THE WORLD OIL AND NORTH AMERICAN GAS OUTLOOK

February, 2001
## CONTRASTING FUNDAMENTALS

### World Petroleum
(Excluding Eastern Europe)

<table>
<thead>
<tr>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Consumption Change</td>
<td>Million Bbls/Day</td>
<td>-5</td>
</tr>
<tr>
<td>Excess Capacity</td>
<td>Million Bbls/Day</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Number of Countries</td>
<td>11</td>
</tr>
</tbody>
</table>

### U.S. Natural Gas

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption Change</td>
<td>Billion Cu. Ft./Day</td>
<td>-10</td>
</tr>
<tr>
<td>Excess Deliverability</td>
<td>Billion Cu. Ft./Day</td>
<td>U.S.</td>
</tr>
<tr>
<td></td>
<td>Canada</td>
<td>3</td>
</tr>
</tbody>
</table>
WORLD PETROLEUM DELIVERIES
(Excluding Eastern Europe)

Million Barrels Per Day


Actual Forecast

United States

Rest of World

Western Europe

Japan, Canada, Australia & New Zealand

Obtained and made public by the Natural Resources Defense Council, March/April 2002
WORLD PETROLEUM PRODUCTION
(Excluding Eastern Europe)

Million Barrels Per Day

- Actual
- Forecast

Total: 65.1
59.7

Non-OPEC: 34.9
22.2
27.5

OPEC: 17.5

Net from E. Europe: 5.3

NON-OPEC CRUDE OIL PRODUCTION

Million Barrels Per Day

Actual Forecast

United States
Norway & UK
Canada
China
Mexico


 Obtained and made public by the Natural Resources Defense Council, March/April 2002
ALASKA CRUDE OIL

Million Barrels Per Day


0.0 0.5 1.0 1.5 2.0 2.5 3.0

Obtained and made public by the Natural Resources Defense Council, March/April 2002
UNITED KINGDOM CRUDE OIL

Million Barrels Per Day

Actual Forecast


Obtained and made public by the Natural Resources Defense Council, March/April 2002
NORWAY CRUDE OIL

Million Barrels Per Day

Actual     Forecast


Obtained and made public by the Natural Resources Defense Council, March/April 2002
EASTERN EUROPE PETROLEUM PRODUCTION, CONSUMPTION & EXPORTS

Million Barrels Per Day

Production

Deliveries

Net Exports

Actual Forecast


0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

5.3

3.2

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OPEC CRUDE OIL PRODUCTION

Million Barrels Per Day

Actual | Forecast

Saudi Arabia

* Excludes Ecuador & Gabon who withdrew from OPEC in 1993 & 1996 respectively

Obtained and made public by the Natural Resources Defense Council, March/April 2002
UNITED STATES NATURAL GAS
Trillion Cubic Feet

Lower 48 Proved Reserves

AGA
EIA

New Reserve Additions
Deliverability

Production
Revisions and Adjustments

U.S. NATURAL GAS CONSUMPTION, PRODUCTION AND PRICE

Billion Cubic Feet Per Day

1999 $/MMBTU

Consumption
Imports & Other
Production
Average Wellhead Price (Right Scale)

Actual Forecast


Obtained and made public by the Natural Resources Defense Council, March/April 2002
U.S. NATURAL GAS SUPPLY FROM MAJOR SOURCES

<table>
<thead>
<tr>
<th>Source</th>
<th>Peak Year</th>
<th>Decline Since</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texas (Onshore)</td>
<td>1972</td>
<td>38%</td>
</tr>
<tr>
<td>LA &amp; TX Shelf</td>
<td>1981</td>
<td>34%</td>
</tr>
<tr>
<td>Louisiana (Onshore)</td>
<td>1970</td>
<td>71%</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>1990</td>
<td>32%</td>
</tr>
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</table>

Trillion Cubic Feet

- Actual
- Forecast

Obtained and made public by the Natural Resources Defense Council, March/April 2002
CANADIAN NATURAL GAS
(Excluding Frontier Areas*)
Trillion Cubic Feet

* Mackenzie Delta, Beaufort Sea, Artic Islands, and East Coast Offshore

Obtained and made public by the Natural Resources Defense Council, March/April 2002
FIRST YEAR NATURAL GAS PRODUCTION DECLINE RATES

- Texas
- Gulf of Mexico Federal Waters
- Louisiana/Texas Shelf
- Western Canada
- U.S. Lower 48 Onshore

Year on Stream:
- 1990
- 1991
- 1992
- 1993
- 1994
- 1995
- 1996
- 1997
WASHINGTON, Feb. 14, 2001 - U.S. energy policy lacks global perspective and contains inherent contradictions, potentially making it difficult to meet emerging supply threats, according to a CSIS report.


"At some point during the next 20 years, the developing world will begin to consume more energy than the developed world," the report states. "Energy supply will need to be expanded substantially to meet this demand growth. Central to the geopolitics of energy during 2000-2020 is the fact that energy demand will be met in essentially the same ways as it was met at the end of the twentieth century."

As this scenario unfolds, the U.S. must take a different policy approach. "The United States deals with energy policy in domestic terms, not international terms; U.S. energy policy is therefore at odds with globalization. Under globalization, we are vulnerable to any event disrupting energy supply or demand anytime and anywhere," said Robert Ebal, director of the CSIS Energy Program. "The SEI report provides background and guidance for energy policy reform. Among the recommendations:

- Avoid indiscriminate use of sanctions. "If global oil demand estimated for 2020 is reasonably correct and is to be satisfied, Iran, Iraq, and Libya should by then be producing at their full potential if other supplies have not been developed."
- Do not obstruct Caspian, Central Asian development. "Tying exports primarily to one pipeline route-with the goal of avoiding Iran and Russia as transit states-before the political and economic viability of the route is known may undercut the peace of energy development in the region."
- Increase foreign investment in energy-producing countries.
- The United States must protect worldwide energy supply with greater burden sharing by allies.
- Governments and the private sector must work together to protect energy infrastructure against sabotage or terrorist attack, including cyberterrorism.
- Economically and environmentally sound technologies, including cost-competitive nuclear electric power, must be made


2/15/01

DOE002-0823

Obtained and made public by the Natural Resources Defense Council, March/April 2002
available to help developing countries meet increasing energy demands.

The SEI consisted of a 65-member task force and 16-member advisory board. The SEI co-chairs were Sens. Frank Murkowski and Joseph Lieberman, Reps. Ellen Tauscher and Benjamin Gilman, former Sen. Sam Nunn, chairman of the CSIS board, and former Secretary of Energy James Schlesinger, a CSIS counselor.

CSIS is an independent, nonpartisan public policy research organization.

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2/15/01

DOE002-0824

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Executive Summary

The Center for Strategic and International Studies (CSIS) launched its Strategic Energy Initiative (SEI) in mid-1998 on the premise that the benign global energy situation that had prevailed since the late 1980s masked two dangers.

First, it obscured significant geopolitical shifts both ongoing and forthcoming that could affect future global energy security, supply, and demand.

Second, it led to complacency among policymakers and the public about the need to incorporate long-term global energy concerns into near-term foreign policy decisions.

By midyear 2000 the state of the world oil market had undergone considerable turbulence, marked by rapidly rising oil prices as oil-exporting countries were benefiting from staged reductions in production that had been initiated more than two years earlier. The delicate balance between supply and demand was demonstrated once again.

Instead of dwelling on the oil market turbulence in 2000, however, this report assesses the international energy supply-and-demand relationships likely to prevail in the first two decades of the twenty-first century, highlighting the different ways that geopolitical developments could affect global energy markets between 2000 and 2020. In light of the world’s future energy needs, this report series also points out the contradictions inherent in certain of the energy objectives and foreign policies pursued by the United States and other Western governments. Finally, the report offers policy considerations that, if implemented, could help ensure that energy supplies are adequate to meet projected worldwide demand, are not excessively vulnerable to major interruptions, and are produced in ways that minimize damage to the environment.

It may appear that parts of this assessment are unduly pessimistic, that positive factors have been overlooked. These SEI assessments do stress prospects for instability and for interference in energy supplies, but only to alert policymakers about the fragility of reliable and timely supplies.

Energy Outlook to 2020

During the next 20 years, providing there is no extended global economic dislocation, energy demand is projected to expand more than 50 percent. This growth will be unevenly distributed, with demand increasing in the industrialized world by some 23 percent while more than doubling, from a much lower base, in the developing world, with Asia accounting for the bulk of this increase. At some point during this period, the developing world will begin to consume more energy than the developed world. Energy supply will need to be expanded substantially to meet
The demand for energy will continue to grow, although the Persian Gulf will remain the key marginal oil supplier, all producing countries must contribute to supply to the extent they can.

Central to the geopolitics of energy during 2000–2020 is the fact that energy demand will be met in essentially the same ways as it was at the end of the twentieth century. Fossil fuels will provide the bulk of global energy consumption, rising marginally from 86 percent in 2000 to an 88 percent share in 2020. Although oil will dominate global energy use and coal will retain its central role in electricity generation, natural gas use will increase noticeably. Indeed, the relative contributions of oil and coal to world energy consumption will actually decline whereas only natural gas will demonstrate a growth in both absolute and relative terms. Nuclear power will decline in both relative and absolute terms: renewables, including hydropower, and alternative energy sources, while growing in absolute terms, will not capture a greater relative share of the market.

Development of oil and gas reserves is judged sufficient to meet projected global demand well beyond this period. The most noticeable trend during 2000–2020 will be the growing mutual dependencies between energy suppliers and consumers. Key aspects of this trend, which are set out below, may appear rather obvious—and they are; how to respond in today’s changing environment is much less so.

- The Persian Gulf will remain the key marginal supplier of oil to the world market, with Saudi Arabia in the unchallenged lead. Indeed, if estimates of future demand are reasonably correct, the Persian Gulf must expand oil production by almost 80 percent during 2000–2020, achievable perhaps if foreign investment is allowed to participate and if Iran and Iraq are free of sanctions.
- While the Persian Gulf’s share of world oil production continues to expand, the share of North America and Europe, the world’s most stable regions, is projected to decline.
- The share of world oil production from the former Soviet Union is projected to increase from 9 percent to almost 12 percent. But, as had been the case in earlier years, this oil will follow the market, not attempt to lead it.
- The Caspian oil contribution to world supply will be important at the margin but not pivotal.
- Asian dependence on Persian Gulf oil will rise significantly, and the resulting necessity for longer tanker journeys will put more oil at risk in the international sea lanes.
- European dependence on Persian Gulf oil will remain significant.
- The European need for natural gas will be covered by a handful of suppliers, Russia being the most significant, which underscores a worrisome dependency.
- U.S. net oil imports will continue their steady growth.
- Anticipated growth in the use of natural gas—in considerable part engendered as a fuel for electric power stations—raises a new series of geopolitical issues, leading to new political alignments.
Electricity will continue to be the most rapidly growing sector of energy demand. Developing economies in Asia and in Central and South America will show the greatest increase in consumption. The choice of primary fuel used to supply power plants will have important effects on the environment.

Technological change and improvements in energy efficiency have made their mark on recent energy supply-and-demand balances. Future energy supply and demand must reflect not only a continuation of these successes but an acceleration wherever possible.

Geopolitics and Energy: A Symbiotic Relationship

How Might Geopolitics Affect Energy?

Four main geopolitical trends are likely to influence energy supply and demand during the years ahead.

The continuing domestic fragility of key energy-producing states. The world drew some portion of its energy supplies from unstable countries and regions throughout much of the twentieth century. By 2020, fully 50 percent of estimated total global oil demand will be met from countries that pose a high risk of internal instability. A crisis in one or more of the world’s key energy-producing countries is highly likely at some point during 2000–2020.

Globalization. Economic globalization will impose new competitive and political pressures on many of the world’s leading energy producers and consumers. It will serve as a spur for growth in global energy supply and demand. It could also lead to serious swings in energy prices and demand because country-specific or regional recessions or other influencing events can now be transmitted quickly around the world. In such a globalized world, energy producers and consumers will become ever more sensitive to their mutual interdependence.

The growing impact of nonstate actors. This impact will be evident in three distinct areas. First, adroitly employing new information technologies, nongovernmental organizations (NGOs) will play a growing role in defining the ways that energy is produced and consumed. Second, terrorist groups, with access to the same technologies, will be in a position to inflict great operational damage on increasingly complex energy infrastructures. Third, radical activists will be in a position to disrupt operational infrastructure through cyberterrorism.

Conflict and power politics. The potential for armed conflict in energy-producing regions will remain high. Early in the twenty-first century, as a result, a weakening of U.S. alliance relationships in Europe, the Persian Gulf, or Asia could have major impacts on global energy security. U.S. concerns over the proliferation of weapons of mass destruction (WMD) and the desire to promote democratization and market liberalization around the world will also have a significant effect on key energy exporters. The future viability of the energy-producing states in the Caspian and Central Asia will be shaped by the competing objectives or interests of Russia, the United States, and adjacent regional powers.
How Might Energy Affect Geopolitics?

There are five main ways in which energy may affect geopolitical outcomes:

Swings in energy demand. A dramatic decline in global energy consumption, brought on by economic recession, could trigger instability in many of the world’s major energy-exporting countries. Conversely, continued economic growth, accompanied by rising energy demand, would place more power in the hands of the exporters.

Swings in energy supply. Just as demand is vulnerable to sharp shifts up or down, so is supply. If discovery and development of new reserves and the addition of producing capacities match demand growth, an acceptable balance between supply and demand can be maintained. But a number of factors must be satisfied if supply growth is to be encouraged, including an attractive host-country investment climate and the opportunity for acceptable investment returns. At the same time, political events and logistical interruptions can interfere with supply.

Competition for energy in Asia. As countries in Asia seek to secure growing levels of energy imports, two geopolitical risks emerge. First, historical enmities might boil over into armed conflict for control of specific energy reserves in the region. Second, the rising dependence of China on Persian Gulf oil could well alter political relationships within and outside the region. For example, China might seek to build military ties with energy exporters in the Persian Gulf in ways that would be of concern to the United States and its allies.

Energy and regional integration. Energy infrastructure projects may serve to strengthen bilateral economic and political ties in certain instances. In Asia, for example, energy networks, along with trade liberalization, could serve to reduce historical tensions and place Asian economic growth on a firmer footing. Similar forces might come into play in Europe, linking Russia to the European Union (EU); in South Asia, drawing Bangladesh and India closer together; and in the Far East, linking Russia and China.

Energy and the environment. Environmental concerns will have an increasingly important geopolitical bearing on energy decisionmaking by governments, by producers, and by consumers in the next decades. Should governments pursue aggressive strategies for reducing carbon emissions, a new political fault line could emerge between developed and developing countries.

Policy Contradictions and Considerations

The interplay of geopolitics and energy early in the twenty-first century is at the root of an array of complex policy challenges that governments around the world must now confront. The three interlocking policy challenges are to ensure that (1) in the long term, supplies will be adequate to meet the world’s energy needs; (2) in the short term, those supplies are reliable and not subject to serious interruptions; and (3) at all times, energy is produced and consumed in environmentally acceptable ways.
Energy Availability

U.S. policy today contains a fundamental contradiction. Oil and gas exports from Iran, Iraq, and Libya—three nations that have had sanctions imposed by the United States or international organizations—are expected to play an increasingly important role in meeting growing global demand, especially to avoid increasing competition for energy within and within Asia. Where the United States imposes unilateral sanctions (Iran and Libya), investments will take place without U.S. participation. Iraq, subjected to multilateral sanctions, may be constrained from building in a timely way the infrastructure necessary to meet the upward curve in energy demand. If global oil demand estimated for 2020 is reasonably correct and is to be satisfied, these three exporters should by then be producing at their full potential if other supplies have not been developed.

History has demonstrated that unilateral sanctions seldom are successful in persuading nations to alter their behavior. Multilateral sanctions provide a broader front and a greater guarantee of success. Multilateral sanctions test the ability and willingness of enforcing nations to hold together for the duration, however, while both multilateral and unilateral sanctions are viewed as targets of opportunity for the entrepreneurial trader.

Western governments should avoid the indiscriminate use of sanctions. The value of multilateral sanctions should be weighed against the value of engagement and dialogue. When the use of sanctions is deemed admissible in the support of international interests, governments should adopt a graduated approach and make every effort to ensure that the coverage of the sanctions is as targeted as possible. This should include a cost–benefit analysis of whether curtailing investment in, or revenue from, energy production will genuinely dissuade the target government from the specific behavior that provoked the imposition of sanctions.

Despite a limited success record, sanctions will continue to be used as a tool of foreign policy—as a means of rejecting the conduct of a particular nation—simply because there are no acceptable alternative courses of action. The world will have to live with the inherent limitations of the sanctions.

Policy consideration: Avoid the indiscriminate use of sanctions. The value of multilateral sanctions should be weighed against the value of engagement and dialogue. When the use of sanctions is deemed admissible in the support of international interests, ensure that the coverage of sanctions is as targeted as possible. Unilateral sanctions are not an effective policy tool.

A similar contradiction exists in U.S. policy toward the Caspian region and Central Asia, where the United States is committed to reinforcing the newly independent states but where contrasting U.S. policies toward Iran, Turkey, and Russia are likely to influence, rightly or wrongly, the construction of commercially viable pipelines for the export of Caspian oil and gas. A policy approach that ties exports primarily to one pipeline route—with the goal of avoiding Iran and Russia as transit states—before the political and economic viability of that route is known may undercut the pace of energy development in the region, to the dismay of both producing states and potential transit states.
Oil and gas exports from the Caspian region and Central Asia hold the prospect of becoming a valuable additional source of energy supply. Even as the U.S. government works to make feasible an East-West transportation corridor that bypasses Russia and Iran, the United States should not obstruct the development of alternative routes that would ultimately offer exporters a diverse and economically attractive set of options for transporting oil and gas to foreign markets, especially those markets in Asia and the Far East.

Policy consideration: Do not obstruct the development of economic routes that would ultimately offer Caspian and Central Asian exporters a diverse set of options for transporting oil and gas to foreign markets.

Beyond these contradictions, if Western governments are to ensure adequacy of supply early in the twenty-first century, policies must be framed toward encouraging energy-producing countries to open their energy sectors to greater foreign investment. This would include provisions for the enforcement of contracts, guarantees for private property, anticorruption measures, and stable fiscal regimes. Increased private investment must occur as early as possible in exploration and production facilities and in transportation infrastructure, especially in Asia, if the world’s energy supplies are to reach markets in sufficient quantities during the 2010–2020 period.

Policy consideration: Encourage energy-producing countries to ensure that their energy sectors attract and support greater foreign investment.

Given the continuing importance of a small group of energy-producing and exporting countries to the future health of the global economy, it is vital that the United States and other Western governments place diplomatic relations, trade policies, and foreign assistance programs with each of these countries at or near the top of policy priorities.

It is in the self-interest of the United States and other Western governments to support China—rapidly emerging as a major oil importer—as it diversifies its sources of and forms of imported energy and encourage China to not rely excessively on the Persian Gulf. China is considering development of an infrastructure to support oil and gas imports from Russia and Central Asia and also for transit onward to other countries in the Far East. Collaborative cross-national energy infrastructure projects can play an important role in lessening the risks of future conflict over energy resources. However, such energy linkages may not always be in the best political interests of the United States.

Energy Reliability

In the early decades of the twenty-first century, because burgeoning energy demand must be met largely by a small number of oil and gas suppliers and because supply routes are lengthening, the risk posed by supply interruptions will be greater than it was at the end of the twentieth century.

Military conflict will remain a threat to most energy-producing regions, particularly in the Middle East where almost two-thirds of the world’s oil resources are located. In addition, domestic turmoil within the key energy-producing countries
constitutes another threat to reliability of energy supplies. At least 10 of the 14 top oil-exporting countries run the risk of domestic instability in the near to middle term.

The United States should retain as far as possible its ability to defend open access to energy supplies and international sea lanes. At a time when the administration faces myriad competing demands for military and peacekeeping interventions, this mission should be considered a strategic priority and may call for greater emphasis on, and increased investment in, appropriate military capabilities.

Policy consideration: The United States should retain as far as possible its ability to defend open access to energy supplies and international sea lanes.

Some observers are concerned that the United States may seek relief from its self-imposed responsibility as the protector of the world’s sea lanes, which are used for the transport of fuels and are becoming more crowded. U.S. allies in Europe and Asia should be prepared to shoulder a greater share of the financial cost of protecting energy supply, including sea-lane protection.

Policy consideration: U.S. allies in Europe and Asia should be prepared to shoulder a greater share of the financial cost of protecting energy supply, including sea-lane protection.

No protector comparable with the U.S. role on the high seas exists for the increasingly important long-distance pipeline infrastructure. At a government-to-government level, international agreements to protect pipeline systems might have a deterrent effect. Governments must also find ways to work with the private sector to minimize the vulnerability of all energy infrastructures to sabotage or terrorist attack. Cyberterrorism may well pose the greatest threat during the time period under review.

Policy consideration: Governments must find ways to work with the private sector to minimize the vulnerability of energy infrastructure to sabotage or terrorist attack, including cyberterrorism.

The more feasible approach in the near to medium term to mitigate the risks of gas-supply interruptions is to encourage importing countries to promote diversity among suppliers and delivery routes. European governments, particularly in view of their high dependence on Russian gas, should look closely at how security of gas supply might be enhanced.

To meet these challenges to reliable supply, importing nations must engage in contingency planning. The practice of holding government-financed strategic petroleum reserves is one essential method of limiting the impact of supply interruptions, provided that the stocks held are truly reserved for the intended purpose and not for manipulating domestic prices. Governments should maintain and, where appropriate, expand government-financed and -controlled strategic petroleum reserves. This could include extending the International Energy Agency (IEA) emergency preparedness program to nonmember countries that will become major oil importers and supporting the concept of regional stabilizing initiatives. For the