroleum Reserves runs out.

During the 1970s and 1980s, the United States developed a variety of policies to hedge against an oil supply shock. The challenge is to adapt these policies to the very different conditions of the 21st century. Supply shocks can impose real economic pain. The oil price shocks of 1973–74 and 1979–80 sent the world economy into recessions, causing reductions in the U.S. GDP on the order of 2 percent for a couple years. If a similar shock occurred today, it would mean a loss of \$300 billion in potential output. Preventing such a shock depends on a combination of policies that would foster quick expansion of output, energy conservation, and the substitution of other fuels.

Acting through the International Energy Agency, 23 industrial countries have agreed to share the impact of a temporary shortfall. Each has a commitment to maintain strategic stocks for this purpose. If Gulf imports were interrupted, the American SPR this reserve would last about 300 days. However, avoidance of a global oil shock also depends on International Energy Agency member nations achieving the required strategic reserves. For the members as a group, the reserves fall far short of the 90-day goal, much less of the 180-day goal set when the International Energy Agency was established.

A long-term disruption is more difficult to foresee, assuming that all producing countries maintain their output. However, a major concern is the heavy reliance on Saudi Arabia, which DOE estimates will provide one-fifth of the world’s oil in 2020. This will require a massive investment program that will be difficult for Saudi Arabia to achieve. It is faced with political

Strategic Petroleum Reserve

The Strategic Petroleum Reserve (SPR) is the first line of U.S. defense against an interruption in petroleum imports. The SPR is a 560-million barrel oil reserve stored in underground salt caverns along the Gulf of Mexico coast. It can be drawn down at a rate of 4.2 mbd, equal to about 40 percent of U.S. oil imports.

The SPR was authorized in 1975 and began operations in 1977, in response to the 1973 oil shock. The industrial nations agreed to establish reserves equal to 90 days worth of imports and, in the event of an oil supply interruption, to coordinate action through the International Energy Agency, which has 23 member countries.

The inventory of oil stored in the SPR peaked, in terms of days of net imports, in 1985 at 118 days. Coverage has diminished as imports have increased and SPR inventory has been sold to raise revenue for the federal budget. No oil has been purchased since 1995. In 1998, the SPR inventory was equal to 63 days of imports at 1997 levels.

The only emergency use of the SPR was in January 1991, at the start of *Desert Storm*. The mere announcement of SPR sales had a considerable stabilizing effect on world markets. Only 17 million barrels were actually sold before market conditions returned to normal.

problems, such as the transition to a new generation of leaders, that could slow or paralyze decision making. Saudi Arabia might become so absorbed in its own problems, to include infighting among the ruling elite, that the tough decisions are not made regarding the mobilization of the tens of billions in investment capital.

Ensuring Caspian Energy Development

The U.S. Government has promoted a trans-Caspian energy corridor to carry oil and gas westward through Turkey or, if economically feasible, eastward to China. Such a corridor has several advantages compared to transporting Caspian oil and gas through Russia or Iran. This corridor would:

- Provide more flexible transport options for Caspian countries, which now rely on Russia to a degree that is economically costly and politically risky
- Transport Caspian energy to market without increasing energy shipments through the heavily trafficked Strait of Hormuz
- Enhance ties between Caspian states and NATO member Turkey, which has linguistic commonalities with the three main energy exporters: Azerbaijan, Kazakhstan, and Turkmenistan.

The region's unstable situation is an obstacle to this corridor. The pipeline would have transit near the Armenian-occupied part of Azerbaijan. It might also transit through parts of Georgia

that have experienced ethnic unrest. Georgia's domestic violence has ranged from organized attacks on the president to separatist insurrections. The security situation in the Caspian basin will be questionable so long as the borders of the economic zones are in dispute. Iran also demands that the five bordering states share in oil development. Additionally, Azerbaijan and Turkmenistan dispute an area on their border that may have rich energy reserves.

The United States has a strong interest in the area's security. U.S. firms are investing billions of dollars in the region. However, a large U.S. military intervention in the Caucasus is unlikely. Any substantial U.S. military deployment would make Iran and Russia nervous and would be seen as destabilizing. The challenge for America is to promote a security architecture for the region that will be accepted by all parties. This would include a framework for resolving ongoing disputes between Armenia and Azerbaijan. Such a security architecture could involve peacekeepers or monitoring for several areas of the Caucasus. U.S. forces might be called upon to support missions associated with this architecture. The United States might also help modernize the region's military forces and reorient them toward promoting stability.

Achieving Consensus on Environmental Issues

Environmental problems transcend national boundaries. However, it is not easy to achieve a domestic and international consensus on how to respond to them. Many newly industrializing countries disagree with the argument that they should share in the response to environmental problems, even though their rapidly growing industries are producing an increasing amount of pollutants. In the absence of such agreement, it may be extremely difficult to secure broad U.S. domestic support for strong action. Failure to reach agreement could preclude the adoption of some relatively inexpensive environmental measures that could have high payoffs. Such was the case with President Clinton's 1998 initiative to reduce greenhouse gas emissions.

Military forces have no direct role in addressing environmental problems. However, they may be required to limit their impact on the environment and to become more environmentally conscious. They also may be used to support environmental protection efforts, such as using intelligence assets for environmental monitoring. This is sure to require additional

funding and may be the subject of debate. Some critics have suggested that the Kyoto Protocol could negatively affect U.S. military operations.

Net Assessment

In the coming decade, worldwide supplies of energy and resources are likely to be ample, with prices little higher than today. Even so, energy, resource, and environmental problems could contribute to security tensions. A variety of pessimistic scenarios can be imagined that are plausible, even if improbable.

The most likely scenario is a continuation of present trends with no major change. If so, Gulf

security responsibilities will fall primarily on the United States, which will maintain a sufficiently robust commitment to deter regional aggression. The other major powers, including China, are likely to do little to advance or complicate global energy security. Water shortages in the Middle East will excite much emotion, but the response will be difficult negotiations rather than the use of force. Global environmental conventions will be the subject of considerable debate, but actual international consensus will be needed to find solutions. Energy and resource issues will continue to be key concerns of U.S. national security policy in the coming years.