29

AICGS POLICY REPORT

U.S. AND GERMAN APPROACHES TO THE ENERGY CHALLENGE

Wilfrid L. Kohl
Friedemann Müller

AMERICAN INSTITUTE FOR CONTEMPORARY GERMAN STUDIES THE JOHNS HOPKINS UNIVERSITY

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TABLE OF CONTENTS

FOREWORD

What is the definition of energy security in the twenty-first century? In the past, one might have been inclined to identify energy supplies as the core of security. Yet, the predictions about the end of oil reserves have been somewhat cyclical in recent decades. The sources of energy, indeed, have been expanding, not necessarily because the oil supplies are running out, but rather because of the impact of the carbon footprint from oil and the need to find alternatives which do not degrade the environment with hydrocarbons. Energy security is therefore about expanding our portfolio of choices when it comes to how we fuel our societies, while also not harming them in the long run. Energy security is also defined by the ways we can enable societies to enjoy levels of growth, unemployment, and wealth without endangering themselves or their neighbors. Developing countries want the same benefits of standards of living enjoyed by the developed world, and resent being told that they cannot have them because they will be a threat to the planet. With more than half the world's population aspiring to a better future, the need for the entire population to work together to offer sources of energy which provide means to better living, including for a better environment, is a shared responsibility. Thus, we are looking for common solutions to energy supplies and efficiency and how they will enable growth and prosperity in a safe environment for the entire planet.

Germany and the United States bear a great responsibility for leading these efforts. Both are major energy consumers and importers; the United States is a major energy producer. And both are producers of the carbon which is the main concern for the world's climate in the coming decades.

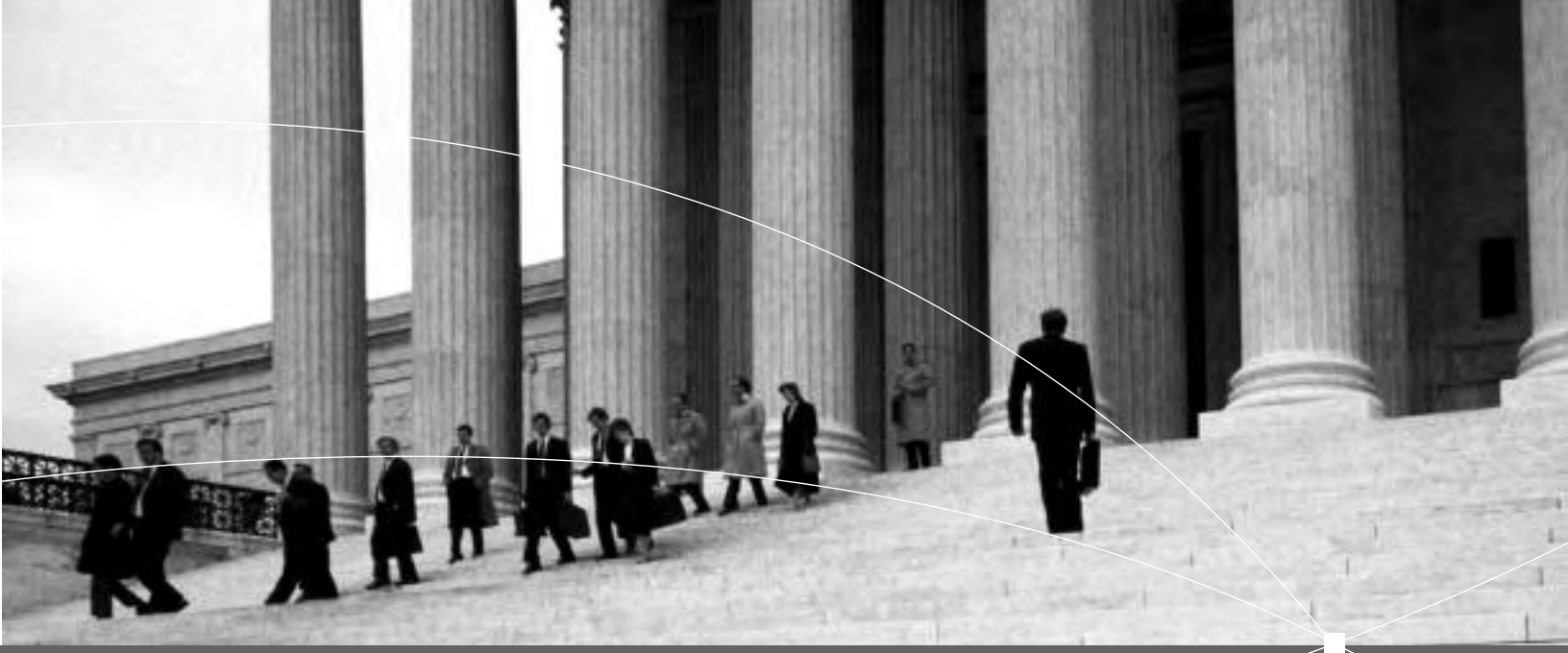
How to approach the challenges we face in balancing growth and energy efficiency, along with facing the risks of our current energy supplies and the search for alternatives, is the charge of the two papers in this volume. Both of our invited experts, Wilfrid Kohl and Friedemann Müller, have examined the parameters of debates and choices with regard to energy security in the United States and Germany. They have presented both the domestic policies now and those which need to be improved in the future. They have also pointed to opportunities for German/European and American cooperation in developing new options for the transatlantic community as well as for the global arena. Energy policy debates have become increasingly driven by expanding concerns of multiple actors and interests. Energy will be a central issue of concern and opportunity across the entire globe in the twenty-first century. We can only hope that we will make maximum use of the latter. We are grateful to Dr. Kohl and Dr. Müller for their insights and recommendations toward that end. We are also grateful to the *DaimlerChrysler-Fonds im Stifterverband für die Deutsche Wissenschaft* for its generous support of this project.

Jackson Janes
Executive Director
AICGS

ABOUT THE AUTHORS

WILFRID L. KOHL, a political economist, is research professor of international relations at the Paul Nitze School of Advanced International Studies, The Johns Hopkins University, where he established and for ten years directed the subfield on "Energy, Environment, Science and Technology." He continues to teach and to direct the International Energy and Environment Program at the Johns Hopkins Foreign Policy Institute. Dr. Kohl has served on the staffs of the National Security Council and the Ford Foundation and has served as consultant to the Office of Technology Assessment of the U.S. Congress, the Nuclear Energy Institute, and the Edison Electric Institute. Dr. Kohl is the author/editor of several books on international relations and energy policy, including: *After the Oil Price Collapse: OPEC, the United States and the World Oil Market* (1991); *International Institutions for Energy Management* (1983); *After the Second Oil Crisis: Energy Policies in Europe, America, and Japan* (1982); and *French Nuclear Diplomacy* (1971). His recent articles have focused on Caspian Sea oil, OPEC behavior, sustainable energy technologies, and U.S. energy security. Dr. Kohl received his B.A. in political science from Stanford in 1961, an M.A. in international affairs from the Fletcher School in 1963, and a Ph.D. in government/international relations from Columbia University in 1968.

FRIEDEMANN MÜLLER is non-resident scholar at the German Institute for International and Security Affairs (SWP), Berlin. He has been head of the research group "Global Issues" at SWP from 1997 to August 2006. Müller also acted as project director of the International Network To Advance Climate Talks (INTACT), a transatlantic project funded by U.S. and European sponsors to involve politicians, the private sector and scientists on the climate policy issue, until October 2006. Dr. Müller holds a diploma and doctoral degree in economics from Freiburg University. He published numerous books and articles on international energy policy issues and writes regularly in German newspapers such as DIE ZEIT, Frankfurter Allgemeine, Handelsblatt.



01

CHAPTER ONE
ENERGY POLICY IN THE UNITED STATES

UNITED STATES ENERGY POLICY AND FUTURE ENERGY SECURITY

WILFRID L. KOHL

This paper begins with a review of the U.S. energy situation and the energy outlook. It then examines the structure of the major energy industries and the players in the making of U.S. energy policy. The concept of energy security is analyzed and how the concept is changing with recent developments in energy markets and the environment.

We then evaluate the energy policy of the current Bush administration and consider current debates and U.S. attitudes on selected issues. The conclusion summarizes the major energy and environmental security challenges ahead and identifies some areas for possible transatlantic energy cooperation.

The reader is reminded that energy trends and issues reflect both the behavior of markets and government policies. Governments usually set the framework in which markets operate (for example, regulation of monopoly power and deregulation). They can intervene to address externalities and market failures (for example, environmental considerations or security). They often invest in longer term research and development (R&D) of new energy technologies, sometimes in cooperation with industry. But governments alone do not control all energy behavior.

The U.S. Energy Situation and the Energy Outlook

The United States is a major energy producer, consumer, and importer. As indicated in Figure 1, the country consumed about 100 Quads (quadrillion BTUs) in 2005, a little less than a quarter of the world's total energy consumption. Of the energy consumed, a major amount of petroleum and a smaller amount of natural gas were imported. Figures 2 and 3, based on the Energy Information Administration's Annual Energy Outlook 2007, show the reference case projections of growth to 2030 in energy consumption by sector and by fuel.

They indicate strong expected growth in transportation, primarily oil demand, and in electricity demand (which goes into the industrial, residential, and commercial sectors). Furthermore, coal use is estimated to grow toward the end of the projection period, surpassing natural gas (in spite of gas's superior environmental qualities) because of projected higher natural gas prices. Almost all coal is used to generate electricity.

Petroleum

The United States is the world's largest oil consumer and oil importer. It consumes about one-fourth of world crude oil production. It is also the third largest oil producer—in 2005 it produced about 8.22 million barrels per day (mbd) (including natural gas and other liquids) and consumed 20.75 mbd. Net imports of liquid fuels (primarily crude oil) amounted to 12.57 mbd or about 60 percent of consumption. The Energy Information Administration projects that import dependence will decline slightly to 54 percent in 2009 (because of increased production in the deep water Gulf of Mexico) before climbing to 61 percent in 2030. (Figure 4) U.S. oil imports come from a variety of countries, mostly in the Western Hemisphere. Only about 20 percent of U.S. oil imports come from the Persian Gulf (see Figure 5).

The United States ranks eleventh in world oil reserves. However, a large portion of the resource base has been produced; domestic oil production has been declining in the lower forty-eight states and Alaska, but increasing in the Gulf of Mexico. Drilling in the Arctic National Wildlife Refuge (ANWR) still has not been authorized by Congress. However, the EIA projects that smaller new discoveries plus enhanced oil recovery techniques facilitated by higher oil prices will stabilize lower forty-eight onshore production between now and 2030. Deep water production in the GOM is projected to increase. Total conventional production therefore increases slightly between 2005 and 2010 when it will stabilize and eventually decline.

The principal user of oil in the United States is the transportation sector, which accounts for about two-thirds of oil demand (see Figure 6). Oil demand is projected to increase along with population and economic growth, driven especially by steady expansion in the number of highway vehicles. Reducing the transportation sector's reliance on oil is the key to enhancing U.S. oil and energy security. Oil use, it should be noted, contributes about one-third of US carbon dioxide (CO2) emissions.

Electricity

Electric power, a secondary form of energy, is the largest U.S. energy source accounting for about 39 percent of primary energy in the U.S. economy. It continues to grow rapidly with the expansion of the service sector and the proliferation of information technologies. Figure 7 shows the primary fuels used in electric generation in 2005, led by coal at 50 percent. The United States has over 200 years of coal reserves and is likely to continue to use coal, despite its polluting emissions.

Air pollution from coal has been regulated and reduced under the Clean Air Act as amended especially in 1990 under the acid rain emissions trading program. However, coal is the most important source of CO2 emissions which are so far not regulated but may be in the future. According to the EIA, which assumes continuation of current energy and environmental policies in its reference case, numerous new coal-fired power plants are likely to be built, especially after 2020, to meet growing electric demand in a period when coal will be more competitive than higher priced natural gas. Coal could increase its share to 57 percent of generation in 2030. (This assumes no carbon capture and sequestration, which of course might be given government incentives before then) (See Figure 8).

Natural gas has expanded its share as a fuel for power generation in recent years, although more recently this has been slowed by a rise in natural gas prices. Natural gas has the lowest carbon emissions of the fossil fuels, and combined cycle gas turbines are easy to install at utilities wishing to expand their generation capacity. EIA projects increased use of natural gas plants to 2020, but reduced use of natural gas thereafter as displaced by new coal and nuclear plants (see Figure 8).

Natural gas is also used in the industrial and other sectors of the U.S. economy. U.S. gas supplies, once thought to be plentiful, are now beginning to reach their limits. The United States lower forty-eight and offshore production will likely peak in the next few years and Canada, the source of about 15 percent of U.S. gas today, is facing resource depletion in Alberta and growing domestic demand (see Figure 9).

Unconventional gas (including tight sands and coal bed methane) hold promise of some growth. Sometime around 2018 an Alaskan natural gas pipeline could be ready to bring more Alaskan gas southward to the lower forty-eight. It seems clear, however, that U.S. dependence on gas imports will increase, especially on liquefied natural gas (LNG.) This will require construction of many new LNG import terminals. The EIA forecast for rising natural gas imports is shown in Figure 10.

Nuclear generating capacity, which contributes 20 percent of electric generation today, is projected in the reference case to increase modestly by 2030, but to decline in overall share. This is in large measure a response to the Energy Policy Act of 2005 which included production tax credits and federal loan guarantees for new nuclear plants. While there have been no new nuclear plant orders in the United States since 1978, there is increasing interest in a revival of

nuclear energy. Concern about global warming and future regulation of greenhouse gases is one of the motivations. Several standardized plant designs have been approved by the Nuclear Regulatory Commission, which should shorten construction times. A number of nuclear utilities are exploring possible new sites for new nuclear plants. At the same time, a number of older plants are facing life-extensions or retirements. While the Department of Energy continues to investigate the proposed site for an underground repository at Yucca Mountain in Nevada, the project is way behind schedule—which means that the problem of a repository for U.S. nuclear waste remains unresolved.

The use of renewable technologies for electricity generation is projected to grow, but from a low base, in response to higher fossil fuel prices, improved technologies, and extended tax credits in EP Act 2005 and state renewable portfolio standards which specify a minimum share of utility generation from renewable sources. Wind power is in the lead among the new renewable technologies. Hydropower is also included under renewables, but it is not expected to expand beyond existing sites. The renewable share of total electric generation is expected to remain at about 9 percent of total generation from 2005 to 2030 (see Figure 8).

Carbon Dioxide Emissions

CO2 emissions from energy use are projected by the EIA to increase steadily from 5,945 million metric tons in 2005 to 7,950 million metric tons in 2030 (1.2 percent annually, see Figure 11). This assumes no deployment of carbon capture and sequestration technology, which is still under development. The projected increases result primarily from continuing use of coal for electric generation and of petroleum fuels in the transport sector. The energy-related carbon emissions intensity of the U.S. economy is projected to fall from 538 metric tons per million dollars GDP in 2005 to 353 metric tons per million dollars GDP in 2030. But this does not negate the increase in absolute value of emissions as the economy grows. This projection indicates that the current pattern of U.S. energy use is unsustainable. Of course, the outlook could change if Congress and the President decide to regulate CO2 emissions (Congress is presently considering several bills on this subject).

Structure of the U.S. Energy Industries

As already mentioned, the United States is a large energy producer. It has a very large privately-owned oil and gas industry. According to a 1995 study by the National Petroleum Council, at that time the industry included some 40,000 companies (defined broadly to include upstream exploration and production, refining, transportation, distribution, and service companies). Consolidation in the industry since that time may have reduced the number a little. In 1995 the oil and gas industry employed some 1.5 million people.[1] The industry at that time was estimated to represent 3-5 percent of the U.S. economy, depending on the measurement used. At that time the oil and gas industry was larger than most other U.S. industries, ranking ahead of health services and pharmaceuticals, the automotive industry, electric utilities, and education and social services in output.

Most U.S. oil and gas industries serve the domestic market, but the sector includes U.S.-based integrated oil and gas companies which operate globally but have their headquarters and frequently their R&D bases in the United States. This group is led by companies such as BP America, Chevron Corporation, ConocoPhillips, ExxonMobil, Marathon Oil, and Shell Oil Company USA. In Washington this group is represented by the American Petroleum Institute. A much larger group are the independent oil and gas producers which tend to be smaller and domestically focused and are represented by the Independent Petroleum Association of America, which has some five thousand members. There is also a National Petroleum Refiners Association. And there are separate associations for service and equipment companies. With regard to natural gas specifically, the American Gas Association represents some two hundred gas utilities that deliver gas to customers, while the Natural Gas Supply Association represents gas producers and the Interstate Natural Gas Association represents gas pipelines. All of the above associations actively lobby the U.S. Congress and executive branch in Washington on behalf of their

interests.

The U.S. electric power industry is a large and complex industry, mostly privately owned and in the process of deregulation. In 2005 the industry earned more than $298 billion in revenue and represented about 3 percent of U.S. GDP. The largest group are the investor-owned utilities (about two hundred) which serve about 72 percent of U.S. customers. They are represented by the Edison Electric Institute. Traditionally, these were integrated monopoly companies involved in generation, transmission, and distribution of electricity, and they have been regulated at the state level by public utility commissions. However, more recently some of these have divested themselves of generation and focus now on transmission and distribution. There are also some government-owned utilities of several types: municipal electric systems serving about 11 percent of customers, federal power marketing administrations, and state power projects—all of which are unregulated. And there are rural electric cooperatives owned by farmers and eligible for subsidized financing. Finally, there is a growing category of non-utility generators including cogenerators, small power producers, independent power producers, and merchant generators.[2]

Electricity regulation is divided between the federal and state levels. While states regulate sale prices to consumers and power plant siting by monopoly utilities, the federal government traditionally has regulated wholesale power transactions (which frequently cross state lines) via the Federal Energy Regulatory Commission (FERC). Since the passage of PURPA in 1978 (the Public Utilities Regulatory Policies Act), there has been a movement to open up the wholesale electric sector to more competition. This was furthered by the Energy Policy Pact of 1992 and subsequent orders on open access by the FERC. Meanwhile, some states—led by California—attempted to encourage retail market competition as well. And the FERC has attempted to encourage the spread of regional transmission organizations (RTOs).

The California electricity crisis of 2000-01 was a major setback to the process of deregulation. As a result, the process is currently stalled, with about half of the states having achieved more competitive wholesale markets and the other half opposed to any mandatory requirements to follow suit (either because they have lower electricity prices, and/or because of the power of their local utilities against change in structure of the market). Natural gas, it should be noted, was deregulated with greater success in the 1980s and 1990s, largely through rule-makings by the FERC. As a result, natural gas is traded on competitive markets mostly at spot prices.

Other Players in the Making of Energy Policy

The making of U.S. energy policy involves the interaction of departments of the federal government, important committees of the U.S. Congress, interest groups, the states, and occasionally the courts. In the federal government the Department of Energy takes the lead on issues of energy supply and energy R&D. (It should be pointed out that DOE also plays a large role in the production and stewardship of nuclear weapons and in basic science research via the national laboratories.) The Environmental Protection Agency has a large role in reducing air pollution by setting fuel emissions standards under the Clean Air Act and promoting energy efficiency. The Department of State takes the lead in the foreign policy dimensions of energy policy and in climate change negotiations. The Treasury Department is important in keeping a watch on the implications of energy policy for the economy. The White House is obviously critical in mediating and steering interagency debates, either via the National Security Council or the National Economic Council. There is also the White House Council on Environmental Quality and the Office of Technology Assessment which advise the president, as does the Council of Economic Advisors. The Federal Energy Regulatory Commission (FERC) is the lead agency involved in regulating the network industries (e.g., electricity and natural gas) and it also keeps an eye on issues of market power. The Nuclear Regulatory Commission supervises the nuclear utilities and their nuclear power plants and grants licenses for new plants.

Since the United States has a presidential, not a parliamentary, system of government, the role of the Congress is very important. Key House and Senate

committees can have different views from the administration in power, especially if they are controlled by the opposition party, or sometimes when they are not. The Senate Committee on Energy and Natural Resources and the House Committee on Energy and Commerce take the lead in oversight of administration policies, in considering administration proposals for new policy, or in making proposals of their own on energy or related issues, including climate change. Since the take-over of Congress by the Democratic Party, the role of these and other Committees is enhanced. Currently, the two key aforementioned Senate and House Committees are holding hearings on climate change and energy efficiency and drafting a host of new bills.

The energy industries and their associations are powerful interests in Washington, as is the automobile industry. Congressman John Dingell, for many years the leading Democrat on the House Committee on Energy and Power (and now again its chairman), comes from Michigan and has strongly defended the interests of the auto industry, which, for example, opposes stronger CAFÉ (corporate average fuel economy) standards. Environmental groups also have strong influence in Washington, led by the Natural Resources Defense Council and Environmental Defense.

The important role of the courts was underscored recently when the U.S. Supreme Court reached a decision in April 2007 affirming that the U.S. Environmental Protection Agency has the authority under the Clean Air Act to regulate carbon dioxide and other greenhouse gas emissions (even if not specifically stated in the Act.) This decision clearly goes against the policy of the Bush II administration.

Meanwhile, various U.S. states led by California have announced their intention to regulate and reduce greenhouse gas emission, sometimes forming regional compacts to do so.

What is Energy Security?

As announced in the 2001 Bush-Cheney National Energy Plan, the goal of U.S. energy policy (and by implication the definition of energy security) is "reliable, affordable, and environmentally sound energy for America's future."[3] The emphasis of this comprehensive early statement was on ways to reduce regulatory barriers and increase domestic energy supplies to support U.S. economic growth and modernize aging energy infrastructure, e.g., oil refineries and pipelines and electric power plants.. The policy also supported the development of clean and renewable technologies and nuclear power. A number of the policy objectives were incorporated into the Energy Policy Act of 2005, discussed further on, which passed the U.S. Congress after several years of debate.

Energy security is broader than oil and includes natural gas and electricity, but oil is the most visible. In recent U.S. administrations, market forces have been seen as the key element in achieving reliable and affordable energy. Oil security is international since oil is priced and traded on a world oil market which can be seen as one great pool. Oil security depends on the stability of the world oil market. Disruptions in that market result in higher world oil prices, regardless of the amount of oil imported by any given country.

Oil price shocks are harmful to the U.S. economy and the world economy. They can be caused by instability in key producer countries or wars. In the postwar period, oil shocks have caused inflation, unemployment, and recessions. The macroeconomic impact of these disruptions depends mostly on total oil consumption, the time interval of the shocks, and the oil intensity of economies. The amount of oil imports plays a secondary role.

Oil price volatility is a major issue. Traditionally, OPEC market power has been seen as a major cause of price volatility. By regulating production, the OPEC cartel has been able most of the time to maintain prices well above production costs. Another issue is the long run outlook for oil supply. The possibility of a near term peak in oil production by say 2020, currently hotly debated, is also a factor in the oil security outlook.

A traditional U.S. strategy in pursuing oil/energy security has been to seek diversity of oil supplies. For

example, the Clinton administration gave important political support to the building of the Baku-Tiblisi-Ceyhan pipeline to transport Caspian oil to western markets. Another strategy has been participation in the International Energy Agency, established under American leadership in 1974, which administers an oil crisis management system based on the coordinated use of emergency oil stocks. The IEA also collects and publishes data on oil markets which is very important to oil companies and consumers, and it coordinates energy policies and seeks to promote the development of alternative energy technologies.

With respect to natural gas, currently about 15 percent of U.S. demand is imported from Canada and 1-2 percent from international markets via LNG. Since Canada is seen as a reliable neighbor and supplier, natural gas supply does not pose a major security issue today. However, as mentioned earlier, the EIA projects U.S. and Canadian supplies to tighten, leaving the United States to depend more in the future on Alaskan supplies if available via an Alaskan gas pipeline or on expanded LNG trade. The latter could make the United States more vulnerable to supply cutoffs. However, the current outlook is for multiple suppliers in a fragmented market. (The situation is different for western Europe where dependence on Russia and Algeria for a major portion of natural gas supplies has made gas security a central issue.)

The 2003 electric power blackout in northeastern United States and parts of Canada demonstrated the vulnerability of the electric grid. Subsequent investigation by a joint US-Canada working group came up with a number of recommendations to improve security of the grid, especially the establishment of mandatory reliability standards to replace the previous voluntary standards overseen by the North American Electric Reliability Council (NERC). This was accomplished in the 2005 Energy Policy Act, discussed later.

Energy Security: The New Context

Since 2004 there are signs that the world oil market has entered a new phase of higher oil prices. Surging oil demand in China, India, and the United States reduced spare capacity in the world oil system and raised oil prices in the summer of 2006 to above $70/barrel, although they have subsequently fallen back to $55-60/barrel. Another important factor is the increased political risk associated with oil production in a number of key producer countries (Venezuela, Nigeria, Iraq, Iran, Russia). Curtailment of production in any one of these countries could give a further upward jolt to oil prices, given the small amount of spare capacity in the system (about 1.5-2 mbd). Moreover, as demonstrated by hurricanes in 2004 and 2005, oil and other energy infrastructure is vulnerable to natural disasters, and may be vulnerable to terrorist attacks. In the United States there has been inadequate new investment in the refining sector and sometimes a shortage of facilities that can process lower grades of crude oil.

Another issue is the prospect, as contended by PFC Energy and Exxon Mobil, that non-OPEC oil production will likely peak during the period 2015-2020, leading to an increased requirement for OPEC oil and unconventional oil (e.g., Canadian tar sands). As non-OPEC oil declines, OPEC's market share and leverage in the world oil market will increase. At some future time, there is the possibility that OPEC, and especially Saudi, oil production will peak, but on this subject there are no reliable estimates since Saudi Arabia and other major OPEC producers do not publish reliable data on their oil reserves. Saudi officials say they are confident they can increase production if there is demand to 12.5 mbd, maybe even 15 mbd. But above that, there may be serious doubts.

A further consideration is the growing consensus that the prospect of global warming is a serious challenge. The International Energy Agency has pointed out that current patterns of energy use are leading to rising levels of CO2 emissions and are not sustainable. It has called for an alternative policy scenario to reduce CO2 emissions.[4] The recently released Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) asserts that the warming of the earth's climate is unequivocal, and is driven largely by human activities. It confirms the prediction in the previous report of serious rise in temperature in this century if nothing is done to limit greenhouse gas emissions, with the temperature range now estimated between 2-4.5 degrees Celsius. Consequences will

include the melting of glaciers, significant sea level rise, an increase of violent storms, spread of disease, etc. Oil use (primarily in transport) and coal use (in power plants) are the main contributors to CO2 emissions in industrial countries. This environmental problem is also becoming a security issue.

Finally, there is increasing concern that oil use reduces U.S. leverage in foreign policy. According to Senator Richard Lugar, until recently chairman and now ranking member of the Foreign Relations Committee, "…energy is the albatross of U.S. national security."[5] Higher oil prices and increased oil wealth feed corruption and slow democratic reforms in many producer governments. This is contrary to the objective of promoting democracy in the Middle East. The United States and other importers are helping to finance regimes that may support terrorism. Saudi Arabia is the leading case of this dilemma. The military costs of defending access to Middle East oil are heavy additional costs to the United States. A recent study of the Council on Foreign Relations emphasizes that U.S. dependency on imported oil constrains U.S. foreign policy and increases U.S. strategic vulnerability. The Task Force recommended adoption of incentives "to slow and eventually reverse the growth in consumption of petroleum products, especially transportation fuels such as motor gasoline" (although it could not agree on how to prioritize incentives such as a gasoline tax, stricter and broader CAFÉ standards, or the use of tradeable gasoline permits).[6] There is growing evidence that U.S. energy security policy has been too focused on the market. Oil consumption needs to be reduced to protect against the economic damage of oil shocks, increase foreign policy flexibility, and improve environmental sustainability. Reduction of oil imports should follow. At the same time, the United States needs to focus on how to reduce CO2 emissions more broadly, but especially from coal-fired power plants.

Evaluating the Policy of the G.W. Bush Administration

A strategy to meet America's oil challenges needs to address actions to: 1) expand and diversify supply, 2) reduce demand, and 3) develop alternatives to oil.[7] The policies of the current Bush administration are focused more on the first and third of these objectives and insufficiently on the second.

For example, the Energy Policy Act of 2005 signed by President Bush in August avoided the controversial demand-side issues of increasing the gasoline tax or strengthening CAFÉ auto efficiency standards. Opening the Arctic National Wildlife Refuge in Alaska to oil and gas development, favored by the administration, was not included in the Act (although the administration still supports this action.) But there are some smaller incentives for oil and gas production. There are some significant incentives for refinery expansion of at least 5 percent to refine oil shale or tar sands.

Regarding alternative fuels, a new ethanol mandate will increase ethanol production (mostly from corn) from 4 billion gallons per year to 7.5 billion gallons in 2012, which represents 4-5 percent of U.S. gasoline demand. There are some tax incentives for purchase of fuel cell, hybrid, or alternative fuel vehicles, which will be available for a few years. And there are tax credits available for investments in alternative fuel refueling stations.

All in all, the Energy Policy Act is more significant for changes in the electricity sector. In response to the northeast power blackout of summer 2003, the Act established mandatory electric reliability rules for utilities and other market participants and created a self-regulating electric reliability organization to be overseen by the Federal Energy Regulatory Commission (FERC). The FERC has more authority vis-à-vis the states to site new transmission facilities if the states cannot act. FERC authority was also strengthened to approve construction or expansion of LNG terminals in the face of the nation's future need for more LNG imports. In the area of renewable energy, a federal renewable portfolio standard (RPS) was opposed by the administration even though twenty-one states have such standards (including Texas). However, the federal government will be required to purchase an increasing portion of its power needs from renewable sources. Tax incentives for investments in renewable generation were only authorized for two years.

Coal and nuclear power received considerable support. Along with an R&D program on carbon sequestration, a $2 billion, ten year R&D program for coal gasification and related technologies was authorized. There are tax incentives for construction of a few ultra clean coal facilities including Integrated Gasification Combined Cycle (IGCC) to assist with commercialization of advanced technologies (but without requiring carbon capture and sequestration—possibly on the assumption that this can be added later). On nuclear power the Act extends Price-Anderson federal insurance limiting liability for nuclear power plant accidents and provides risk insurance for unexpected cost overruns caused by regulatory delays in construction of new plants. To further encourage new nuclear construction, a production tax credit of 1.8 cents per kwh is provided for the first 6000 MW of new plants built before 2021.

There is a lengthy section setting forth an R&D agenda on various energy technologies, the funding of which is subject to future decisions by Congress.

The administration of President G.W. Bush has supported filling and expanding the Strategic Petroleum Reserve as insurance against oil market disruptions. With a current capacity of 727 million barrels, the SPR will be expanded to 1 billion barrels. A small amount of oil was drawn down and/or exchanged in the fall of 2005 in a coordinated action with other IEA member countries in the wake of hurricanes Rita and Katrina. At this writing the SPR stands at 688 million barrels. More recently, the president has proposed doubling the size of the Strategic Petroleum Reserve to 1.5 billion barrels by 2027.

In his January 2006 State of the Union address, President G.W. Bush stated that "America is addicted to oil, which is often imported from unstable parts of the world."

In his view, the best way to break America's oil addiction is through technology. He announced an advanced energy initiative to be funded by a 22 percent increase in the Department of Energy's office of energy efficiency and renewable energy, which will include R&D on better batteries for hybrid and electric cars and hydrogen vehicles, also the production of cellulosic ethanol. This is an example of the current administration's over-emphasis on technology development, which can take a long time, rather than demand side measures to moderate or reduce the steadily increasing U.S. appetite for oil.

The president called for increased technology development to break the American oil addiction and "to replace more than 75 percent of our oil imports from the Middle East by 2025."[8] This was a curious statement, since only about 20 percent of U.S. oil imports come from the Middle East (see Figure 5)—although that percentage will likely increase in the future.

In his 2007 State of the Union address, President Bush further addressed America's oil problem by setting a goal of reducing the country's gasoline consumption by 20 percent over the next ten years. This will require a reform of CAFÉ standards, he noted, along with more alternative fuels such as ethanol and the setting of a mandatory fuel standard to require 35 billion gallons of renewable and alternative fuels by 2017. He urged that the nation "press on with battery research for plug-in and hybrid vehicles, and expand the use of clean diesel vehicles and bio-diesel fuel. We must continue investing in new methods of producing ethanol using everything from wood chips to grasses, to agricultural wastes." Concerning electric power, the president noted: "We must continue changing the way America generates electric power, by even greater use of clean coal technology, solar and wind energy, and clean, safe nuclear power."[9] Diversifying the U.S energy mix, he observed, will also help with climate change. Many of the president's proposals will require actions by Congress. The administration has subsequently submitted a bill, the Alternative Fuel Standard Act of 2007, that would mandate production of 10 billion gallons of alternative fuels (especially ethanol) in 2010, increasing to 35 billion gallons in 2017. It appears that any increase in CAFÉ standards will be left to the discretion of the Department of Transportation. A separate bill authorizing expansion of the SPR to 1.5 billion barrels has also been submitted to Congress.

Current Attitudes and Debates

Following the November 2006 midterm elections, the new Democratic majority in both houses of the U.S. Congress is changing the dynamics in certain energy and environmental debates, along with other factors. For example, there is now growing public support in the United States for mandatory federal reductions in carbon dioxide.

Several industry associations, led by the Edison Electric Institute, are now supporting federal action to reduce greenhouse gas emissions.

At least five bills are circulating in Congress proposing GHG regulation, and the new leadership in both the House and Senate have expressed strong support for action.

Governors of five western states have announced their intention to deploy a cap-and-trade program to reduce GHG emissions (following earlier announcement of similar action proposed by the New England states and New York).

Chief executives of America's largest automakers—General Motors, Ford, Chrysler, and Toyota North America—pledged in an appearance before Congress to support mandatory caps on carbon emissions, as long as the caps covered all sectors of the economy.

The proposed buyout of TXU Corporation, the large Texas utility, by private equity firms was accompanied by a side deal with leading environmental groups leading to an announced cutback in plans for new coal-fired power plants, from eleven to three, reflecting concern about the environmental viability of the earlier plans.

Chairmen of both the Senate and House energy committees have sent letters to leading industry and environmental groups requesting guidance on how legislation on mandatory GHG controls should be shaped.

It is unclear whether agreement can be reached in this Congress before the next election on mandatory federal GHG or CO2 controls, and if it were to be achieved, whether President Bush would sign any such bill. At a minimum preparation is being made for action after the next presidential election in 2008.

With regard to reform of CAFÉ fuel efficiency standards, new bills are being introduced in the Congress. Senators Barack Obama, Richard Lugar, Joseph Biden, and others have introduced the Fuel Economy Reform Act of 2007 which would establish a 4 percent increase each year in CAFÉ standards. It also would provide different standards for different types of cars, rather than insisting on a fleet wide average of a manufacturer. In the House, Congressman Edward Markey, chair of the new House Select Committee on Energy Independence and Global Warming, has introduced a bill that would raise CAFÉ standards from 27.5 to 35 miles per gallon by 2018 and provide for 4 percent annual increases each year thereafter. However, U.S. automakers have made clear their continuing opposition to CAFÉ standards and their views are strongly represented by Congressman John Dingell of Detroit, longtime chair of the House Energy and Commerce Committee. Mr. Dingell has, however, become persuaded that climate change is a problem and may be open to considering some kind of new CO2 standard for automobiles. House Speaker Nancy Pelosi is pressing for some kind of House action on CAFÉ, as well as climate change.

U.S. attitudes toward nuclear power have become much more positive, in contrast to the situation in Germany. There seems to be strong bipartisan support for nuclear energy in the U.S. Congress, as demonstrated by the incentive provisions included in the Energy Policy Act of 2005. This extends to important new Democratic committee chairs such as Senators Jeff Bingaman, chair of the Senate Committee on Energy and Natural Resources, and Barbara Boxer, chair of the Senate Environment and Public Works Committee, and John Dingell, chair of the House Energy and Commerce Committee. The one slight complication is Senator Harry Reid (Nevada), majority leader of the Senate, who favors nuclear power but opposes the Yucca Mountain project for deep geologic waste disposal in his state. This may shift attention to establishing an interim site

for waste disposal. Public opinion polling done for the Nuclear Energy Institute indicates more than 80 percent of the U.S. public favors a continuing role for nuclear in America's energy future, and two-thirds of the public are in favor of building new nuclear reactors.

Meanwhile, with anticipated rise in electric demand, some fifteen companies or consortia are preparing license applications to build and operate as many as thirty-three nuclear reactors, or approximately forty thousand megawatts of generating capacity. There are three early site permits under review at the Nuclear Regulatory Commission (one for Exelon has just been approved). Two designs for new standardized reactors, the Westinghouse AP1000 and the GE Advanced Boiling Water Reactor, have received NRC approval, and two more designs are under review.

Another recently announced nuclear initiative at the governmental level is the DOE's Global Nuclear Energy Partnership—an ambitious program over the next twenty or so years to develop advanced, more proliferation-resistant reactors, along with new methods for reprocessing and recycling spent reactor fuel. This might be an area for transatlantic cooperation.

Future Energy Challenges

As stated at the outset, the United States is the world's largest oil consumer and importer. The voracious American appetite for oil makes the country vulnerable to increasing risks. Sudden oil market disruptions caused by political turmoil in producer countries or by natural disasters can lead to price shocks that weaken the U.S. and world economies. OPEC market power, while somewhat weaker today in the wake of very high oil prices driven by increased worldwide political risk, will tighten in the future as non-OPEC production declines. Oil use, mostly in the transportation sector, contributes importantly to carbon dioxide emissions and global climate change. Revenues from oil production and sales often slow democratic reform and increases corruption in the producer countries—e.g., in the Middle East, and they may help to support terrorism. This interferes with and makes more difficult the exercise of U.S. foreign policy in the region.

To reduce oil vulnerability, the United States must focus on its transportation sector and improve the efficiency of oil use while developing alternative and lower carbon fuels. The options are:

1. ENCOURAGE IMPROVED VEHICLE MILEAGE USING EXISTING TECHNOLOGIES:

—Promote gasoline-electric hybrid vehicles (e.g., the Toyota Prius gets forty to fifty miles per gallon)

—Provide incentives for advanced diesel vehicles which are widespread in Europe but not in the United States. (Manufacturerers should be encouraged to reintroduce diesel vehicles and educate the public about their efficiency advantages.)

—Reform and strengthen CAFÉ standards, but based on vehicle attributes or classes

—A higher gasoline tax (unlikely to pass Congress)

2. ENCOURAGE COMMERCIALIZATION OF ALTERNATIVE FUEL VEHICLES AND FLEX-FUEL VEHICLES THAT CAN BE AVAILABLE SOON AND ARE COMPATIBLE WITH EXISTING INFRASTRUCTURE:

—Ethanol (first from corn, later from cellulose materials such as switch grass and agricultural waste). E-85 will require more ethanol filling stations.

—Bio-diesel and renewable diesel

—Plug-in-hybrids and improved batteries, which they will require.

In the United States ethanol is currently made from corn with a federal subsidy. It is expensive and requires a good deal of energy to make it. In 2005, about 13 percent of the U.S. corn crop was used to make ethanol. This is now to be expanded. Most ethanol is presently used as an additive to gasoline (about 10 percent). For a small additional cost, it is possible to shift to an E-85 (85% ethanol) vehicle. But this will require deployment of more ethanol filling stations. The environmental benefit of ethanol has

been debated. While burning corn ethanol does not itself create any additional carbon (it is a natural part of the carbon cycle), the use of fossil fuels to fertilize, grow, and harvest corn and change it into ethanol does release new CO2 and other greenhouse gases. At best, the greenhouse gas benefit can be about 15 percent less than the amount produced by burning gasoline.

The hope for the future is to use cellulosic ethanol which could be made from wood chips or switch grass and other prairie grasses grown on previously uncultivated land. Here the greenhouse gas benefit can be much greater. However, the technology to convert cellulose materials in a bio-refinery at acceptable cost does not yet exist. The Department of Energy is investing R&D funds into several demonstration plants.

In Brazil ethanol is made from sugar cane, which is much more energy efficient. Brazilian ethanol refineries burn cane residue which in effect recycles carbon from the atmosphere. As pointed out in a recent article by David Tillman and Jason Hill, "sugar cane ethanol grown on established soils releases 80 percent less greenhouse gases than gasoline."[10] But this changes if newly cleared lands have to be used to expand production, since clearing land itself releases large amounts of greenhouse gases into the air. The climate in the United States is not suitable for us to adopt large-scale growth of sugar cane to produce ethanol.

Bio-diesel is made from soybean oil in the United States and rapeseed and sunflower oil in Europe. Market development is more advanced in Europe and at an early stage in the United States. Blends of bio-diesel are 2 percent, 5 percent, and 20 percent. In 2005 bio-diesel was only responsible for .21 percent of total diesel fuel produced in the U.S., as compared with 2.85 percent as the ethanol share in the total gasoline pool.[11] With government incentives, however, bio-diesel production could also increase. At the same time the availability of B20 filling stations would also have to increase.

Hybrid vehicles are offered on the market by Toyota, Honda, Lexus, and other manufacturers. They offer greater energy efficiency and therefore savings in GHG. The next step in hybrids will likely be the plug-in hybrid electric vehicle. It will require a larger battery and electric motor to allow about 30 percent of miles driven to be electrically driven miles, with corresponding reduction in oil use and potential reduction in GHG as well as criteria emissions. There may even be potential to sell some electric power back to the grid. The immediate problem is the larger electric battery required for large swings in power use. Such a battery will be expensive and is still being developed.

3. LONGER TERM OPTION: HYDROGEN FUEL CELL VEHICLES

The hydrogen fuel cell vehicle, when perfected, carries the promise of high efficiency performance with practically no emissions and a replacement of petroleum. While the fuel cell vehicle was a primary focus of discussion a few years ago, consensus now seems to have formed that it is decades away. Much R&D work remains to be done to reduce fuel cell costs and extend their lifetimes, to explore the requirements of a hydrogen infrastructure and how to establish it, and to reduce the costs of hydrogen production—ideally from nuclear or renewable sources. If the hydrogen is produced from coal, CO2 will have to be captured and stored. Two authoritative studies, one by the National Academy of Sciences, the other by the IEA, suggest that fuel cell vehicles might be available to begin penetrating the market in the period 2025-2050.

Given the size of the American fleet of light duty and other vehicles (over 200 million) and the time it takes for entry of new models into the market and turnover of old vehicles, major change in the transportation sector will likely take decades. It will take some time to reduce U.S. oil dependence and vulnerability and the environmental implications of oil use.

With regard to the electric power sector, the major challenge is how to restructure the sector to reduce the very large carbon emissions from coal-fired power plants (about one-third of U.S. CO2 emissions today, and scheduled to grow larger in the future). Over time the expansion of nuclear power can certainly play a role if and as utilities place orders for more nuclear

plants (which will probably require 5-6 years to build). So can the expansion of renewable energy sources (especially wind and solar), which will grow, but starting from a very low base. Given that coal is abundant in the United States and relatively cheap, it will continue to be used. To make this possible in a carbon-constrained world, as pointed out in a new study from MIT, The Future of Coal: Options for a Carbon Constrained World, it will be necessary 1) to place a charge or price on emissions of CO2, which could be either a tax or the price of an emission allowance in a cap-and-trade system, and 2) to make progress on development and demonstration of CO2 capture and sequestration technologies. The latter will make coal use more expensive, but should be affordable, according to the MIT group, with a starting CO2 price of $25/ton.[12]

Coal is a very dirty fuel. Since the passage of the Clean Air Act of 1970, as amended, we have made considerable progress at reducing sulfur oxides, nitrogen oxides, and particulates from coal burning—especially under the acid rain emissions trading program established with the 1990 amendments. CO2 and global warming remain to be addressed. The scale of emissions is very large. One five hundred megawatt coal-fired power plant produces about three million tons/year of CO2. The United States, which has the equivalent of more than 500 megawatt coal-fired power plants (average life thirty-five years), produces about 1.5 billion tons/year of CO2 from coal-burning power plants.[13] The 2005 Energy Policy Act provided incentives for new clean coal plants, such as IGCC, but without requiring carbon capture and sequestration. Today there is no operating coal plant in the United States with CO2 capture and storage. The DOE FutureGen project, which is supposed to demonstrate an integrated clean coal system, is moving slowly and may take 8-10 years. The MIT study urges the government to accelerate and expand its efforts to demonstrate several alternative coal combustion and conversion technologies (e.g., IGCC, oxygen fired pulverized coal) along with CO2 capture and storage in order to provide the data and experience needed to make technology choices in the future. The United States also needs to encourage allied industrial countries to do the same, and to share data and experience.

Areas for Future Transatlantic Cooperation

The following are some areas identified for possible future transatlantic energy cooperation:

Advanced Nuclear Reactors and Fuel Cycles: The Bush administration's new intiative called the Global Nuclear Energy Partnership seeks international cooperation on the longer term development of advanced, proliferation-resistant reactors and limited reprocessing of spent nuclear reactor fuel.

Clean Diesel Engines: With their greater fuel efficiency, advanced diesel engines for passenger vehicles with low emissions are an attractive opportunity for the U.S. vehicle fleet. However, a major effort at demonstration and education is required to share European experience with the U.S. market and change existing stereotypes formed years ago about diesel technology.

Climate Change and Related Technologies to Reduce Carbon Emissions:If policies in Washington change (as appears likely) and the threat of climate change is assigned greater urgency, there should be important opportunities for European-American sharing of experience on reducing carbon emissions. This could range from lessons learned from the European emissions trading program, to R&D on carbon capture and storage and alternative fuel development.

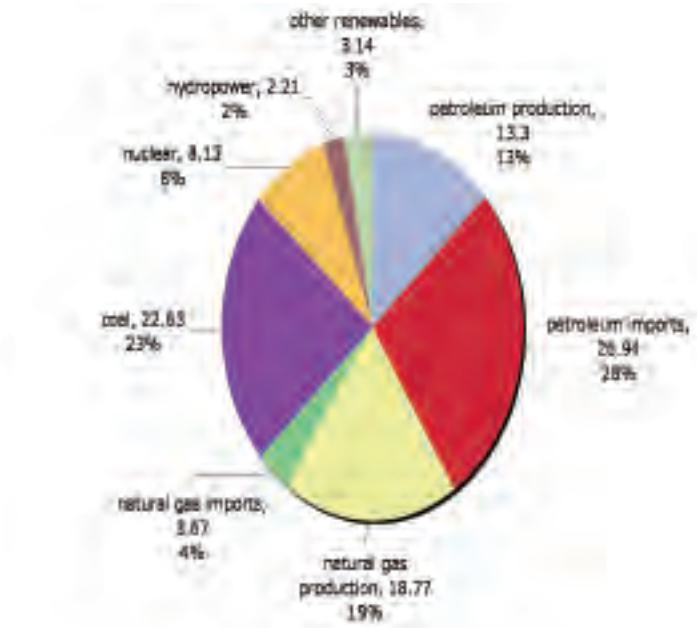


FIGURE 1. U.S. Primary Consumption (2005) (Quadrillion BTU)[a]

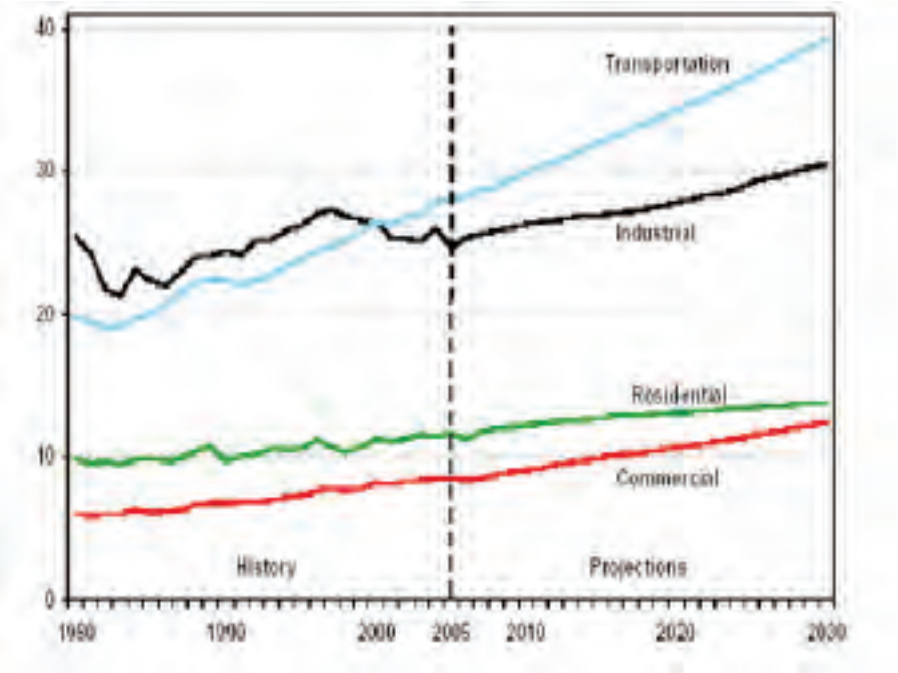


FIGURE 2. Delivered Energy Consumption by Sector, 1980-2030 (Quadrillion BTU)[b]

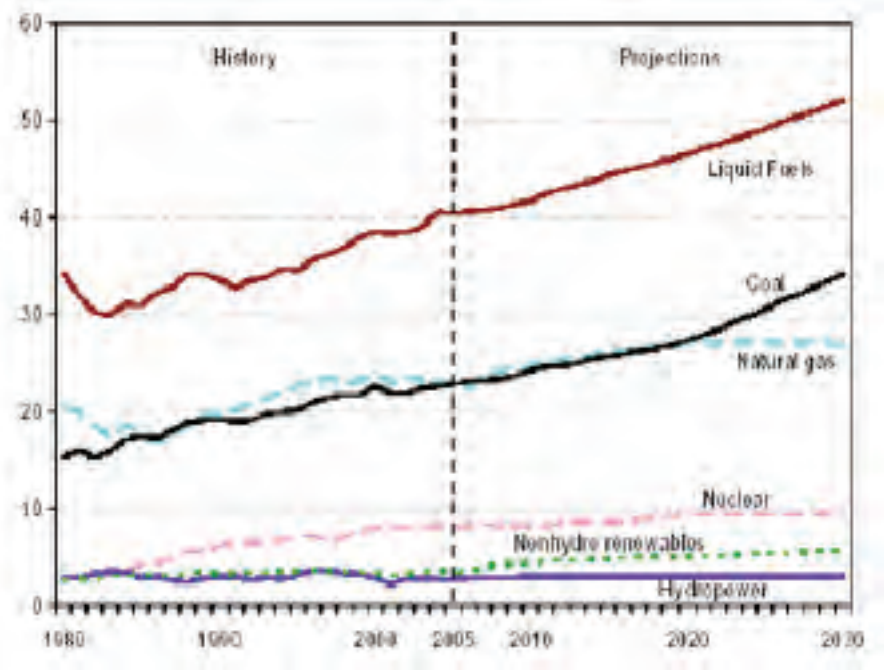


FIGURE 3. U.S. Energy Consumption By Fuel, 1980-2030 (Quadrillion BTU)[b]

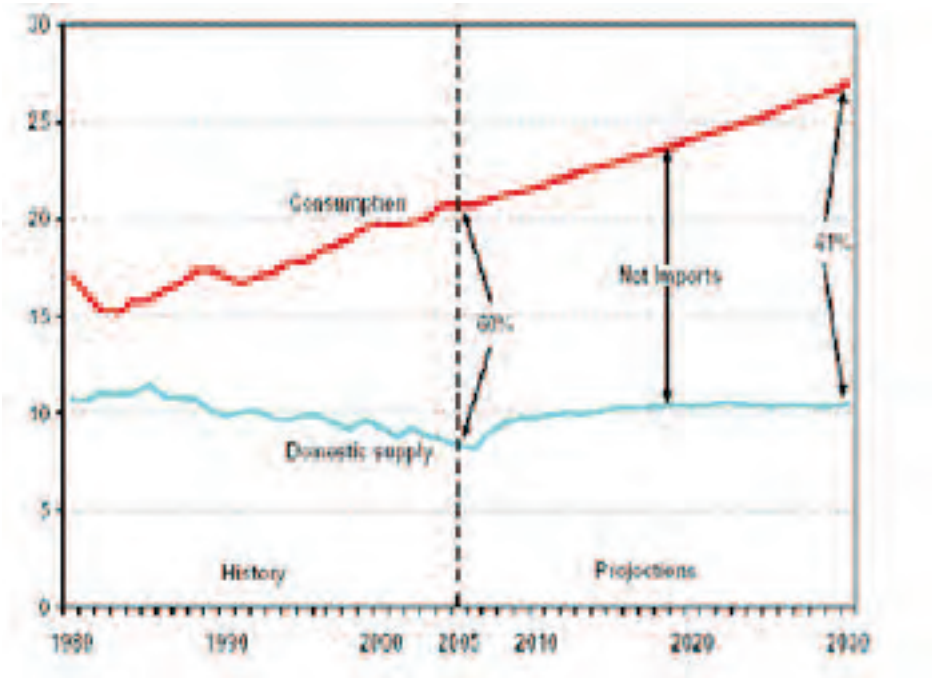


FIGURE 4. Liquid Fuels Supply, Consumption, and Net Imports,1980-2030 (million barrels per day)[a]

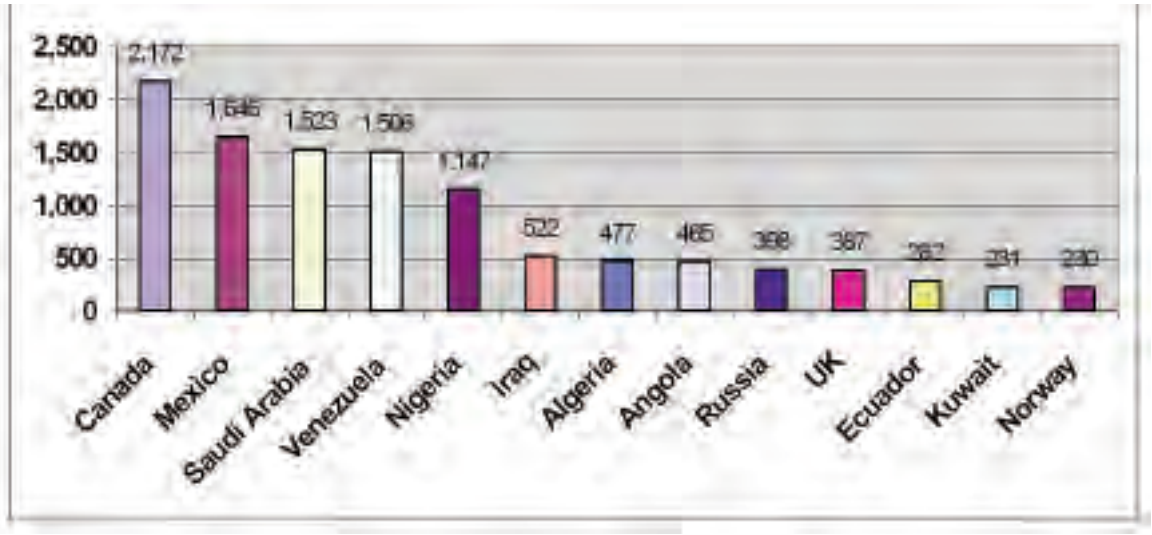


FIGURE 5. U.S. Oil Imports 2005 – Top Sources (thousand barrels per day)[c]

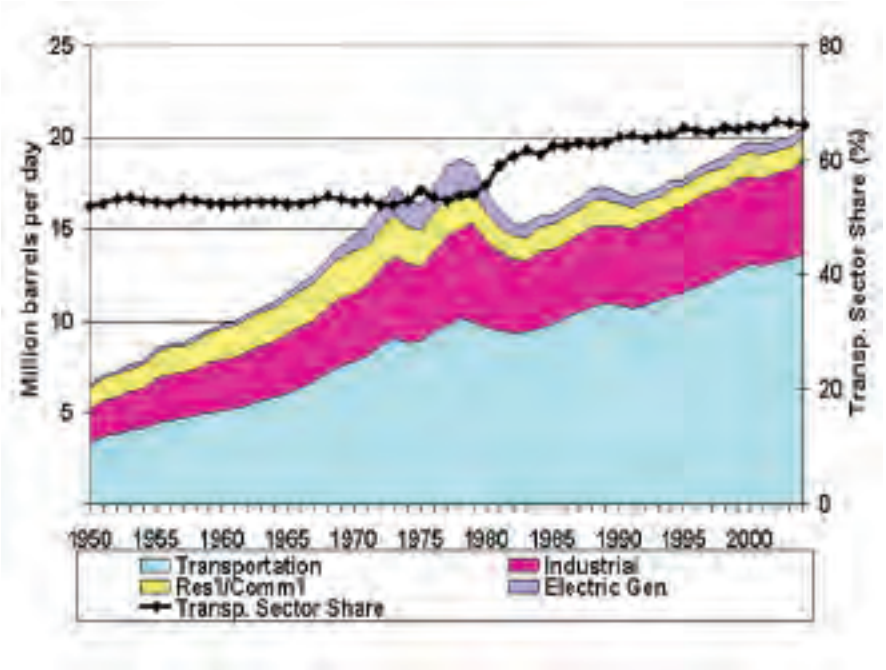


FIGURE 6. U.S. Oil Demand by Sector, 1950 - 2004 [a]

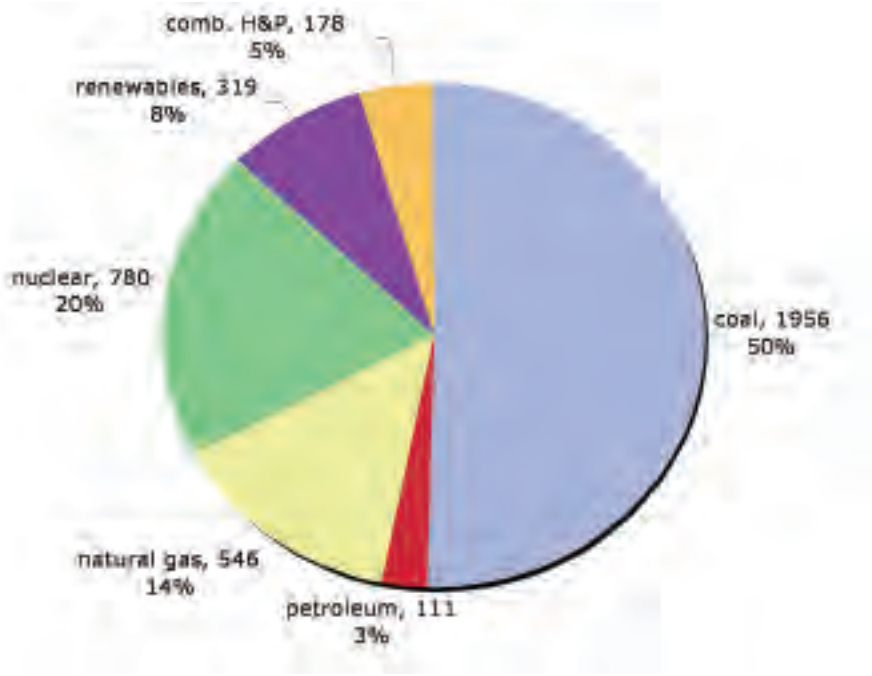


FIGURE 7. U.S. Electricity Supply (2005) (billion KWH)[a]

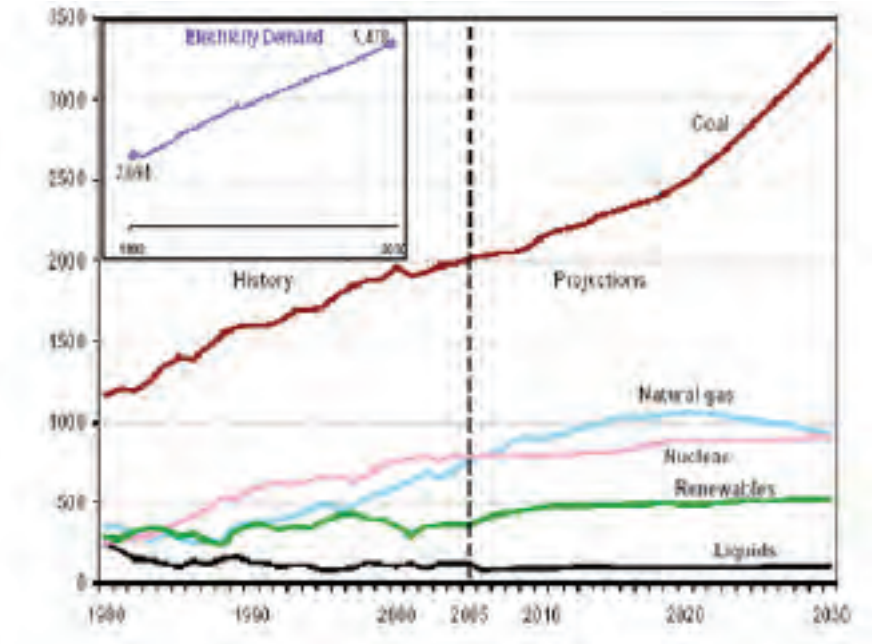


FIGURE 8. Electricity Generation by Fuel, 1980-2030 (billion kilowatt hours)[b]

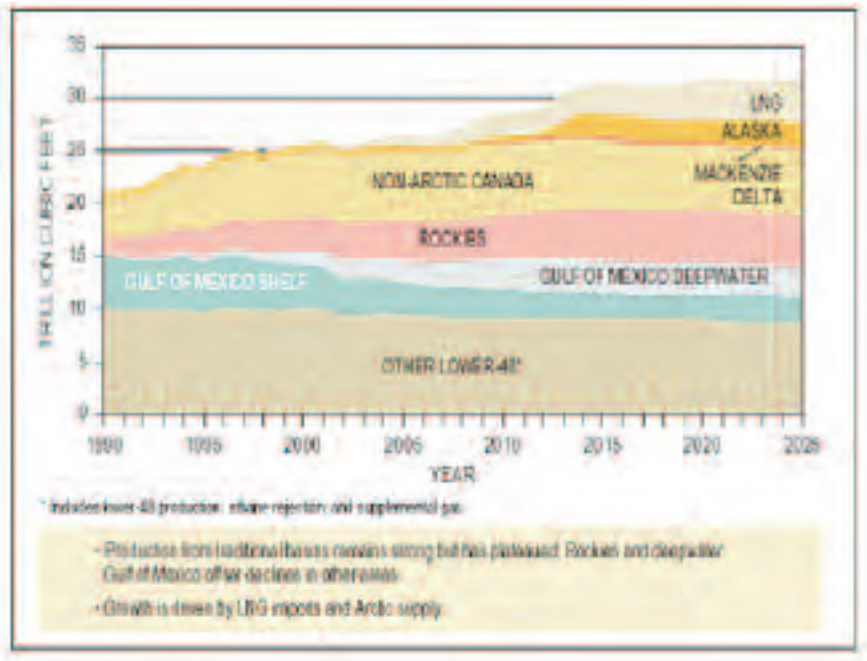


FIGURE 9. U.S. and Canadian Natural Gas Supply[d]

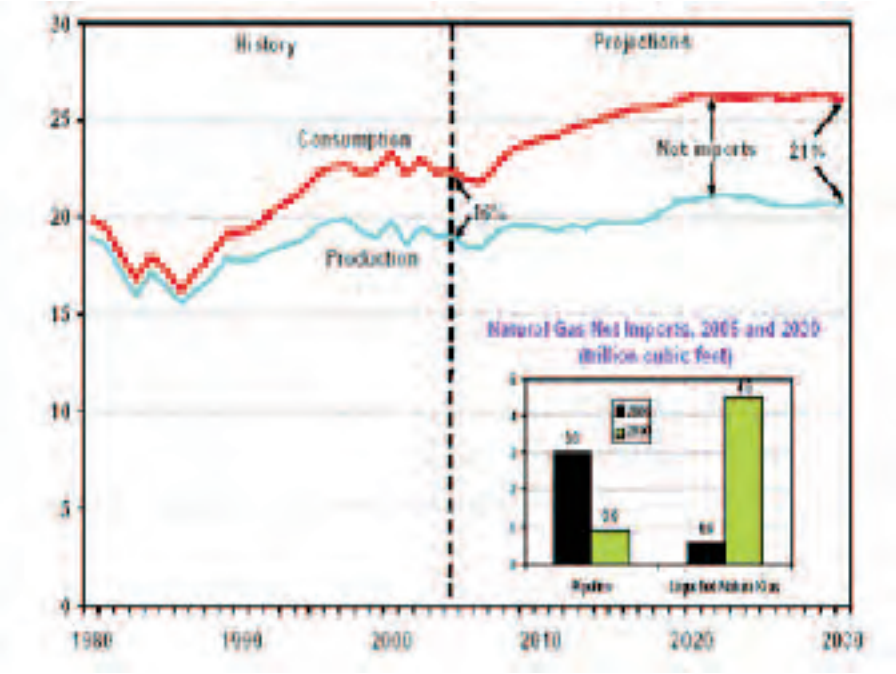


FIGURE 10. Natural Gas Production, Consumption and Imports, 1980-2030 (trillion cubic feet)[b]

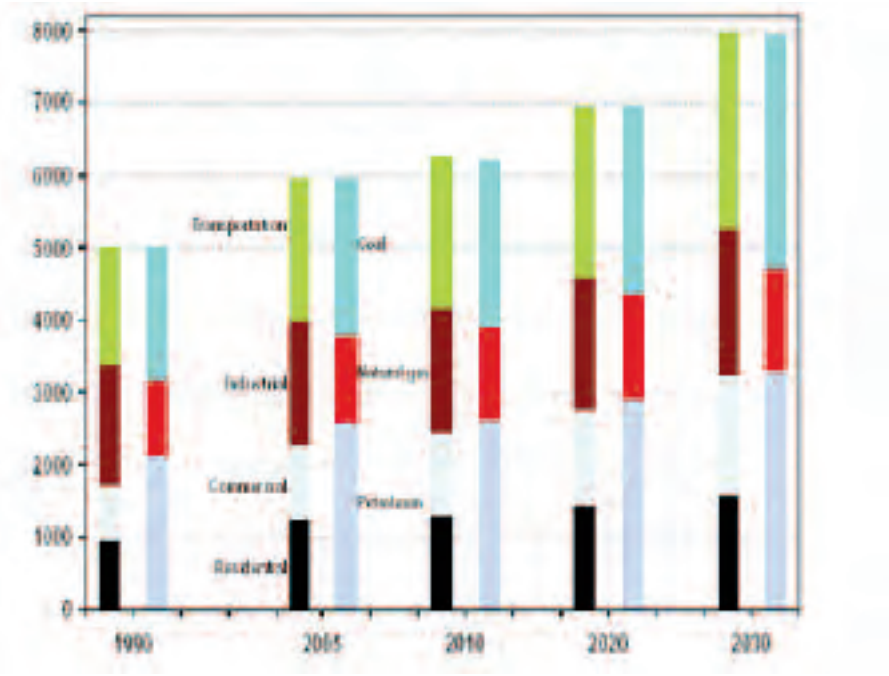


FIGURE 11. U.S. Carbon Dioxide Emissions by Sector and Fuel, 1990-2030 (million metric tons)[b]

Graph Sources:

[a] EIA data

[b] EIA, Annual Energy Outlook 2007

[c] EIA data Monthly Energy Review

[d] National Petroleum Council, Natural Gas Study (2003)

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02

CHAPTER TWO
ENERGY POLICY IN GERMANY

HOW TO SECURE RELIABLE ENERGY SOURCES IN GERMANY

FRIEDEMANN MÜLLER

Germany is the sixth largest energy consumer after the United States, China, Russia, Japan, and India. Germany's per capita consumption is approximately three times the world average but half that of the United States. The efficiency of energy consumption is rather high. The energy consumption per GDP unit in Germany is about half the world average.[1]

Introduction

During recent years, Germany's energy policy has come under pressure for two, or some might say three, reasons. The first of these is the occurrence of crises on the world energy markets, which have raised doubts about the reliability of oil and natural gas supply, a particularly critical issue in light of Germany's high degree of dependence on imports of these fossil fuels. The second is the publication of new findings on climate change, for instance in the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, Spring 2007), which has raised public awareness on the issue of climate change and called into question the sustainability of German and European energy use, particularly in light of the absence of a coherent energy strategy. A third might be the engagement of the Commission of the European Union, which possesses and makes use of its mandate to push forward the liberalization of the European energy market; this activity is, however, constrained by the very different philosophies prevailing among member states with respect to the question of which structure of the energy sector best serves national interests.

It is clear that energy policy is no longer a purely economic issue and thus no longer solely within the domain of the Federal Ministry of Economics as it was at the beginning of the twenty-first century. Instead it has become an issue dealt with by the German Chancellor, the Federal Ministry of Foreign Affairs, and the Federal Ministry of the Environment, as well as a focus of enduring public attention. Given this impetus for change in German energy policy, it is important to understand what drove German energy policy in the past and what options exist for a modernized approach.

Current Situation

THE STRUCTURE OF ENERGY PRODUCTION AND CONSUMPTION

Germany's energy consumption is structured very similarly to that of the rest of the world: oil is the most important energy source with a 36 percent share in total consumption (in 2006), followed by hard coal and lignite with 24 percent, natural gas with 23 percent, nuclear energy with 13 percent, and renewables with about 5 percent (see Table 1). Where Germany differs considerably from the rest of the world is in its efficiency gains in the past decades (26 percent between 1990 and 2006), which have outpaced economic growth, so that energy consumption in 2006 was not higher than in 1990 (or in 1980). The structure of energy consumption changed moderately during this sixteen year period. Oil retained its share of just over one third of total energy consumption, natural gas and renewables gained

seven and four percentage points respectively, and hard coal and lignite lost three and ten percentage points, respectively. In spite of the April 2002 decision to give up nuclear power, this energy source has retained its share of around one eighth of total energy consumption during the period in question.

The share of domestically produced energy in total energy consumption has decreased from 52 percent to 39 percent between 1990 and 2006.iii This decline applies to oil, natural gas, and hard coal as individual energy sources as well. Table 2 shows an absolute decrease in oil and coal production as well as a small increase in natural gas production (much smaller than the increase in consumption). The absolute decline in hard coal production during the sixteen year period and the decrease in domestic supply of hard coal are remarkable. This plunge is a result of the decision to replace domestic coal with cheaper foreign coal. A government decision of 7 February 2007 provided for a steady reduction of coal subsidies to zero and thus for a closure of the last hard coal mine in Germany by 2018.[4]

Lignite production warrants special attention here. In the German Democratic Republic (GDR), lignite was the only domestic energy source (apart from nuclear power produced using uranium from sources under Soviet control). After German reunification in October 1990, lignite production was reduced drastically but remained the most important domestic energy source next to nuclear power. Lignite is produced in surface mines in the new Laender (the former GDR) as well as in North-Rhine Westphalia at prices competitive with those prevailing on the world market. It is primarily used for production of electricity, with 92 percent of supply being used for this purpose. The disadvantage of this energy source lies in its high CO2 emissions per unit of energy produced.

Production of electricity absorbs roughly one third of primary energy production. Only about ten percent of electricity produced is traded with neighboring countries. While natural gas increased its share in electricity production from 6.5 to 11.6 percentage points and all renewables from 3 to 11.9 percentage points, coal lost 11.6 percentage points, dropping from 56.7 to 45.3 percent (see Table 3).

This trend in the distribution of shares in total energy consumption is likely to continue in the coming years. This will mean an increase in the use of renewables and natural gas and a loss of market share by nuclear power and hard coal. This trend is driven mainly by legislative measures including the establishment of carbon trading, the cutting of price supports for domestic lignite, and the 2002 decision to phase out nuclear power in Germany. Whether lignite can maintain its substantial market share depends to a large degree on progress in R&D on clean coal power. The imposition of carbon trading alone is expected to significantly increase the economic incentive to use renewables as well as natural gas as opposed to energy from coal-based power plants not equipped for carbon capture and sequestration (CCS).

IMPORT DEPENDENCE

The share of imports in German energy consumption has grown steadily since 1990. Two major reasons can be given to explain this development. One reason is the significant increase in natural gas imports, coupled with stagnation in domestic natural gas production since 1995. While domestic production covered 25 percent of consumption in 1990, this figure fell to 15 percent by 2006. The other reason for Germany's increased dependence on imports is the trend towards a liberalized hard coal market, which has had the effect of raising the import share in consumption from 9 percent in 1990 to 66 percent in 2006. From the perspective of import dependence, hard coal imports cannot be considered as problematic as oil and natural gas imports. The major exporters of hard coal to Germany are Poland (23 percent), South Africa (20 percent), Commonwealth of Independent States (CIS) countries (18 percent), Australia (11 percent), and Columbia (9 percent). With regard to oil and natural gas, German import dependence is more troubling due to the fact that the major exporters of these energy resources are countries that generally do not play by the rules of a free market.

The major supplier of oil to Germany is Russia with a share of more than one third of total imports, followed by two European countries, Norway and the United Kingdom (see Table 4). The former Soviet Union

(Russia plus the Caspian states) produces 43 percent of German oil imports, the North Sea region 31 percent, and OPEC 21 percent. While this distribution is relatively diversified, it still cannot be regarded as sustainable. Production of North Sea oil is rapidly diminishing, with the joint production of Norway and Great Britain falling from 5.9 million barrels per day (mbd) in 2001 to 4.8 mbd in 2005, a decrease of around 19 percent. This trend is expected to persist. Russia may decide not to maintain its share in German exports at the current level due to technical limitations preventing large production increases and its plans to diversify its exports to increasingly include East Asia.[7]

Diversification is more critical in the case of natural gas imports to Germany than in the case of oil. One country and, in fact, one company, namely Gazprom, supplies 41 percent of imports to Germany, accounting for 35 percent of consumption. Germany derives 59 percent of imports, accounting for 50 percent of consumption, from the North Sea (Norway, Netherlands, UK, Denmark), a group of natural gas producers with stagnating and, in the longer run, declining natural gas production (see Table 5).

The main problem is that Germany receives all its natural gas imports by pipeline. No liquefied natural gas (LNG) ports exist yet in Germany. The only site earmarked for an LNG port—in Wilhelmshafen—has been owned by E.ON-Ruhrgas for decades, but to date no construction has taken place there. The beginning of construction is, however, perhaps in sight. Nevertheless, Germany does not have the technical capacities to substitute natural gas from Russia with natural gas from other sources in case of a cut in Russian supply. The only spot market from which natural gas could be transported into the German net, in Zebrugge (Belgium), is much too small to provide an alternative to Russian natural gas sources. Second thoughts were raised in Germany about the reliability of Russian natural gas supply at the beginning of 2006, when a conflict between Russia and the Ukraine over the price of natural gas to be paid by the Ukraine resulted in the interruption of natural gas deliveries from Russia to central and west European countries. To date the natural gas transport infrastructure does not, however, permit alternatives to the existing sources.

THE STRUCTURE OF THE DOMESTIC ENERGY INDUSTRY

Foreign companies control the importation and distribution of oil in Germany; Exxon, Shell, BP, ENI, and Total are the major companies that operate the network of gas stations in Germany and control the distribution of heating oil. The domestic market is generally a competitive market and, where it is not, can be corrected through the instruments available to the Federal Cartel Agency (Bundeskartellamt). The markets for types of energy distributed through a grid (electricity and natural gas) are less competitive.

Four companies produce 80 percent of electricity used in Germany: RWE (with a capacity of 26.6 GW), E.ON (24.9 GW), Vattenfall Europe (16.9 GW), and EnBW (13.8 GW). RWE and E.ON are majority German-owned companies, Vattenfall Europe primarily Swedish-owned, while a significant share of EnBW is French-owned (through Electricté de France). These companies have divided Germany into four regions in which they act as quasi-monopolists, with RWE controlling the western, EnBW the south-western, E.ON the central and south-eastern, and Vattenfall the eastern (former East German) section. They also operate parts of the electricity grid, delivering power to roughly one third of end consumers.[10]

About thirty regional companies contribute 10 percent to electricity production and similarly control a market share of around one third of end consumers. Approximately 60 percent of these companies are state-owned. The number of regional companies has declined from fifty-two companies in 1997 to thiry companies in 2002 as a result of the process of liberalization of the distribution market. A group of around 850 local distributors, or “Stadtwerke,” claim about one third of electricity distribution to end consumers. Thus only a limited degree of competition has been possible to date. However, the path towards liberalization of the electricity market has been set. The decision was made at a summit of the European Council in Lisbon in March 2000 to liberalize all sectors not yet subject to liberalization, including the

energy market. In 2003, the European Parliament endorsed the directive of the European Commission to enforce third-party access to all electricity grids as well as the right of industrial consumers to freely choose their electricity supplier from July 2004, to be extended to private households from July 2007.

In principle the natural gas market is subject to the same directive. This directive was translated fully into German law at the end of 2001, granting third-party access to natural gas pipeline networks under equal conditions as those available to the owners of these networks. In its strategy paper to the European Council of 10 January 2007, the European Commission recommended unbundling of ownership of pipeline networks from ownership of the means of energy production and distribution.xi Whether this recommendation will become law is doubtful, however, since France immediately announced its unequivocal resistance to property unbundling. Major German companies such as the Big Four of the energy market also lobbied massively against this proposal.

POLICIES INFLUENCING ENERGY CONSUMPTION AND PRODUCTION

In principle, German energy legislation is guided by a triad of goals known as the "magic triangle," namely economic efficiency/competitiveness, security of supply, and environmental sustainability. While there is no question that the fulfillment of all three goals is in the interest of German society, these three goals are not necessarily compatible. Consequently, interest groups have incentives to seek to emphasize one of the three goals at the expense of one or both of the others. German policy seeks to shape energy production and consumption in order to support all three goals. Basically four instruments are employed in this context: subsidies, taxes, a special law designed to increase the share of renewables in electricity production, and emission trading on a European level.

Subsidies: Direct subsidies are applied only in order to maintain hard coal production in Germany for the next dozen years. Between 1990 and 2005, domestic hard coal production was cut to one third and replaced by imports, while subsidies during the same period were reduced to less than half, from €5.3 billion in 1990 to €2.5 billion in 2006.xi The official rationale for these subsidies is the maintenance of supply stability in the electricity sector. The primary reason is to protect jobs in the mining sector for a limited period in combination with an exit strategy to prolong the demise of this sector, which is linked to the industrial development of Saar and Ruhr regions. On 7 February 2007 a government decision was issued to steadily reduce and to end all subsidies by 2018.

Taxes:[13] The petroleum tax (Mineraloelsteuer) and eco-tax pursue a number of goals. The legal basis of the petroleum tax is given by the petroleum tax law of 21 December 1992. The object of this law is:

—To raise money for the federal budget, in particular for transport infrastructure measures. Roughly half of the revenues from the petroleum tax are allocated to road construction.

—To internalize environmental costs. While gasoline, oil, and natural gas for heating systems, etc., are subject to the petroleum tax, biofuels are not, at least not until after 31 December 2006. Since the beginning of 2007, the system has changed insofar as biofuels are no longer subsidized by tax exemption but are instead promoted through regulations that prescribe the addition of biofuels to all gasoline sold in Germany.

—To give domestic energy sources preferential treatment. The coal tax is much lower than the petroleum tax.

The eco-tax was established in parallel to the petroleum tax after the coalition of Social Democrats and Greens came to power following the 1998 parliamentary elections. This tax is applied to all energy sources including renewables. The rationale behind the imposition of this tax is that the market does not reflect the limitations of (primarily fossil) energy. If a price increase results in a more economical use of energy, this should contribute to the goal of sustainability. In the first round of implementation, starting on 1 April 1999, only electricity was subject to additional

taxation through the eco-tax beyond the already existing petroleum tax. In the five subsequent rounds, all other energy sources were included so that state revenues from this tax grew from €4.3 billion in 1999 to €18.1 billion in 2004. No tax increases were ordered since. The goals of the eco-tax are twofold:

—To contribute to the awareness of the scarcity of energy;

—To lessen wage dependent contributions to the social security system.

From its inception, the eco-tax was designed to finance the social security budget. In 2004, for instance, €16.0 billion out of the €18.1 billion collected through the eco-tax flowed to the state pension fund and only €0.1 billion went to supporting renewable energies.

The petroleum tax discriminates between leaded gasoline, unleaded gasoline, and diesel, and between fuels with high sulfur content and those with low sulfur content (see Table 6).

The Renewable Energy Sources Act:[15] The Renewable Energy Sources Act came into force on 1 April 2000 and the current revised version on 1 August 2004. This Act regulates the purchasing of renewable energy and compensation for renewable energy fed into the electricity grids. Grid operators are obliged to connect renewable energy installations to their grids and to compensate the (renewable) electricity producers according to the following price list:

The range of prices fixed for individual energy sources and differences in prices between energy sources reflect the size of power plants and the level of development of the technology (hydro power is considered a fully developed technology, while small power plants are deemed as requiring support, even if they are not fully competitive).

wind power	5.5 to 8.7	Euro ct/kWh
offshore wind	6.2 to 9	Euro ct/kWh
geothermal electricity	7.2 to 9	Euro ct/kWh
bio electricity	8.4 to 11.5	Euro ct/kWh
hydro power	3.7 to 7.7	Euro ct/kWh
solar	45.7 to 62.4	Euro ct/kWh

The Act is designed to serve the goal to have a 12.5 percent share of renewables in electricity production by 2010 and 20 percent by 2020.

The Emission Trading System (ETS) of the European Union: The European Union established a system of emissions trading among its member states in order to achieve the goal of reducing greenhouse gas emissions by 8 percent by the period from 2008-2012 relative to 1990 levels as required under its Kyoto Protocol obligations. Each member state was required to provide a National Allocation Plan (NAP) for CO2 credits during the first implementation period from 2005-2007 (NAP I). Roughly 12,000 EU installations were included in the system, representing 45 percent of EU energy consumption. The system covers only the energy production sector and energy intensive industries. For Germany, the cap during the NAP I period was set at 499 million tons of CO2 emissions per year. For NAP II, Germany initially proposed a cap of 482 million tons. This proposal was, however, rejected by the EU Commission. Germany finally accepted a cap of 453.1 million tons.

ETS Phase II (2008-2012), the parameters of which have not yet been fully established, will probably also cover the aviation sector, the sector experiencing the fastest rate of greenhouse gas emissions growth. ETS will be extended beyond the twenty-seven EU member states to include four European non-member countries. During Phase I, the price of carbon emissions on the stock market reached a high of €30 per ton of CO2 in April 2006, a price level high enough to have an effect on consumption and competitiveness of fossil fuels with respect to other energy sources. However, the price fell to below €10 per ton when it became clear that no real shortage of emissions rights would be experienced during Phase I. The EU is seeking to ensure that there will be a significant scarcity of emissions rights during Phase II.

Apart from utilizing the four instruments described above to serve the "magic triangle" of goals, Germany

has set into motion a massive change in the structure of energy production and consumption through its decision to give up nuclear power. An agreement between the Social Democratic/Green coalition government and German energy industry was reached on 14 June 2000 under which the parties decided not to build new nuclear power plants and to close existing nuclear power plants by around 2020. The agreement was translated into a revised law on nuclear energy that came into force in April 2002. Although the Christian Democratic parliamentary faction voted against the law, the Christian Democrats agreed to disagree with the Social Democrats but not to change the law in the coalition treaty signed between them on 11 November 2005.xvi As the debate on climate change heated up in recent months, both Christian Democrats and representatives of the German energy industry attacked the Social Democrats for clinging to the 2002 decision, arguing that forgoing nuclear energy would make it impossible to achieve ambitious CO2 reduction goals. Christian Democrats and the majority of energy industry representatives claim that, even if no new nuclear power plants are built, the extension of the operational lifetimes of existing power stations would buy time to shift to other energy sources. Although some Social Democrats have expressed doubts about the wisdom of a complete relinquishment of nuclear power within the next fifteen years, it seems improbable that a majority could be established in the parliament to revise the law prior to the 2009 elections.

The Players and Their Agenda

Historically, the German energy market has been rather fragmented. This fragmentation dates back to the late nineteenth century, when many small companies developed regional electricity markets.xvii Before and after World War I, very small companies were merged into more efficient regional enterprises. During the 1930s, the Nazi regime centralized the whole energy sector. After World War II, the energy distribution companies were generally privatized, and the former situation of fragmentation was re-established, at least on the level of distribution to the end consumer. The monopolistic structure, however, was not given up. The Act against Restraints of Competition (Gesetz gegen Wettbewerbsbeschraenkung) of 1957 explicitly exempted regional monopolistic structures for the distribution of electricity and natural gas from this Act.xviii It is liberalization directed from the EU level that has brought about, on the one hand, the establishment of competitive structures and, on the other hand, a series of mergers designed to help companies survive in an efficiency-driven market.

According to EU regulations, foreign companies may not be discriminated against as investors in the energy sector. As the largest economy in the EU, Germany has an interest in preventing its energy sector from being mostly or totally partitioned among foreign companies. The threat of this occurring is imminent insofar as Germany traditionally has no big companies involved in oil or natural gas exploration. While other European countries are the home of companies such as BP, Shell, Total, ENI, and Statoil, German companies are not involved in this business. All efforts during the 1960s and 1970s to develop such a company—Deminex, a company for which the big electricity companies provided the capital —failed. Deminex was sold to a Canadian company in the 1990s. Therefore, the philosophy of supporting "national champions" gained influence in German political circles. The Ministry of Economics has promoted this idea, which is not necessarily compatible with the principle of supporting competition. The case of the November 2001 application by E.ON, one of the major German electricity companies, for a merger with Ruhrgas, the largest German natural gas importer, is illustrative of the politics of industry promotion in Germany. This application was rejected by the Federal Cartel Agency (Bundeskartellamt) in January 2002. As Ulf Boege, head of the Agency, argued, "The fusion of E.ON and Ruhrgas would cement the dominant position of Ruhrgas during a phase of burgeoning liberalization on the natural gas market."[19] However, the Minister of Economics made use of the prerogative granted him under German law to veto the decision of the Federal Cartel Agency in cases of urgent political necessity, paving the way for final approval of the merger in March 2003. The basis for this decision was that, in a globalizing energy market, "national champions" would be needed as partners for firms such as Gazprom, whose largest

international client is Germany.

These policies have promoted five national champions, four in the electricity sector (E.ON, RWE, Vattenfall, EnBW) and two in the natural gas market (E.ON-Ruhrgas and BASF-Wintershall), whereas E.ON counts for both markets. These national champions have a tremendous influence on the Ministry of Economics when it comes to lobbying in Brussels or, for instance, designing the NAP and distributing emissions rights.

Apart from the energy industry, the automobile industry is particularly engaged in lobbying to influence the decisionmaking process on regulatory measures in the energy field. When the EU Commission, for instance, proposed a mandatory limit for automobile CO2 emissions of 120 grams per kilometer in January 2007, after the automobile industry had failed to fulfill its voluntary goal of 140 grams per kilometer, lobbying against this proposal was so extreme that the Minister of Economics and the Chancellor herself put pressure on the Commission not to impose such measures. The reason for the particularly strong resistance of Germany to this proposal, as compared to other EU member states, derives from the fact that the German automobile industry produces on average bigger and more expensive cars than other European automobile industries.

The German Industry Association (Bundesverband der Deutschen Industrie, BDI) published a position paper calling upon the federal government to ensure, particularly in the context of its EU presidency, that:

—Nuclear energy is part of the modern energy sector;

—More R&D is undertaken on energy technologies;

—Efficiency increases are a central focus of European policy;

—The United States, China, and other major economies are included in any post-Kyoto Protocol climate policy arrangements.[20]

Apart from the Ministry of Economics, the major government agencies that exert an influence on the energy sector are the Ministry of the Environment — particularly through its mandate over national and international climate policy issues—and, more recently, the Ministry of Foreign Affairs. It is notable that the Ministry of Economics, which regularly proclaimed its unique capacities in dealing with energy policy in its annual report on the state of the economy,[21] since 2006 refers to the "global dimension of energy supply, the risk on the world energy markets, Germany's growing dependence on imports and the danger of climate change [which] all require intensive cooperation on European and international level."[22]

Foreign Minister Frank-Walter Steinmeier launched the concept of "Energieaussenpolitik" (external energy policy) in January 2006, writing in a seminal article that "energy must not become the currency of power in international politics."xxiii Concern over the possibility of energy becoming just that is not unfounded. Increasingly, leaders of energy-producing countries such as Venezuela and Iran, but also Russia, which is economically closely linked to Germany and the European Union, have expressed new self-confidence due to the their ability to pick and choose countries with whom to supply their energy. In a speech given at the start of Russia's first G8 presidency in December 2005, President Vladimir Putin stated: "Our country enjoys a natural competitive advantage, and has natural and technological capabilities for taking more prominent positions on the energy market. We must use these positions in the interest of the whole international community, but not to the detriment of our national interests".[24] In contrast to a few years earlier, no doubts exist among serious stakeholders that foreign policy has to contribute to securing energy supplies.

The Ministry of the Environment is involved in energy policy with regard to the structure of energy production and consumption (the share of renewables and the nuclear component), on the issue of supporting improvements in energy efficiency, and the structure of the NAP. It supports R&D and finances subsidies to make renewables competitive. It advocates efficiency requirements for energy-intensive equipment and vehicles and supports renouncing nuclear energy

—at least since 1998 when the leadership of the Ministry was held by Greens or Social Democrats.

Each of the three ministries active in energy policy claims to be the prime advocate of one of the three goals represented in the "magic triangle," with the Ministry of Economics associating itself with the goal of economic efficiency and competitiveness, the Ministry of Foreign Affairs with that of security of energy supply, and the Ministry of Environment with that of sustainability. Each of the Ministries appears to doubt, however, that the others are adequately fulfilling their respective goals. Thus, the Ministry of the Environment questions whether the Ministry of Economics does enough to promote energy efficiency; the Ministry of Foreign Affairs suspects that the Ministry of Economics engages in lobbying Brussels more to advance the interests of national champions than to promote more competitive structures that might serve both to reduce prices but also guarantee greater security of energy supply.

Being aware of the high degree of disagreement prevailing among the major players in the energy game, the Chancellor convened an "Energiegipfel" (energy summit) in 2006. The intention of this project was to bring together all relevant parties for three meetings in the space of two years (2006/2007) and establish three working groups, "international issues," "national issues," and "research and efficiency," to operate between the summit meetings. The first meeting took place on 3 April 2006. Major outcomes of the meeting included a pledge by the energy industry to invest more than €70 billion into new power plants and transport infrastructure by 2012 and a decision to increase the public R&D budget for energy technology by at least 30 percent by 2009. The second meeting on 9 October 2006 did not bring much visible progress. Instead of making use of the opportunity to build a consensus, the divide widened between those promoting a revival of nuclear power and those insisting on phasing out this source of energy. After the meeting, however, the Chancellor pointed out the need for improved efficiency (the ambitious goal is to halve energy consumed per GDP unit by 2020 as compared to 1990), to generate more competition, and to establish climate policy for the period following the expiration of the Kyoto Protocol in 2012.[xxv] The final third meeting in 2007 might help to establish a better understanding of how to harmonize the lobbyism of different interest groups with regard to the triad of goals. It should also explore different scenarios on the development of the international energy market and serve to prepare a comprehensive national energy concept, which should be provided by the government in the second half of 2007.[26]

New Challenges

In the last few years, the German public has become increasingly aware that energy is not a normal world market good with a price closely matching marginal costs. On the contrary, energy can be used as a political weapon as it was during the first oil crisis of 1973/74. The limited availability of fossil fuels, particularly oil and natural gas, as well as the high concentration of the remaining reserves in very few regions, which generally do not adhere to western (or WTO) market rules, creates major distortions of the market. It also transforms the ability to choose whom to supply with scare energy resources into a powerful political weapon.

Another factor that must be taken into account by energy policy is the potential for climate change, whose economic dimensions are becoming increasingly important. This topic is no longer just an issue for environmentalists. A study published by the German Institute for Economic Research, which gained much public attention, argues that the direct impact of climate change will cost the German economy €330 billion by 2050 and even more in the second half of the century if no drastic additional measures are taken. Combined with the indirect costs of climate change to health, in terms of adaptation, etc., the total costs would amount to around €800 billion by 2050 or 0.5 percent of economic growth annually. Considering that the average economic growth rate for Germany has been around 1.5 percent annually over the past two decades, this factor must be considered very significant indeed.

GROWING DEPENDENCE AND CHANGING CONSTELLATIONS ON THE WORLD MARKET

After one and half decades of functioning competition on the international oil market, OPEC has once again been able to successfully use its main policy instrument, production limitation, to drive up the oil price, as it did during the 1970s and early 1980s. It has become clear that non-OPEC suppliers cannot capture the market shares given up by OPEC through its production limitations, as they did during the 1980s. On the contrary, the price tripled between Spring 1999 and Summer 2000. This spike in the oil price signaled the beginning of a newly invigorated cartel and the politicization of the oil trade. Although OPEC pledged in 2000 not to use its cartel power for political ends and introduced a price band of twenty-two dollars to twenty-eight dollars per barrel, within which it promised to keep the oil price, this relatively stable situation held for only three years. In late 2003, the oil price broke through the upper limit set by the price band and never returned to this range again. Several influential OPEC member country representatives, such as the presidents of Venezuela and Iran, made clear that they consider their oil export potential to be a political weapon.

The increase in the oil price to above seventy-five dollars per barrel and the volatility of the oil price, as perceived by investors, but also crises provoked by relatively minor events like strikes in Venezuela, riots in Nigeria, hurricanes in the Gulf of Mexico, or three-day delivery cuts in Russia, generated a debate on energy security in Germany that is by no means ended yet.xxvii There are fears that the situation on the international oil market will become more and not less strained. Four long-term trends could support this hypothesis:

Existing oil reserves are increasingly becoming concentrated in the Middle East region, which already now controls 62 percent of world reserves.xxviii This trend is a result of the faster exploitation of oil reserves in other regions. The frequently cited argument that non-conventional sources of oil such as oil sands but also coal liquifaction could compensate shortfalls in conventional production is of dubious validity. Particularly in Germany there is an expectation that the problem of climate change will become more urgent in international politics and that a universal price will be set on carbon emissions; thus, non-conventional oil, which is intensive in terms of CO2 emissions, would not gain major market shares. This belief is supported by the findings of major institutions dealing with trends in the international oil market.xxix The concentration of remaining oil reserves in the Middle East is not good news, particularly for OECD countries. In spite of the fact that numerous spot markets exist on the world market, relations between producer and consumer countries are governed primarily by stable long-terms trade structures. Russia, for instance, delivers practically all its exported oil to Europe, while Canada, Mexico, and Venezuela export primarily to the United States. The Middle East already today delivers more than half of its oil to Asia and will likely increase this share substantially in the future.xxx

All major consumer regions (North America, Europe, East/South East Asia) will face an absolute reduction in their oil production during the coming decades.xxxi Thus import dependence will increase, even if these regions maintain oil consumption at the present level, which is a tall order considering rapid expansion of the transportation sector, the fastest growing energy-consuming sector in these regions and worldwide.

The increase of demand in the emerging economies of Asia will bring about a dramatic change in the world oil market. This change reflects the development process of approximately three billion people in Asia who want to motorize their professional and private lives in the twenty-first century, mirroring the process that took place in industrialized countries with their (today's) 1.2 billion people (including Russia) in the twentieth century. China alone has changed from a net exporter, as it had been until 1993, to the third largest importer of oil in the world. Asia as a whole will become the world's largest import region, though it is unclear how far world oil supply, increasingly in the hands of the Broader Middle East, will be prepared to adjust to new demand from Asia in addition to demand from its other traditional consumers.

If in 1973 approximately 20 percent of the oil extraction business was in the hands of state-owned

companies, today it is more than 80 percent. This tendency supports the politicization of oil investment and trade. Saudi Arabia has never accepted foreign investors in its oil extraction industry, and Iran has followed this example since the inauguration of President Mahmoud Ahmadinejad. Both Venezuela and Russia have increasingly limited opportunities for foreign investors in their oil extracting industries. Combined with the special case of Iraq, where foreign companies are hesitant to invest due to security concerns, a situation materializes in which open market conditions are not provided for investors in any major oil producing country. The result is a massive undercapitalization of the oil industries in these countries.

No similar trends can be identified on the international natural gas market. First of all, it must be pointed out that there is no such thing as a world natural gas market. Instead three almost completely separate natural gas markets exist, one in North America, one in Russia/Europe, and one in the Asia/Pacific region. The reason for this fact is that most internationally traded natural gas is transported by pipeline, with only one quarter being transported by LNG tanker, of which 60 percent is delivered to just two countries, namely Japan and South Korea. LNG is, however, the sole possibility for a link between the separate markets and the Middle East, principally Qatar, which will be the major source of natural gas supply in the future.

Germany is by no means prepared to face the future challenges on the natural gas market. More than 40 percent of its imports come from Russia, the rest from North Sea littoral states. The major problem is that both sources, combined with the 15 percent share of domestic production in consumption, will not be able to retain their market share in Germany. Russia plans to diversify its natural gas exports towards the East Asian market and possibly even the US market. Estimates based on EU statistics indicate that, although Russia will increase its exports to Europe by about 12 percent between 2000 and 2020, the Russian share in European natural gas imports will decline from 67 percent to 33 percent.xxxii The North Sea, including German domestic natural gas production, is already today declining in absolute terms.

It will be impossible to cover the continuously rising demand for natural gas in Germany (1.4 percent average annual growth over the past ten years) with supply from declining production in the North Sea. The problem lies in the lack of infrastructure that could enable access to other supply markets in the South Caspian area and the Middle East. To overcome this problem, efforts must be concentrated on two projects: one is the construction of an LNG port, the other is the completion of the European Nabucco pipeline project, which will cross Turkey from east to west and could, at least theoretically, open extraction sites not only in Azerbaijan, Turkmenistan, Iran, but also in Egypt and Qatar to the European market and increase competition on this market. The political challenges to this project are twofold: the first lies in the fact that Russia opposes such a project, since it has an interest in preserving its rather monopolistic position as the supplier of the world's largest natural gas import market, Europe; the second derives from the fact that geography gives Iran a key position. If Iran is not included in the network, the project hardly makes sense. At present, though, the dispute over the Iranian nuclear program prevents a cooperation deal of this size and importance from being concluded. While Europe is unwilling to make a deal in this matter in order to gain access to the region's natural gas, China may not be as hesitant. For China, securing adequate supplies of natural gas is a major long-term concern too.[33]

CLIMATE CHANGE

Germany, like 188 other states including the U.S., China, and India, is committed to the United Nations Framework Convention on Climate Change (UNFCCC), which in its Article 2 states the goal of restricting emissions of carbon dioxide and other greenhouse gases in such a way as to "prevent dangerous anthropogenic interference with the climate system."[34] The Third Conferences of Parties to the Climate Convention passed the Kyoto Protocol to which the European Union and all its member states, including Germany, are bound. The Protocol obliges the EU to reduce its greenhouse gases by 8 percent relative to emissions in the base year 1990 during the period from 2008-2012. An agreement reached at a meeting of EU environment ministers in

Luxembourg on 17 June 1998 established a burden-sharing scheme within the EU, the so-called EU bubble. Under this burden-sharing scheme, Germany must reduce its greenhouse gases by 21 percent during the period from 2008-2012. Germany was in a position to take on this more than proportional burden since East German energy consumption plunged after the German unification in 1990, due to the restructuring of its inefficient economy and shifts in the structure of energy use (less lignite, more natural gas), both of which brought about significant reductions in greenhouse gas emissions. By 2005, Germany achieved a 19 percent reduction in greenhouse gas emissions as compared to 1990.[35]

A number of recent events such as record temperatures in Summer 2006 and in Winter 2006/2007 sparked new concern in Europe about the threat of climate change. Perhaps more significant even was the publication of the Fourth Assessment Report (AR4) of the United Nations Intergovernmental Panel on Climate Change (IPCC) and more specifically that of Working Group 1 ("The Physical Science Basis") on 2 February 2007.[36] This concern intensified the discussion on energy consumption and climate change at international meetings such as the first EU summit under the German presidency, held in Brussels from 8-9 March 2007. After years of having been the sole domain of environment ministers with their narrow mandate, following the conclusion of the Climate Convention at the 1992 UN Conference on Environment and Development (UNCED) in Rio de Janeiro and the adoption of the Kyoto Protocol in 1998, the topic has finally arrived on the agendas of heads of state in Germany and other EU countries. As a consequence of this new development, no strategic step with regard to the structure of the energy sector is made without taking into account the link to climate policy.

EU AMBITIONS

Since 2000, the EU Commission has published a series of papers drawing the attention on the worsening situation in the areas of both security of energy supply and climate change. The green paper "Towards a European Strategy for the Security of Energy Supply"[37] (November 2000) could not initiate, as intended, a discussion on issues related to security of energy supply under a given Kyoto-based framework of obligations, because too many contradicting interests were touched. The paper was therefore attacked with the imputation that the Commission was seeking to claim competences that are, in fact, in the hands of the member states. It is indeed a problem that the Commission has been granted competences in competition policy and environmental policy by the member states but not in energy policy as such. This authority is conceded to the EU in the draft of the European Constitution.[38] But so far the constitution contract has only been ratified by two thirds of the member states, with referenda in France and the Netherlands producing negative votes. As a result, the constitution has not come into force yet.

Nevertheless, the member states have become more sensitive to the necessity of a common strategy for securing energy supplies. The Commission took a new start with the green paper "A European Strategy for Sustainable, Competitive and Secure Energy," released on 8 March 2006.[39] This green paper, which was much more warmly received than its predecessor, draws the attention to the growing dependence of Europe on imports, the growing energy demand on the world market, and dramatically increasing global CO2 emissions—which have risen by 60 percent with respect to 1990 levels. At the beginning of 2007, the Commission drafted the paper "An Energy Policy for Europe" in accordance with a request from the European Council.xl This paper forms the basis of the decisions on the agenda of the German presidency in the European Council during the first half of 2007. It makes clear that primary challenges to be addressed by a coherent European climate policy are deficiencies in the liberalization process and growing import dependence. It contains an action plan as well as concrete proposals such as the contentious suggestion to "unbundle" ownership of means of energy production and transport, as discussed above. It is up to the German presidency to make progress with regard to these controversial discussed issues.

OPTIONS AND THE DOUBLE PRESIDENCY

Germany holds the presidency of the European

Council during the first half of 2007 and the presidency of the G8 during the whole of 2007, at a time when energy security and climate policy have grabbed headlines the world over. The many different interests of major players in Germany, in the European Union, and within the Group of Eight make it very difficult to achieve significant results with regard to the challenges posed by a volatile international oil market, an inadequately structured natural gas market, and the necessity of much stronger global measures to fight global change if the common goal of Article 2 of the UNFCCC is to be achieved.

What are the options for achieving greater security of oil supply? Better diversification of supply sources than currently exists is, at least with regard to the most important energy carrier, oil, not a possibility for Germany. On the contrary, the three countries with the largest share in German oil imports, Russia, Norway, and the United Kingdom, with a combined share of the consumer market of 63 percent (see Table 4), will not be able to provide the necessary amount of oil to keep this market share in the coming years. Countries that are less committed to free market rules will have to take over these shares of the supply. In principle, Germany can influence its security of supply on three levels. However, taking action in this context makes sense only if Germany can cooperate with other European and/or G8 states.

On the first level, a possible option is to initiate a consumer-consumer dialogue. Thus far, the newcomers on the international oil market, China in particular, have not adopted rules of transparent competition. China's state-controlled oil companies can make concessions on the political level and pursue a political agenda. Nevertheless, it is becoming more and more difficult for China to solve its own problems with respect to security of energy supply. The growth of China's oil demand is extremely rapid (with a growth rate of 7.4 percent annually between 1995 and 2005), and it is additionally faced by a world market structure that privileges established multinational oil companies. Thus China, like India and other newcomers, must be interested in common rules instead of conflicts over access to oil supply. This dialogue can, however, only take place on a global level, through forums such as the G8.

On the second level, a possible option is to launch a consumer-producer dialogue. The EU has established such a dialogue with its main energy supplier, Russia, but a similar dialogue with OPEC has remained at a low level. Between 2000 and 2003, OPEC demonstrated some sense of responsibility for the world economy by trying to keep the world oil price in the range between twenty-two dollars and twenty-eight dollars per barrel. A serious high-level dialogue might remind OPEC of its responsibility in a globalizing world.

Both dialogues will, however, probably not solve the structural problem generated by a steadily growing demand in Asia and the reluctance of the countries with major oil reserves to invest into oil exploration according to market rules. The problem is that demand in Asia for a very attractive energy source, namely oil, is growing at a time when peak production of this resource is to be reached within two decades. This problem can only be solved if those countries that dispose of technologies that could substitute oil make a "man to the moon" R&D effort and combine it with a regulatory regime that prohibits the use of oil-powered engines in new cars from a fixed year (such as 2030) onwards. This kind of solution is only practicable as a joint effort by the G8 countries.

With regard to natural gas, the options to reduce the problem of securing energy supply are totally different. First, while for oil a system has been organized since the 1970s to establish strategic reserves coupled with a mechanism to exchange oil in case of a regional oil shortage, nothing comparable has been created for natural gas. The storage of natural gas is more difficult because it requires empty caverns that are not universally available. Germany has relatively ample options for storing natural gas. But because of geological differences, it is more difficult to develop a system of exchange between different EU or OECD countries for natural gas than for oil. But more could be done to agree on a common mechanism.

The more important option is to better diversify sources of natural gas imports. Italy, for instance, imports natural gas from Russia, the North Sea, and North Africa (Algeria, Libya, Egypt) and makes significant use of LNG. Germany can only import natural

gas from Russia and the North Sea and very small amounts of LNG via Zebrugge. The lack of infrastructure at Germany's disposal has to do with the interests of the main importing companies. They prefer to minimize competition on the German market because they are vulnerable due to their long-term purchasing contracts with Gazprom. It is critical that the German government adopts the interests of the consumer in competition and security of supply by supporting the development of infrastructure within Europe and from potential exporters to the European market.

With regard to the restrictions to energy supply needed to prevent climate change, the German government must attend to two components. The first is to develop a comprehensive least-cost strategy, rather than relying on isolated measures such as vehicles emission standards. The second is to recognize that the climate change problem is a global problem and to direct more political energy toward reaching a global consensus, or at least one that incorporates all major countries (G8 plus O5), on a concept for future climate policy. It is obvious that the type of grandfathering principle for distributing emission rights enshrined in the Kyoto Protocol is unacceptable to the newly emerging economies in Asia. A strategy has to be developed that gives the Asian countries an incentive to participate in emission restrictions.

The EU summit held in Brussels from 8-9 March 2007 concluded with a relatively disappointing result: a commitment by the European Union as a whole to reduce greenhouse gas emissions by 20 percent until 2020 relative to 1990 levels and to impose a mandatory 10 percent share of biofuels in the gasoline mix by 2020. These measures will not ease the problem of security of energy supply. The EU Commission's paper "An Energy Policy for Europe" proposes farther-reaching targets, including that "by 2020 all new coal-fired plants should to be fitted with CO2 capture and storage and [that] existing plants should then progressively follow the same approach."xli A strong regulatory regime setting, for instance, a date for phasing out all oil-fueled automobiles, would have an impact both on security of energy supply and climate change. It may be difficult to achieve a consensus on such bold measures. On the other hand, the risk and political costs of a policy that hardly differs from "business as usual" are incalculable. The year 2007 will be decisive for Germany because of the coincidence between its national energy summit process and its control of the EU and G8 presidencies. If this year does not bring breakthrough results, it seems difficult to imagine that the topic will again reach the same priority on the agendas of top politicians in the near future unless a real catastrophe forces the implementation of crisis management measures.

Recommendations for a joint transatlantic approach

The availability of energy on the world market has been transformed into a central foreign policy issue by a number of factors: limited global reserves of fossil fuels, mainly oil; shift of worldwide demand towards the Asian emerging economies; the link between fossil fuel consumption and climate change; and the re-nationalization of the production sector in the most important oil-exporting countries and, thus, politicization of oil and natural gas export potential. It is obvious that conflicts in Africa and potentially in the Middle East and the Caspian region are generated or fueled by global power politics designed to create access to exploration sites, transportation lines, or long term contracts. These conflicts are unrelated to market adjustments or transparent and fair bidding schemes. Rather, they reflect the state-controlled monopolistic structure of international oil supply.

The United States and Europe have common interests as major traditional oil consumers and both have at their disposal an array of new technology options as leading industrial countries. Common interests exist primarily in two dimensions, a resource management dimension and a rule-making and enforcement dimension. In the first dimension, a mutual interest exists in applying common rules for stock building and concerted management and distribution of stocks during times of abrupt scarcity. The establishment of the International Energy Agency (IEA) in 1974 and its mandate reflect this shared interest. To date, the IEA is considered to adequately fulfill objectives in this dimension. In the second dimension, a shared interest exists in establishing common international rules for a transparent and fair world market. As a

newcomer, China may feel compelled to condone corruption, violence, human rights violations, and a weakening of the rule of law in producer countries in order to seize a foothold in the rigid world oil distribution system; however, using such dubious methods will only gain it a temporary advantage. The United States and Europe must assume a leadership role in (re-) establishing common rules together with both emerging major consumers and also with producers, reminding them of their responsibility in a globalizing world.

The United States and Europe must make much greater use of the array of new technology options available to them than is currently the case. On both sides of the Atlantic, the awareness has emerged that the Oil Age is coming to an end—and within the lifetime of people living today. Specifically, the end of the Oil Age would mean the elimination of oil as the leading energy source in general and sole (significant) fuel in the transportation sector. We also know that roughly three times as many people live in Asia as currently inhabit western industrialized countries (including Japan) and expect that these people will want to develop in a way that copies the western style of individual mobility and transportation. This aspiration can only be realistically reached if those who have alternatives to oil as the main fuel for transportation actually make use of them. Western industrialized countries, which have thus far accounted for the largest share in global oil consumption, must make an effort to develop breakthrough technologies leading to a post-Oil Age, whether this technology be in the direction of bio-fuels, hydrogen, electro-cars, or some other source of energy for the transportation sector. It is obvious that technological progress on its own will not solve the problems outlined above. Since the market does not adequately reflect future scarcities or externalized costs of distribution conflicts or climate change, a regulatory regime is required to break consumer countries out of their defensive position relative to oil-producing countries.

A joint transatlantic R&D effort coupled with a ban on the sale of new cars using oil-fueled engines from 2030 onward could give science and investors an incentive to compete for market shares in a post-Oil Age automobile market and transportation system. It is quite clear that there will be winners and losers on these new markets. Therefore it is of extreme importance that at least western industrialized countries establish a unified front and do not provide a safe haven to the lobbyism of potential losers. If western industrialized countries enter into the post-Oil Age, emerging Asian countries will inevitably follow with a few decades' delay, since, in the long run, there is not enough oil for even them alone. The necessity of a transition into a post-Oil Age will be further underlined by the requirements imposed by the shared goals of the Climate Convention.

Common R&D efforts should not be restricted to developing alternatives to oil in the transportation sector but also to increase the share of non-carbon emitting energy sources in general. These alternatives might include carbon capture and storage, nuclear fission, nuclear fusion, and, of course, renewable energy. Joint R&D efforts already exist in all of these fields. Nevertheless, R&D expenditures on energy technologies on both sides of the Atlantic Ocean suffered under budget cuts during the past decades. A new effort should speed up the search for alternative options. A major project to this effect could be to establish solar power stations in the sun belt of African and Asian countries, linked with hydrogen production, which could be a natural substitute to oil production in the long run. This, of course, would necessarily mean political cooperation with these countries in order to generate investment of petro dollars into this future energy source. The prevention of violent distribution conflicts and disastrous climate change effects should encourage such an attempt to involve African and Asian countries in the search for a solution to the common global energy security problem.

	1990	Share in Total Percent	2005	2006	Share in Total Percent
Oil Products	5238	35.1	5152	5164	35.7
Natural Gas	2316	15.5	3250	3300	22.8
Hard Coal	2306	15.5	1843	1876	12.7
Lignite	3201	21.5	1596	1573	10,9
Nuclear Energy	1668	11.2	1779	1826	12.6
Renewables and Others	187	1.3	697	797	5.5
Minus Net Electricity Exports	-	-	-31	-72	-
Total Consumption	14916	100	14286	14464	100

Table 1: Germany's Primary Energy Consumption in Peta Joule (PJ)

	1990	Share in Consump-tion Percent	2005	2006	Share in Consump-tion Percent
Oil	156	3	152	152	2.9
Natural Gas	589	25	604	596	18
Hard Coal	2089	91	756	639	34
Lignite	3142	98	1606	1594	100
Nuclear Energy	1662	100	1777	1825	100
Renewables and Others	180	96	668	768	96
Total Energy Production	7821	52	5563	5574	39

Table 2: Germany's Primary Energy Production in peta joule (PJ)

Primary Energy Source	1990	Share in Total Percent	2005	2006	Share in Total Percent
Hydro	19.7	3.5	27.3	27.9	4.4
Nuclear	152.5	28	163	167.4	26
Hard Coal	140.8	26	134.1	136	21
Lignite	170.9	31	154.1	152	24
Natural Gas	35.9	6.5	71	73.5	12
Oil	10.8	2	11.6	10.5	1.7
Wind Power	-	-	27.2	30.5	4.8
Others	19.3	3.5	32	38	6
Total	549.9	100	620.3	635.8	100
Renew-ables	3.00%		10.40%	11.90%	

Table 3: Germany's Gross Electricity Production in terawatt-hours (TWh), 1990-2006[6]

Exporting Country	Imports thousand barrels/day	Import Share percent
Russia	738	34
Norway	372	17
UK	264	12
Libya	248	11
Kazakhstan	152	7
Saudi Arabia	72	3.3
Syria	68	3.1
Nigeria	62	2.9
Algeria	46	2.1
Azerbaijan	38	1.7

Table 4: Distribution of Germany's oil imports (2006)[8]

Exporting Country	Imports	Share in Imports	Share in Consumption
	TWh	Percent	Percent
Russia	418	41	35
Norway	322	32	27
Netherlands	227	22	19
UK/Denmark	48	5	4
Total	1015	100	85
Domestic Production	182	-	15
Consumption	1197	-	100

Table 5: Distribution of natural gas imports (2005)[9]

Fuel	Euro cents	Euros
	per Liter	per gallon
Unleaded gasoline	66.98	2.54
Sulphur above 10 mg/kg		
Unleaded gasoline	65.45	2.48
Sulphur below 10 mg/kg		
Leaded gasoline	72.1	2.73
Diesel	48.57	1.84
Sulphur above 10 mg/kg		
Diesel	47.04	1.78
Sulphur below 10 mg/kg		
Light heating oil	6.34	0.24
Heavy heating oil	2.5	0.09
LNG	60.6	Euros/1000 kg
Natural Gas	5.5	Euros/MWh

Table 6: Tax on Different Fuels 2005[14]

NOTES

1 World Energy Council, Energie fuer Deutschland 2006 (Berlin, October 2006): 49.

2 DIW Berlin, Wochenbericht 8/2007: 107; and EEFA (Berlin, February 2007):4.

3 Nuclear energy is treated here as a domestic energy source because energy production through nuclear power stations takes place domestically. The raw material (uranium), however, is imported. Some German statistics therefore treat nuclear energy as imported.

4 The federal government as well as the governments of North-Rhine Westphalia and Saarland, the two states (Laender) where hard coal is produced, were involved in this decision. Under this decision, the federal parliament (Bundestag) must revisit the policy in 2012 and can revise the decision if the burden of the subsidies falls entirely on federal authorities. The Laender will cease to share the burden of subsidies (Der Tagesspiegel, 8 February 2007).

5 EEFA (Berlin, February 2007): 4; and DIW Berlin, Wochenbericht 8/2007: 107.

6 Source: DIW Berlin, Wochenbericht 8/2007: 116

7 Roland Goetz compares a number of estimates on peak Russian oil production from Russian and OECD country sources. These sources conclude that peak production lies somewhere in the range of 11 to 12 mbd, which should be reached between 2015 and 2020. By comparison, production in 2005 was 9.6 mbd. See Roland Goetz, Russlands Erdoel und der Welterdoelmarkt, Stiftung Wissenschaft und Politik, S 40, December 2005:15.

8 DIW Berlin, Wochenbericht 8/2007: 110.

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11 EU Commission, An Energy Policy for Europe (SEC (2007) 12), Brussels 10 January 2007. See: http://ec.europa.eu/energy/energy_policy/doc/01_energy_policy_for_europe_en.pdf

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13 Bundesministerium fuer Finanzen, Lexikon Steuern, 26 June 2005.

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18i See http://www.bundeskartellamt.de/wEnglisch/download/pdf/06_GWB_7__Novelle_e.pdf.

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22 Federal Ministry of Economics and Technology, Annual Economic Report 2006, Berlin 2006: 69.

23i Handelsblatt, 23 March 2007.

24 Speech by Vladimir Putin on 22 December 2005, cited in: http://www.rferl.org/featuresarticle/2006/02/7428f1aa-b0af-4262-9ef4-b9ec69e48afa.html.

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26 Bundesministerium fuer Wirtschaft, Jahreswirtschaftsbericht 2007: 46.

27 Friedemann Mueller, Demands Imposed on German and European Foreign Policy by Changed Configuration in the World Market, Stiftung Wissenschaft und Politik, RP 2, January 2007.

28 BP Statistical Review of World Energy, June 2006: 6.

29 The two most prestigious institutions for international energy projections, the Energy Information Agency (EIA) of the US Department of Energy and International Energy Agency, an organization affiliated with the OECD, project that non-conventional oil will account for a less than an 8 percent share of global oil consumption in 2030, while the increase in global oil demand will be in the range of 40 percent. Source: Energy Information, International Energy Outlook 2006, Washington, June 2006: 30; International Energy Agency, World Energy Outlook 2005: 90.

30 EIA, International Energy Outlook 2006: 35.

31 IEA, World Energy Outlook 2006: 92.

32 Roland Goetz, Russlands Energiestrategie und die Energieversorgung Europas, SWP. S 6, March 2004: 17.

33 David Zweig and Bi Jianhai, China’s Global Hunt for Energy, Foreign Affairs 84, No. 5 (September/October 2005): 25-38.

34 UNFCCC, June 1992, see http://unfccc.int/essential_background/convention/background/items/1349.php.

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36 The results of the report are summarized at http://en.wikipedia.org/wiki/IPCC_Fourth_Assessment_Report.

37 COM (2000) 769, Brussels, 29 November 2000, http://eurlex.europa.eu/smartapi/cgi/sga_doc?smartapi!celexplus!prod!DocNumber&lg=en&type_doc=COMfinal&an_doc=2000&nu_doc=769.

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