CHAPTER 11

Recent Developments in Energy

Energy is essential to the U.S. economy. It provides light and heat for our homes and businesses, brings our computers and appliances to life, and powers life-saving medical devices. It propels the automobiles, buses, and trains that carry us to home, work, and school, and the aircraft that fly us from city to city. It fuels the tractors that harvest our food, the machines we use to turn raw materials into final products, and the trucks, trains, and ships that carry these goods across our Nation and around the world. All told, the United States spent about $870 billion on energy in 2004, an amount equivalent to 7.4 percent of GDP, and was on pace to spend an estimated $1.1 trillion on energy in 2005, or about 8.6 percent of GDP.

Over the past several decades, the U.S. economy has seen a steady decline in its energy intensity—that is, the ratio of total physical units of energy consumed per dollar of real GDP. Nonetheless, households and businesses remain keenly aware of the prices they pay for energy products and the impact of rising energy prices on their budgets and bottom lines. When prices change gradually, households and businesses have time to adapt their energy consumption levels, fuel choices, and purchases of energy-using products to new price levels. Sometimes, however, disruptions to our energy production and distribution infrastructure, such as those caused by the recent hurricanes Katrina and Rita, result in temporary but sharp price increases to which households and businesses cannot adjust quickly.

This chapter discusses energy markets—systems that connect consumers and suppliers of energy products, where prices are determined by what buyers will pay and what sellers will accept. The chapter reviews recent developments in energy markets for crude oil, refined petroleum products, and natural gas, as well as recent developments in the electricity-generation sector. It considers these developments in the context of historical experience, and offers an economic perspective on energy market, policy, and technological innovations that benefit the Nation.

The key points in this chapter are:

- Crude oil prices have risen steadily over the past several years due to growing world demand, leading to rising prices for gasoline and other refined petroleum products and stimulating further development of alternative energy sources. Recent price increases have occurred more gradually than in the past.
- Disruptions to energy supply and distribution networks can lead to sharp short-term price increases. Recent hurricanes Katrina and Rita

demonstrate that competitive markets connecting energy producers, distributors, and consumers play a central role in encouraging conservation and allocating scarce energy resources, especially during times of natural disaster or national emergency.

- The continued expansion of natural gas and other energy markets through regional and global trade can improve our economic security by increasing access to low-cost energy resources and mitigating the impacts of local energy shortages and price increases. Innovative market instruments designed to insure against market volatility can also help lessen these impacts.
- Absent policy, individual energy market participants may not have an incentive to tackle certain problems associated with their energy production and consumption. Carefully targeted policies that reduce U.S. vulnerability to energy disruptions, encourage energy efficiency, and protect the environment can therefore be beneficial supplements to markets. These policies can be made more effective and less costly when designed based on economic incentives.

The first section below provides an overview of U.S. energy sources and uses. The second section discusses the world market for crude oil. The third section examines markets for refined petroleum products, including the impact of crude oil prices on refined product prices. The fourth section considers the expansion of natural gas markets from limited geographic regions to a more global level. The fifth section describes challenges and recent changes in the electricity-generation sector, and the final section concludes with a look toward the future.

Energy Sources and Uses

One British thermal unit (Btu) is the amount of energy required to raise the temperature of one pound of water one degree Fahrenheit. The United States used approximately 100 quadrillion Btu of energy in 2004 (see Table 11-1)—the energy equivalent of about 17 billion barrels of oil or 60 barrels of oil per person. Eighty-six percent of this energy came from fossil fuels, including 40 percent from petroleum, 23 percent from coal, and 23 percent from natural gas. The remaining 14 percent of this energy came from nuclear and renewable sources, such as hydroelectric power, wind, biomass (e.g., wood and agricultural crops), and solar energy.

On the consumption side, 39 percent of total U.S. energy use in 2004 passed through the electricity-generation sector. Roughly one-third of electricity-sector energy input was converted into electricity and delivered to end-use customers. The remaining two-thirds was lost due to inefficiencies in the production and transmission of electricity. Of the 73 quadrillion Btu of energy delivered to

TABLE 11-1.—*Energy Sources and Uses, 2004*
[Quadrillion BTU]

Energy sources	Energy Uses						
	End-use sectors					Electricity sector	All sectors
	Transport	Industrial	Residential	Commercial	All end-use		
Total primary	27.7	22.1	7.0	4.1	60.9	38.9	99.7
Petroleum	26.7	9.6	1.6	0.8	38.6	1.2	39.8
Natural gas	0.7	8.7	5.0	3.1	17.5	5.5	23.0
Coal	0.0	2.2	0.0	0.1	2.3	20.3	22.5
Nuclear	0.0	0.0	0.0	0.0	0.0	8.2	8.2
Renewable	0.3	1.7	0.4	0.1	2.5	3.6	6.1
Electricity retail sales	0.0	3.5	4.4	4.2	12.1		
Total end-use	27.7	25.6	11.4	8.3	73.0		

Note: Because total primary energy consumption in 2004 was almost exactly 100 quadrillion Btu, numbers in the table can also be interpreted approximately as the percent of total primary energy consumption coming from various sectors and going to various uses. Total end-use energy consumption of 73 quadrillion Btu is less than total primary energy consumption due to electricity-sector energy losses.

Source: Department of Energy (Energy Information Administration).

end-use customers, 38 percent went to the transportation sector (to power vehicles used to transport people and goods), 35 percent went to industry (for manufacturing, agriculture, mining, and construction), 16 percent was used in residences, and 11 percent was used by the commercial sector (in business, government, schools, and other public and private organizations).

Crude Oil

U.S. crude oil consumption in 2004 was 15.5 million barrels per day, approximately 65 percent of which was imported. Crude oil is used to produce a wide array of petroleum products, including gasoline, diesel and jet fuels, heating oil, lubricants, asphalt, plastics, and many other products used for their energy or chemical content. Not surprisingly, crude oil markets are monitored closely by consumers, businesses, and governments, because the prices of petroleum-based products depend heavily on the price of crude oil.

A Global Market in Crude Oil

Crude oil can be transported long distances cheaply. Transportation costs average roughly $2 per barrel for crude oil imported into the United States. As a result, oil prices generally are determined by the balancing of supply and demand at the global level, where prices are roughly uniform for a given grade of oil. U.S. refiners, and ultimately U.S. consumers, realize great benefit from having the option of purchasing crude oil from both nearby sources, such as Texas or Oklahoma, and from sources halfway around the globe, such as Russia or the Middle East.

The international crude oil market is very active. Out of a total global crude oil production of 67 million barrels per day in 2002, roughly 60 percent was traded internationally. However, crude oil is produced in large quantities for export in a relatively limited number of locations around the world. In the first nine months of 2005, the top ten oil-producing countries accounted for over 50 percent of global production, and nearly 30 percent of global production originated in the Persian Gulf. Although the United States was the world's third-largest oil producer in 2004, trailing only Saudi Arabia and Russia, the United States ranks eleventh in total proven oil reserves, with just 2 percent of total proven world reserves (Chart 11-1).

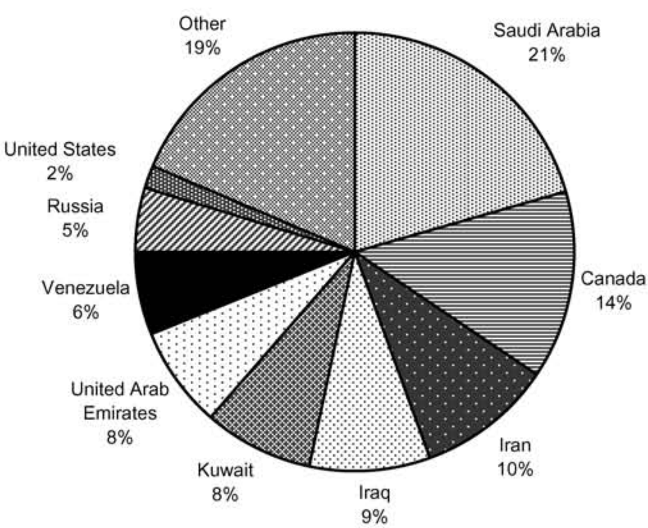
Crude Oil Prices

Crude oil prices generally change gradually in response to slowly evolving domestic and international trends in oil demand and supply, though prices have spiked sharply on a limited number of occasions. Some of these spikes were short-lived, while others persisted for several years.

Recent Price Rises

Because crude oil is traded in a global market, long-term trends in demand by other consuming nations and unexpected events in other countries affect the world market price that U.S. refiners pay and the price that domestic oil

Chart 11-1 **World Proven Oil Reserves**
The United States holds a small fraction of total reserves.



Note: Canada includes oil sands representing 98 percent of its total reserves.
Numbers do not sum to 100% due to independent rounding.
Sources: Department of Energy (Energy Information Administration), PennWell Corporation (Oil & Gas Journal).

producers receive. Due to robust economic growth in the United States, China, and other high-growth countries in Asia, world consumption of petroleum products grew strongly over the past several years.

On the supply side, industrial countries have exhausted most low-cost opportunities for profitable domestic exploration and development, and international energy companies often face considerable risk when making investments for exploration, development, and production in less-developed countries. Some countries, particularly those with national oil companies, prohibit or restrict foreign investment. Consequently, new production capacity has been slow to emerge. World crude oil production in 2005 stood at about 74 million barrels per day, while the Department of Energy estimates that current world oil production capacity is only 1-1.5 million barrels per day higher—the lowest level of world spare capacity in more than three decades. Most of this spare capacity is in Saudi Arabia. As a result of this tight market, crude oil prices have increased roughly threefold since the beginning of 2002.

Past Oil Price Spikes

Although high, the current price of West Texas Intermediate (WTI) crude oil (a common pricing benchmark) is lower than the historic peak of over $87 per barrel (in 2005 dollars) reached in 1980. Oil prices more than doubled from the last quarter of 1973 to the first quarter of 1974 as a result of the Arab Oil Embargo. Oil prices more than doubled again from mid-1979 to mid-1980 following the 1979 Iranian Revolution. Prices fell gradually from this point until 1985-1986, and then they fell rapidly after Saudi Arabia and other oil-exporting countries increased production. A short-lived shock in 1990 was associated with the Persian Gulf War. The recent increase in crude oil prices, which has come largely through a surge in world oil demand, has occurred much more gradually than past price spikes, which resulted from abrupt reductions in production in oil-exporting countries.

The Strategic Petroleum Reserve

Sudden oil supply shocks are potentially damaging to the U.S. economy. The Strategic Petroleum Reserve (SPR) provides the United States with an insurance policy should a severe energy supply disruption occur. These Federally owned crude oil stocks, which totaled 684 million barrels in late 2005, are sufficient to cover about 68 days of U.S. crude oil imports or 44 days of total U.S. crude oil consumption. The President of the United States has authorized an emergency drawdown of the SPR on two occasions: once during Operation Desert Storm in 1991, and a second time in September 2005 following Hurricane Katrina, which temporarily shut down crude oil production facilities in the Gulf of Mexico (See Box 11-2). The Secretary of Energy has also approved a number of short-term loans of SPR oil to help companies address short-term disruptions to their operations, including after hurricanes Lili in 2002, Ivan in 2004, and Katrina in 2005. The Administration recognizes the critical importance of the SPR, and has increased SPR stocks by about 25 percent since January 2001.

Future Price Expectations and Incentives for Nonconventional Fuels

Although world oil production capacity is expected to increase, world demand is expected to increase as well, and we are likely to face tight crude oil markets for a number of years. Prices on contracts for future deliveries of crude oil (called crude oil *futures*) indicate that market participants expect oil prices to remain elevated at or near current levels through at least the end of 2006. Box 11-1 looks at the development of energy futures markets, which can help energy suppliers and users manage the risks associated with market fluctuations, and which can help facilitate investment in new conventional and alternative sources of energy.

In the longer term, an expectation of high future petroleum prices serves as a signal to potential developers of alternative fuels and producers of petroleum from nonconventional sources that investment in exploration, research, development, production, and marketing of such alternatives is likely to be profitable. Chart 11-2 presents cost estimates for commercial production of potential alternative fuels and nonconventional petroleum sources. Commercial production of some of these alternatives has already begun. For other alternatives, such as coal-to-liquids and oil shale, the technologies needed for production are not yet mature, and their production cost estimates do not include research, development, and initial demonstration costs. In all cases, the production cost estimates reflect expenditures on variable inputs (e.g., raw materials and labor), as well as capital costs for production facilities. These production costs vary widely.

Although oil prices have risen to more than $60 per barrel in recent months, they have averaged as low as $25 per barrel within the last five years. Having experienced past volatility in oil prices, oil companies report using a working assumption of $15-$30 per barrel for the future price of oil when making long-term investment planning decisions. Only a handful of alternative fuels and nonconventional sources of petroleum are profitable at these prices, including petroleum from Canadian oil sands and ethanol (when subsidized at current levels). Canada's petroleum industry reports that production of crude oil from oil sands is currently at 1 million barrels per day and is expected to approach 2.7 million barrels per day by 2015.

Ethanol—an alcohol fuel made from the sugars found in corn and other crops—can be burned by most automobile engines in the United States when blended with gasoline. U.S. ethanol production, which is supported by

Box 11-1: Energy Futures Markets

A futures contract is a legal agreement to buy or sell a particular, precisely defined commodity at a specified price and location at a specified date in the future. Trading in energy futures allows suppliers or consumers of energy to lock in a specific price at which they can sell or purchase energy products, thereby reducing or eliminating price risk. This can aid in investment planning for energy production.

The market for crude oil futures in organized exchanges, such as the New York Mercantile Exchange (NYMEX) and the International Petroleum Exchange in London, is well developed and increasing in size. For example, the quantity of oil committed under NYMEX futures contracts with maturities of three months or less increased from a value equal to 30 percent of U.S. oil production in 1997 to 80 percent in mid-2005. The expansion of markets for contracts with longer maturities is even more striking, with the quantity of oil committed under NYMEX futures contracts with six-year maturities growing from less than 1 percent of U.S. production in 1997 to 9 percent in 2005.

Although there is very little trading in crude oil futures with longer maturities, futures contracts for horizons of longer than six years can be arranged privately with the assistance of investment banks or other financial intermediaries in so-called over-the-counter transactions.

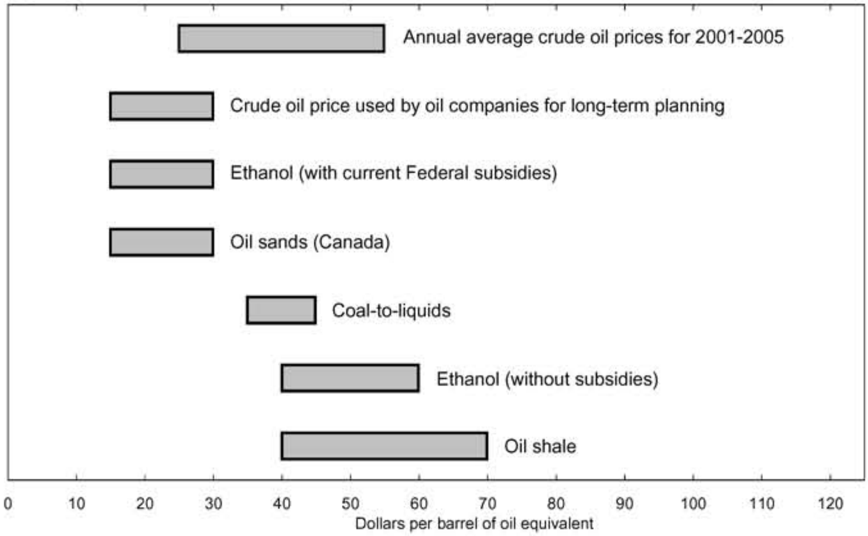
Energy futures are examples of financial instruments known as derivatives, which firms use to manage risks associated with market fluctuations. Weather derivatives also have been used by firms in recent years in order to manage risks associated with fluctuations in temperature and precipitation, which can have a significant effect on energy markets.

various Federal subsidies, currently stands at about 250,000 barrels per day. Ethanol production is expected to increase substantially in response to a mandate included in the Energy Policy Act of 2005 that gasoline sold in the United States contain at least 7.5 billion gallons of renewable fuels in 2012 (about half-a-million barrels per day).

Private-sector development of nonconventional fuels, such as coal-to-liquids or oil shale, may accelerate if high oil prices are sustained over the long term. For the time being, however, these alternatives are in a developmental stage and their future commercial success will depend on future energy prices, technological advances, and environmental and other regulatory requirements.

High energy prices also provide incentives for expanded domestic production of conventional oil and gas. The Administration supports greater access to oil and natural gas resources in Federal waters off shore states that support such

Chart 11-2 **Estimated Production Costs of Alternatives to Conventional Oil**
High oil prices make alternatives to conventional oil more attractive.



Note: Annual average oil prices are for West Texas Intermediate crude. Oil shale and coal-to-liquids are not currently commercial in the United States; cost estimates are for a mature industry and do not include research, development, and initial demonstration.
Sources: Wall Street Journal, Department of Energy, Department of Agriculture, Council of Economic Advisers.

development and supports opening a small portion of the Arctic National Wildlife Refuge (ANWR) in Alaska for environmentally responsible oil and gas exploration. According to estimates by the U.S. Geological Survey (USGS), the 1.5-million-acre coastal plain of ANWR and adjacent Native lands and state offshore waters hold between 5.7 and 16 billion barrels of technically recoverable reserves, with a mean estimate of 10.4 billion barrels—enough to supply 1 million barrels per day for over 28 years.

Gasoline and Other Refined Products

The United States derives approximately 40 percent of the energy it uses from petroleum, making petroleum the single largest source of energy for our Nation. Refined petroleum products, such as gasoline, diesel, and jet fuel, provide 96 percent of the energy used in the U.S. transportation sector, and are also important for the industrial sector, which gets 37 percent of its energy from petroleum. The residential sector gets 14 percent of its energy from refined petroleum products (mainly home heating oil), while petroleum supplies 10 percent of the energy used in the commercial sector.

Gasoline Prices

The prices that consumers and other end users pay for gasoline depend heavily on the prices that petroleum refiners pay for crude oil. During the first eleven months of 2005, the cost of crude oil accounted for about 53 percent of the retail price of gasoline (the most recent available data from the Department of Energy). Refining costs and profits accounted for 20 percent, Federal and state taxes another 20 percent, and distribution and marketing about 8 percent of the retail price of gasoline.

Crude oil price changes are passed directly through to consumers in the form of changing prices for gasoline and other refined products, at the rate of about 2.4 cents per gallon of refined product for every $1 per barrel change in the price of crude oil. According to Department of Energy data, rising crude oil prices explain roughly two-thirds of the increase in average gasoline prices between 2000 and 2005.

In addition to crude oil prices, other factors have a lesser but sometimes pronounced effect on the price that consumers pay for gasoline. Refinery or pipeline shutdowns caused by damaging weather, such as hurricanes Katrina and Rita, can impede the ability of refiners to produce or distribute refined petroleum products, leading to short-term local or regional spikes in the price of gasoline and other refined products that do not coincide with spikes in the price of crude oil (Box 11-2).

Box 11-2: The Effects of Hurricanes Katrina and Rita on Energy Supplies

In late August 2005 the states of Alabama, Louisiana, and Mississippi were struck by Hurricane Katrina, a powerful storm that disrupted, damaged, or destroyed portions of our Nation's energy infrastructure. Hurricane Rita followed almost exactly one month later, while recovery from Katrina was still underway. The impact of these disruptions on prices for crude oil, gasoline, other refined petroleum products, and natural gas varied substantially, and the divergent impacts help illustrate key differences in markets for these energy sources (see Chapter 1 for a discussion of the effects on the economy generally).

Due to evacuations and subsequent damage of oil rigs and platforms, virtually all of Gulf-region oil production—about 28 percent of total U.S. production—was shut down. Because there is a robust world market for crude oil, however, the effect on world prices and the prices that U.S. refiners pay for crude oil was relatively small. The Administration approved several temporary loans of oil from the Strategic Petroleum Reserve (SPR) to help refineries offset short-term physical supply

Box 11-2 — *continued*

disruptions. The President also authorized the emergency sale of up to an additional 30 million barrels of crude oil from the SPR. These actions also helped to moderate any impact the production shut-downs had on U.S. oil supplies.

About two dozen Gulf region refineries were also shut down by flooding and electricity outages associated with the hurricanes, so that following Hurricane Rita more than half of Gulf region refining capacity and roughly one-quarter of total U.S. refining capacity were shut down. Katrina initially led to a shutdown of the Colonial and Plantation pipelines, which deliver most of the refined petroleum products consumed on the East Coast, as well as the Capline pipeline, which delivers crude oil from the Gulf region to pipeline systems serving refineries in the Midwest. After the storm passed and safety assessments revealed no damage, these pipelines began operation substantially below capacity due to electricity outages and product shortages. Hurricane Rita subsequently led to shutdowns in several other pipelines. As a result of these shutdowns of refineries and pipelines, gasoline and refined product price increases were particularly pronounced in regions served by these refineries and pipelines—namely, the East Coast, Midwest, and Gulf regions. The effects on West Coast refined product prices were less pronounced.

The International Energy Agency (IEA) of the Organisation for Economic Cooperation and Development responded by coordinating the release of IEA members' reserve stocks of petroleum. The United States made SPR crude oil available, while other IEA countries primarily offered refined petroleum products. These and other imports of refined petroleum products helped ease the impact of the hurricanes on gasoline and refined product prices, and prices declined further as petroleum refineries and pipelines came back on line.

Offshore natural gas production faced similar disruptions, with shutdowns of up to about 85 percent of Gulf daily natural gas production or 16 percent of total U.S. production. Onshore natural gas processing facilities and gathering lines were also damaged, further disrupting natural gas markets. Unlike crude oil prices, however, natural gas prices rose by over half as a result of the hurricane-related supply disruptions, due to the regional isolation of U.S. natural gas markets.

By the end of 2005, less than 10 percent of U.S. oil production capacity, less than 5 percent of U.S. refining capacity, and less than 5 percent of U.S. natural gas production capacity remained off-line, and further recovery was expected. Prices for crude oil, gasoline, and natural gas had returned to pre-Katrina levels, although natural gas prices were still experiencing volatility.

Another related factor is that surplus refining capacity has declined substantially during the last 25 years. In the early 1980s, U.S. petroleum refiners were producing at only about 70 percent of their total potential production capacity. In contrast, total refiner output has been over 90 percent of capacity for the last decade. Several factors explain this trend. First, many small, inefficient refineries exited the industry in the early 1980s following the removal of poorly conceived Federal petroleum price and allocation controls that had favored such refineries. Without these controls, inefficient refineries were no longer profitable, and total U.S. refining capacity fell by 19 percent from roughly 19 million barrels per day at its peak in 1981 to about 15 million barrels per day in 1994. Second, low profitability in the refining sector during the early to mid 1990s did not provide the necessary incentive to expand total refining capacity. Finally, local concerns about environmental quality have made it increasingly difficult to site new heavy industrial facilities, including refineries. Constraints on the expansion of refining capacity to keep pace with growing demand can lead to higher prices for refined products in the long run.

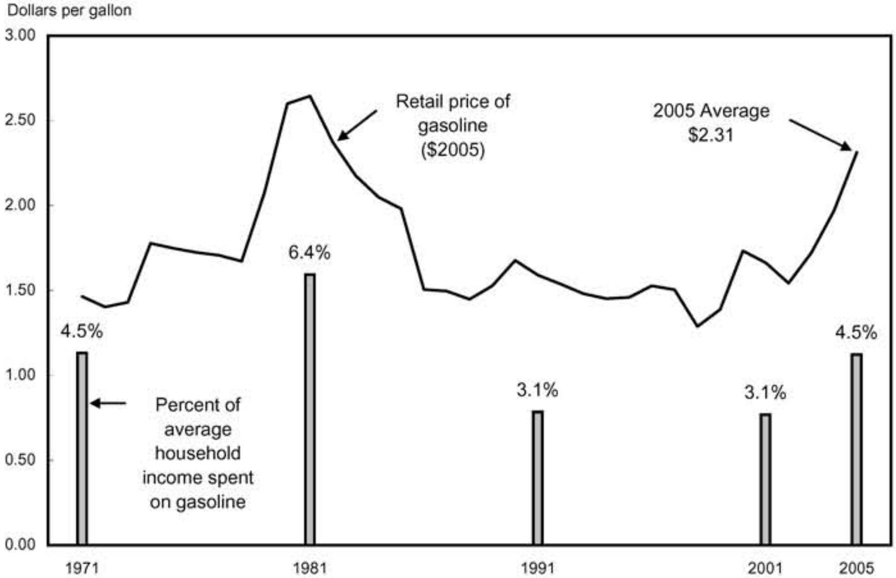
Refinery profitability increased in the late 1990s, however. As a result, domestic refining capacity rose 12 percent from 1994 to 17 million barrels per day in 2004. This increase in capacity has come exclusively through the expansion of existing refineries, as no new refinery has been built in the United States since 1976. In response to more-stringent clean-air regulations over the last two decades, much of the recent investment in refining has been directed toward increased capacity for producing cleaner fuels, even while using heavier crude oils with higher sulfur contents. Rising refinery costs and profits explain roughly one-quarter of the increase in average gasoline prices between 2000 and 2005.

Short-Run Impacts of High Gasoline Prices

When gasoline prices increase unexpectedly, households and businesses are not able to cut their gasoline consumption quickly enough to fully offset the higher costs. In the short term, then, gasoline price increases cut into household budgets and increase business costs. Price increases can have a substantial impact over the longer term, as well. Mirroring year-to-year changes in gasoline prices, household gasoline expenditures have increased recently after declining for several years from a peak of about 6 percent of mean household income in 1981 (Chart 11-3). Fuel-intensive transportation industries, such as airlines and trucking, also face substantially higher costs when prices of refined petroleum products increase.

When such price increases occur in response to a natural disaster or a failure of energy supply infrastructure, sellers are often accused of "price gouging." Following hurricanes Katrina and Rita, which caused energy supply disruptions and price spikes, the Administration remained vigilant to pursue and

Chart 11-3 **U.S. Household Gasoline Expenditures**
High gasoline prices can burden household budgets.



Sources: Department of Energy (Energy Information Administration), Department of Transportation (Bureau of Transportation Statistics), Department of Commerce (Census Bureau), Council of Economic Advisers.

investigate reports of illegal pricing practices, while recognizing that competitive markets are the most effective means for delivering energy supplies to areas of greatest need. Rising prices encourage consumers to conserve fuel and provide domestic producers and importers with incentives to increase supply. If prices are controlled artificially and not allowed to increase, however, consumers will demand more than suppliers are willing to deliver, leading to nonprice rationing (e.g., long lines) and potentially exacerbating the shortage. At least 28 states currently have statutes that address potential market manipulation in the aftermath of a disaster, and a number of these states have initiated investigations of anticompetitive behavior. The Federal Trade Commission has also launched an investigation to scrutinize the refining industry for evidence of unlawful and anticompetitive behavior.

Refining Capacity and Trade

Efficiency improvements and restructuring in the refining industry have led to lower operating costs per barrel. Excluding oil and other energy inputs, refinery operating costs fell roughly 20 percent between the early 1980s and 2003. These cost reductions tend to reduce the price of gasoline for consumers. Lower surplus capacity may, however, increase the sensitivity of gasoline prices to temporary disruptions in production at particular refineries. When production at one refinery is disrupted, it is difficult for other refineries to compensate by ramping up production. As a result, we are more likely to see short-term spikes in the price of gasoline.

Although U.S. refining capacity and utilization have increased since the early 1990s, these increases in production have not kept pace with U.S. demand for gasoline and other refined products. As a consequence, U.S. imports of refined petroleum products, including gasoline, have grown from 11 percent of total refined product consumption in 1993 to 15 percent in 2004.

Demand for various types of petroleum products within a country and the configuration of its domestic refining capacity drive much of this international trade. For instance, Europe has moved toward consuming more diesel fuel relative to gasoline. According to industry sources, diesel-powered vehicles increased from roughly 30 percent of European new car sales in 2000 to 40 percent in 2005. This has resulted in an excess supply of gasoline at European refineries, which Europe now exports to the United States. At the same time, Europe imports diesel fuel from the United States and other countries. Likewise, other countries have differences between domestic consumption patterns and production capacity. These patterns have resulted in the United States exporting certain refined petroleum products to North America, South America, and Europe, while importing other refined products from these same countries, as well as from the Middle East and the Caribbean.

Transport costs for refined petroleum products are sufficiently low that international trading can moderate the effects of regional price spikes. For example, when supplies of gasoline and other refined petroleum products ran short in the United States following Hurricane Katrina, and prices began to rise quickly, importers responded to this price incentive by delivering significantly more product to the United States.

Price-Induced Substitution and Technological Change

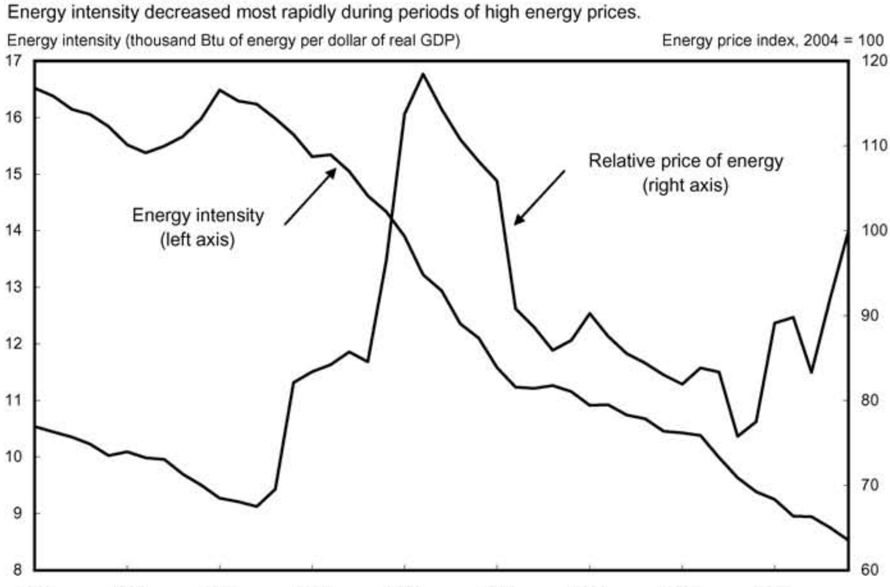
In the long run, households and businesses respond to higher fuel prices by cutting consumption, purchasing products that are more efficient, and switching to alternative energy sources. Higher energy prices also encourage entrepreneurs to invest in the research and development of new energy-conserving technologies and alternative fuels, further expanding the opportunities available to households and businesses to reduce energy use and switch to low-cost energy sources.

The energy intensity of the U.S. economy—that is, the ratio of total Btu of energy consumed per dollar of real GDP—has declined substantially over the past several decades (Chart 11-4). And, as one might expect, energy intensity declined most rapidly from the mid-1970s though the mid-1980s, when energy prices were at their highest in real terms. Reductions in overall energy intensity result from both shifts in economic activity toward less energy-intensive sectors, as well as from energy efficiency improvements within particular sectors. Recent research suggests that energy efficiency improvements account for roughly one-third of the reduction in energy intensity between 1985 and 2002, after controlling for shifts in economic activity between different sectors.

Although reductions in energy consumption are made primarily in response to changes in market conditions, government policy may also play a role in facilitating improvements in energy efficiency. This role has included supporting the development of new technologies, encouraging investment in improved efficiency, and in some areas, mandating efficiency improvements to new appliances, equipment, buildings, and vehicles. For example, on-road fuel efficiency for new cars and light trucks (e.g., minivans, pickup trucks, and SUVs) increased from an average of 13 miles per gallon in 1975 to 21 miles per gallon in 2005. This rise is due in part to higher fuel prices, technological improvements, and Corporate Average Fuel Economy (CAFE) standards, which mandate fuel efficiency in passenger cars and light trucks (Box 11-3). The benefits of any such government policy must be weighed carefully against the costs to U.S. taxpayers, consumers, workers, and businesses. The Administration recently proposed new CAFE standards for light trucks in model years 2008-2011 based on a careful accounting of these benefits and costs.

Chart 11-4 **U.S. Energy Intensity**

Energy intensity decreased most rapidly during periods of high energy prices.



Sources: Department of Energy (Energy Information Administration), Department of Commerce (Bureau of Economic Analysis).

Box 11-3: Automobile Fuel Economy Standards

For three decades, Corporate Average Fuel Economy (CAFE) standards have mandated separate average fuel economy targets for passenger cars and light trucks sold in the United States, and each domestic and foreign manufacturer must meet these same targets in every model year. Congress has established a default level of 27.5 miles per gallon for passenger cars, and passenger car standards have remained at this default level since 1990. The Department of Transportation (DOT) sets CAFE standards for light trucks for each model year, and the Administration raised those standards from 20.7 miles per gallon in 2004 to 22.2 miles per gallon by model year 2007.

There are concerns that the structure of current CAFE standards encourages manufacturers to build minivans, SUVs, and other light trucks instead of cars, because the fuel economy standard for light trucks is lower than the standard for cars. This could lead to an overall decrease in average fuel economy. There are also concerns that manufacturers might meet higher CAFE targets primarily by reducing vehicle size and weight, rather than by applying fuel-saving technologies, and that these size and weight reductions could have a negative impact on the safety of vehicle occupants.

Motivated by these concerns, DOT has proposed a new CAFE rule for light trucks for model years 2008-2011 (to be finalized by April 2006) that incorporates two notable reforms. First, DOT has proposed that CAFE standards for light trucks depend on vehicle size, whereby smaller light trucks will face higher fuel economy standards than larger light trucks. Size-dependent CAFE standards will reduce the incentive to build light trucks instead of cars, discourage manufacturers from achieving CAFE standards only by selling smaller vehicles, encourage greater fuel savings in small light trucks, and spread the burden of achieving CAFE standards more evenly across manufacturers. Second, proposed standards for 2011 would be set using a new economic model developed by DOT that sets CAFE standards to maximize economic benefits minus costs—a milestone in the use of benefit-cost analysis in the rule-making process. The model takes into account the impact of mandated fuel economy improvements on vehicle costs, the value of fuel savings, environmental benefits and costs, and other factors. The proposed rule will save an estimated 10 billion gallons of fuel over the lifetime of the light trucks affected by the rule.

The Administration has requested authority from Congress to implement further reforms to the CAFE system, including utilization of market-based incentives, such as trading of fuel economy credits, to obtain fuel savings at the lowest possible cost to consumers. The Energy Policy Act of 2005 signed by the President calls for a report on CAFE reform ideas to be delivered to Congress within one year.

Reform of the New Source Review Program

Unfortunately, government mandates sometimes lead unintentionally to outcomes that are contrary to their environmental goals. An example of this is the New Source Review (NSR) component of the 1977 Clean Air Act Amendment. NSR requires that new refineries, electric generating units, and other industrial sources of air emissions apply the best-available air emissions control technology. Existing facilities that undertake significant modifications are also required to apply the best-available technology. NSR requirements were designed to ensure that new emissions sources are appropriately controlled so that the local air quality is not compromised. Unfortunately, NSR has led over time to sources seeking to avoid its requirements because the permitting process was complicated, potentially expensive, and time-consuming, especially for sources modifying their facilities. This can provide an incentive for existing sources of emissions to continue their business operations for longer than would have been the case under normal market conditions without the regulation. It also provides an incentive for existing plants to forgo modifications.

New production sources tend to be less polluting than old ones even in the absence of regulations, so extending the business operations of older plants without making modifications could result in higher emissions. Applying different regulations for “routine” versus “major” modifications also leads to ambiguity, litigation delays, and uncertainty in business planning, all of which can harm the economy and may impede environmental improvements. The Administration recently addressed this problem by establishing clear rules that remove disincentives for facilities to modify and undertake routine equipment replacement activities that could improve the safety, reliability, and efficiency of the plants. The Administration also established rules that provide facilities with greater flexibility to modernize their operations without increasing air pollution, encourage the installation of state-of-the-art pollution controls, and base NSR requirements more accurately on actual facility emissions levels. These changes will help to address the extreme demands being placed on our Nation’s energy supply infrastructure by assuring that the NSR program provides greater regulatory certainty and flexibility for business investment decisions, while protecting the environment.

Natural Gas

Nearly a quarter of U.S. energy consumption is supplied by natural gas. Natural gas has numerous uses in homes, industry, commerce, electricity production, and transportation and is a vital component of fertilizer and chemical production. The United States consumed 61 billion cubic feet of natural gas per day in 2004: 38 percent in industry (roughly one-tenth of which was used as a feedstock), 24 percent in electricity generation, 22 percent by households, 13 percent in the commercial sector, and the remaining 3 percent in transportation. U.S. natural gas consumption is projected to grow to 74 billion cubic feet per day by 2025.

Natural gas is produced from underground reservoirs that are sometimes associated with crude oil; much smaller amounts are generated from landfills, coal mines, and other sources. Domestic onshore production totaled about 42 billion cubic feet per day in 2004, while offshore production totaled 12 billion cubic feet per day. Total domestic production of 54 billion cubic feet per day is enough to heat about 300 million typical Midwestern homes for one year. After extraction, natural gas is processed to remove impurities (e.g., heavier hydrocarbons) and distributed via pipelines to retailers and eventually to end-use consumers in all sectors of the economy.

Regionalized Natural Gas Markets

Unlike crude oil, which trades on a global market at roughly uniform world prices, the current natural gas marketplace is highly regionalized. As a point of comparison, about 60 percent of global crude oil production was traded internationally in 2002, whereas only 28 percent of global natural gas production was traded. These differences stem from relatively high shipping costs for natural gas and a less-developed infrastructure for natural gas trade. International trade in natural gas occurs mainly within the regions of North America, Western Europe/Russia, and Asia-Pacific/Japan, each with its own unique pricing system and other market characteristics.

In North America, pipelines move natural gas between the United States, Canada, and Mexico with subregions of the continent supplying the majority of their own consumption needs. U.S. net imports of natural gas were 9.3 billion cubic feet per day in 2004, representing 15 percent of total U.S. natural gas consumption. Most imports came by gas pipeline from Canada. Only a relatively small amount was imported from beyond North America, as liquefied natural gas (LNG) from Trinidad, Algeria, and other countries. The United States also exports small amounts of natural gas to Canada and Mexico by pipeline and to Japan as LNG from Alaska.

Natural Gas Prices

Wholesale natural gas prices at Henry Hub on the Louisiana Gulf coast (a common natural gas pricing benchmark) averaged around $2-$3 per million Btu from 1994 through the middle of 2000. One million Btu of natural gas is equal to about one thousand cubic feet of natural gas. Prices then spiked to a peak of $10.50 per million Btu in December of 2000 in response to an unusually cold winter before falling back to their previous low levels. Prices have increased substantially since then from roughly $3 per million Btu in early 2002 to over $10 per million Btu in November 2005. Prices rose roughly in tandem with crude oil prices due to the presence of close substitution possibilities between natural gas and oil in power production and heating, though there have been some bumps along the way. Prices spiked to a peak of $19 per million Btu in February 2003 in response to another unusually cold winter, rose as high as $15 per million Btu in September 2005 following hurricanes Katrina and Rita, and increased to over $15 again in December 2005 with the onset of cold temperatures.

Volatility in Natural Gas Prices

Regionalization reduces the frequency and extent to which natural gas price spikes in other regions affect U.S. natural gas prices. However, the absence of a robust international market for natural gas also makes the United States more susceptible to price shocks within our own region. Disruptions to supply or increases in demand may necessitate large price changes to reestablish equilibrium between regional supply and demand. Opportunities for the import of natural gas from other regions would dull these sharp price spikes, although localized price spikes in some regions will likely never be eliminated completely due to limitations in the natural gas distribution infrastructure.

Volatility in natural gas prices in the United States is often related to extreme and unexpected weather events. In the summer months, for example, periods of extreme heat drive up demand for electricity to power air conditioners, leading to increased demand for natural gas for electricity production. Droughts and periods of low rainfall deplete resources for hydroelectric power generation and may require increased use of natural gas for replacement electricity generation. In the winter, periods of extreme cold drive up demand for natural gas for heating. Hurricanes, floods, and other severe weather events may shut down natural gas production and processing facilities and pipeline distribution networks, leading to supply disruptions.

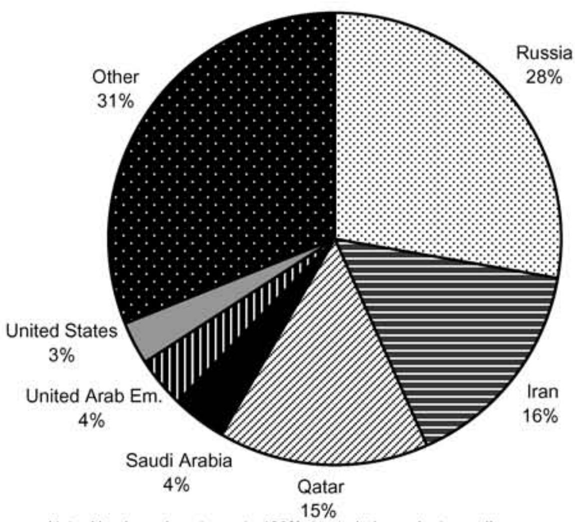
Liquefied Natural Gas

Liquefied natural gas (LNG)—natural gas in liquid form—is expanding natural gas markets to a more global level, which in the future holds potential to moderate some of this price volatility. LNG is created by cooling natural gas to minus 260 degrees Fahrenheit, at which point it turns into a liquid, significantly reducing its volume. Specially manufactured double-hulled ships are then able to transport LNG over long distances at lower cost than pipeline transport of natural gas. Upon reaching port, LNG is pumped into a receiving terminal where it is converted back into gas (regasified) and then distributed to consumers via pipeline.

Although some inter-regional movement of natural gas does occur, three key factors have limited the development of a full-scale international market. First, natural gas resources are widely distributed internationally, which at least until recently, has limited the need of many countries to import natural gas from distant sources. Second, it is still costly to transport natural gas as LNG over long distances, which means that regional price differentials need to be large before international trade is cost-effective. Finally, natural gas price differentials are now high enough to justify long-distance shipping of LNG, but the infrastructure for liquefying natural gas into LNG is not well developed in many countries with natural gas supplies.

Although the United States has been able to maintain a high level of natural gas production, North America holds only 4 percent of proven world reserves, including 3 percent of world reserves in the United States and 1 percent in Canada (Chart 11-5). Assuming U.S. demand continues to increase, the need for imports from sources outside the region will grow. At present, it appears that LNG is the best means for importing natural gas from beyond North America, and current Department of Energy projections are that LNG imports from various regions will increase from about 3 percent of U.S. natural gas consumption in 2004 to 15 percent by 2025.

Chart 11-5 **World Proven Natural Gas Reserves**
The United States holds a small fraction of total reserves.



Note: Numbers do not sum to 100% due to independent rounding.
Sources: Department of Energy (Energy Information Administration), PennWell Corporation (Oil & Gas Journal).

LNG Conversion and Transport Costs

A truly global market for natural gas will require transporting natural gas over long distances, and LNG is superior to pipeline transport in this regard. Currently, pipeline transport is less expensive than LNG for distances up to about 1,300 miles in the case of offshore pipelines and up to about 2,400 miles in the case of onshore pipelines. Beyond these distances, LNG transport in tankers is less expensive.

In addition to the cost of extracting and processing natural gas at the supply source, LNG must be liquefied, transported via special tanker, and then turned back into gas upon arrival. The costs associated with liquefying LNG have decreased between 35 percent and 50 percent over the past ten years, while transport and regasification costs have also fallen. These costs are still high enough, however, that U.S. natural gas prices need to exceed wellhead prices in LNG-supplying countries by at least $1.50 to $3 per million Btu—roughly $9 to $17 per barrel of oil equivalent—before LNG transport is cost-effective. As these costs continue to fall, the international marketability of LNG will grow.

U.S. LNG Terminal Capacity

Total LNG import costs are about $2-$4 per million Btu, which is far below current domestic natural gas prices. Given sufficient LNG infrastructure capacity, therefore, domestic prices eventually could be reduced through increased imports. Over 150 LNG tankers were in operation in 2003, and another 50 are under construction. Currently, there are five existing LNG import terminals in the continental United States (four onshore and one offshore), and these facilities operated at about 40 percent of capacity in 2005. About a dozen additional terminals have been approved, and about 20 others have been proposed. The recent Energy Policy Act of 2005 signed by the President took steps to remove unnecessary impediments to siting LNG terminals by clarifying the role of the Federal Energy Regulatory Commission (FERC) as the lead agency for coordinating authorization of onshore LNG terminals and LNG terminals in state waters. Federal approval of projects will continue to be conditional on state approval under various environmental laws.

With ample capacity in both shipping and receiving, the current bottleneck in LNG imports to the United States is an insufficient supply of overseas facilities for liquefying LNG. As long as capacity for liquefying LNG is in short supply abroad, there will be great competition in international markets for LNG cargoes, as is already happening among the major importers of LNG, including the United States, Japan, Spain, and other countries. Not surprisingly, high natural gas prices in these and other countries have led to an expansion of capacity to liquefy LNG abroad. Qatar, which has 15 percent of proven world natural gas reserves, recently began exporting LNG. The

12 nations that currently export LNG hold more than one-quarter of proven world reserves, and some of the world's largest natural gas exporters are in the process of constructing plants to develop LNG export capacity, including Russia and Norway.

Future Prospects for an International LNG Market

Currently, LNG markets are undergoing a substantial evolution, with demand growing and strong future growth expected. Between 1993 and 2003, international LNG trade grew at an average annual rate of 7 percent, and global LNG capacity is expected to grow by more than one-third between 2003 and 2007. Although international trade in LNG is expanding, the market has not yet evolved to the point where it can respond fully to price spikes in North America and other regional markets. The market for prompt delivery of LNG "spot cargoes," although growing, is still less than 10 percent of world LNG trade, with most LNG cargoes delivered under long-term contracts.

Prospects for Domestic Production of Natural Gas

The emergence of international natural gas markets does not eliminate the need to develop domestic production. Greater domestic natural gas production holds promise both in Alaska and on the outer continental shelf (OCS)—Federally controlled offshore areas within the 200-mile exclusive economic zone of the United States but beyond the 3-mile zone under state jurisdiction—as well as other areas. A difficulty in Alaskan production has been the lack of infrastructure to transport remote natural gas resources to market, which would be solved by development of the Alaska natural gas pipeline to the lower 48 states. The Alaska Natural Gas Pipeline Act signed by the President in October 2004 established an expedited Federal approval process for construction of the pipeline, and FERC has been working with state, Federal, and Canadian agencies to establish a framework for coordinating permitting activities.

The OCS has vast additional natural gas resources. Proven Federal offshore reserves as of 2003 were about 23 trillion cubic feet—12 percent of total U.S. proven reserves of 189 trillion cubic feet. The Department of Interior estimates the OCS also contains 400 trillion cubic feet of undiscovered, technically recoverable natural gas. About 20 percent of this natural gas—80 trillion cubic feet—is currently subject to Federal offshore leasing moratoria. The Administration supports greater access to natural gas and oil resources in Federal waters off shore of states that support such development. This would open up substantial additional natural gas supplies for the Nation.

Electricity

Although 39 percent of total U.S. energy consumption in 2004 passed through the electricity-generation sector, only about one-third of electricity-sector energy input was converted into electricity and passed on to end-use customers (Table 11-1). The remaining two-thirds was lost due to inefficiencies in the production and transmission of electricity. Some of these losses could be avoided through further efficiency improvements, though most are unavoidable due to the physics of electricity production and transmission. Retail electricity consumption is divided roughly equally among the residential, commercial, and industrial sectors. The residential sector consumed 36 percent of this electricity for lighting, heating, air conditioning, and powering household appliances, while 35 percent went to the commercial sector for similar uses. Industry consumed 29 percent, and less than 1 percent went to the transportation sector to power electric rail transport.

Electricity-Generation Technologies

A range of energy sources and technologies are used to produce electricity. A total of 71 percent of generated electricity comes from fossil fuels, including 50 percent from coal, 18 percent from natural gas, and 3 percent from petroleum. Nuclear power provides about 20 percent of electricity, while hydroelectric power provides 7 percent, and other renewable sources, such as wind, biomass, and solar, provide a combined 2 percent.

With the exception of solar power and diesel-powered internal combustion engines, all electricity is generated by the turning of turbines that drive electric generators. Falling water drives the turbines in a hydroelectric plant, and wind turns the turbine of a windmill. Natural gas plants use a combustion process like that in a jet aircraft engine to generate a high-speed stream of combustion gases, which is used to drive a natural gas turbine. In natural-gas-combined-cycle plants, exhaust gases exiting the gas turbine are used to heat water, which generates high-pressure steam that drives a second turbine. Nuclear and conventional coal plants generate high-pressure steam to drive turbines by heating water using the energy released by nuclear reactions and coal combustion, respectively. Advanced coal-fired generating plants use various alternative technologies to enhance efficiency and cut emissions. Combined heat and power plants can very efficiently generate steam or hot water for heating and production processes, as well as for electricity.

The Real-Time Challenge of Electricity Markets

Most fuels, such as gasoline, home heating oil, or natural gas, can be manufactured and then stored for later distribution and use. Unlike these energy sources, however, the generation and consumption of electricity must match exactly in real time. Although it is possible to store electricity in batteries, storing electricity on a large scale is too costly. If generation fails to provide the energy needed to satisfy demand, the electricity production and distribution network can become unstable, leading to outages or system failures. Shutdowns of generating plants in one location can therefore affect the entire network, as was the case in August 2003, when a plant shutdown in Ohio triggered cascading failures that ultimately forced the shutdown of at least 265 power plants. These shutdowns left an estimated 50 million people in the United States and Canada without power and led to economic losses of $4-$10 billion in the United States and noticeable downturns in Canadian hours worked, manufacturing shipments, and economic output. The Federal government took a number of actions after the blackout to diminish the risk that a similar disruption would occur in the future.

The demand for electricity fluctuates with the seasons and during the course of each day. For example, the hot summer months bring increased demand for electricity to power air conditioners, and electricity demand peaks each afternoon and drops to its lowest level late at night. Because the production and use of electricity must match in real time, electricity generation fluctuates one-for-one with these seasonal and daily consumption patterns. Electricity-generating capacity is tuned to match these fluctuations. Plants that have low operating costs or that are difficult to turn on and off, such as nuclear and coal-fired steam plants, provide the "baseload" power that is used all day every day. Plants that have higher operating costs or that can be started up quickly, such as natural gas turbine plants, start up incrementally as electricity demand increases and peaks, with some units remaining idle for much of the day or even much of the year. Hydroelectric plants, which have low operating costs and can be started quickly, are suitable for both baseload and peak electricity production.

These fluctuations can have impacts in other energy markets. Reduced hydroelectric power due to low rainfall and falling reservoir levels can increase demand for electricity from natural gas. Likewise, particularly hot summers increase electricity demand to power air conditioners, increasing demand for natural gas as gas-powered generators come on line. If the weather is drier or the summer is hotter than marketers of natural gas anticipate, stored levels of natural gas will be low relative to unexpectedly high demand, and natural gas prices will increase.

Real-Time Pricing and Other Reforms

Because electricity-generating units are dispatched incrementally in order of increasing operating cost, the marginal cost of producing electricity—that is, the additional cost of producing one additional unit of electricity—is highest during periods of peak production and lowest during periods of low production. In practice, however, most retail customers pay a fixed seasonal rate for the electricity they use and thus have no incentive to reduce their consumption of electricity during the times of day when it is most costly to produce. As a result, electricity producers must invest in generating units that remain idle most of the time, and the capital costs of these units are passed on to consumers in the form of higher average prices. Constraints in the electricity transmission system, which limit the extent to which electricity can be directed to areas of high demand or low supply, can also lead to high electricity prices in some regions.

The recent Energy Policy Act of 2005 signed by the President addresses the issue of inefficient pricing by requiring electric utilities and competitive retailers to offer customers time-based rates by February 2007. By ensuring that electricity suppliers offer their customers rates that better reflect the cost of electricity generation, these provisions will encourage consumers and businesses to conserve electricity during times of peak demand. This will reduce the need for excess generating capacity that remains idle most of the time and will, as a result, lower average electricity bills for retail customers. The Act also establishes energy-efficiency standards for household products and Federal buildings, which will reduce consumption of energy.

Environmental Protection

Combustion of fossil fuels, coal in particular, generates sulfur oxides and nitrogen oxides, which contribute to poor air quality if not controlled. Currently, emissions of sulfur and nitrogen oxides from electric utilities are regulated under the 1990 amendments to the Clean Air Act, which established a cap-and-trade system of tradable permits that holds total annual emissions to a mandated level at low cost. See Box 11-4, which includes a discussion of the Clean Air Interstate Rule and the President's Clear Skies proposal, which calls for a further 70 percent reduction in air emissions.

Fossil fuel combustion also generates emissions of carbon dioxide and other greenhouse gases, which contribute to the warming of the Earth's surface. The Administration is supporting the development of various technologies that will improve power plant efficiency, while greatly reducing air pollution and greenhouse gas emissions. For example, the Department of Energy is supporting research and development of technologies that turn coal into a highly enriched hydrogen gas, which can be burned much more cleanly than burning coal directly or can be used as an industrial feedstock. These technologies also provide opportunities to remove and sequester emissions of carbon dioxide and air pollutants prior to combustion. In February 2003 the President announced FutureGen, a government-industry partnership to build a prototype fossil fuel power plant that will demonstrate these technologies.

Box 11-4: Cap-and-Trade Programs for Air Pollution

Title IV of the 1990 Clean Air Act Amendments established a national cap-and-trade system for sulfur dioxide (SO2) emissions. SO2 emissions, which are generated by the burning of fossil fuels—such as coal in an electric power plant—can lead to health concerns and are a component of acid rain. Title IV's program caps total allowable SO2 emissions from power plants nationwide and requires that each facility own a permit for every unit of SO2 it emits. The Environmental Protection Agency (EPA) monitors and enforces this cap rigorously.

Under the Title IV program, SO2 permits can be bought and sold by emitting facilities. Trading allows facilities with high pollution-reduction costs to purchase permits from facilities with low reduction costs, thereby allowing the power industry to achieve mandated emissions reductions in a cost-effective manner. The program does not tell power producers how to reduce pollution, but rather they are free to choose the most cost-effective method for achieving reductions.

The SO2 trading program has been very successful at reducing emissions at a lower cost than direct plant-level emissions standards. The compliance has been nearly 100 percent, and research shows the trading program saves U.S. power producers hundreds of millions of dollars per year relative to direct plant-level standards. Thus, cap-and-trade programs promote clean air while reducing the cost impact on energy consumers. A similar regional cap-and-trade program exists in the eastern United States to control nitrogen oxide emissions, which contribute to regional ozone and smog problems.

In 2002, the President proposed "Clear Skies" legislation, which would expand the Clean Air Act Title IV cap-and-trade approach for SO2 to also include nitrogen oxide and mercury, reducing these emissions to roughly 70 percent below 2000 levels by 2018. As Congress has not yet enacted Clear Skies, the EPA has sought to achieve much of the benefits of the Clear Skies legislation by issuing the Clean Air Interstate Rule (CAIR) and the Clean Air Mercury Rule (CAMR) in March 2005. CAIR requires 28 states in the eastern half of the country to regulate power plant emissions of SO2 and nitrogen oxides and encourages them to do this within the framework of an interstate cap-and-trade system. When fully implemented, CAIR will reduce power-plant SO2 emissions in these states by over 70 percent and nitrogen oxide emissions by over 60 percent from 2003 levels. CAMR is the first-ever regulatory action to reduce mercury emissions from coal-fired power plants and includes a cap-and-trade approach as a way of achieving nearly 70-percent reductions in mercury emissions.

The Administration is also supporting further development of renewable sources of electricity, such as wind, solar energy, and biomass (e.g., wood and agricultural crops), which generate little or zero net greenhouse gas emissions. Finally, the Administration is supporting the development of nuclear power, which does not generate air pollution or greenhouse gases. The Nuclear Power 2010 program is a cost-shared government-industry partnership to identify sites for new nuclear power plants, improve nuclear technologies, and demonstrate untested regulatory processes. The Generation IV nuclear power program supports the development of future technologies with reduced capital costs, enhanced safety, minimal waste, and reduced risk of weapons materials proliferation.

Electricity Markets in Transition

The electric power industry has gone through a transition over the past several decades, evolving from a highly regulated, monopolistic industry to a less regulated, more competitive industry. Traditionally, electric utilities owned and operated electricity-generating units, transmission lines, and distribution systems, and were the sole providers of electricity to a specific geographic area. Federal legislation and rule-making activities during the last decade, however, have opened up access to transmission lines and encouraged greater wholesale trade of electricity between generators and retailers. The market changes vary from state to state and are dynamic, with continual adjustments being made as problems emerge. Some states continue to operate under a traditional, integrated market structure, others are striving to encourage greater competition among generating companies, and some even have opened up competition between electricity retailers.

Recent Electricity Market Policy Reforms

Successful operation of the electric power system requires coordination among system participants. Competition can lead to better products and lower costs for consumers. Ensuring the benefits of competition and reliability are therefore key components of successful reform. Provisions in the Energy Policy Act of 2005 signed by the President promote competition and investment in transmission infrastructure by providing for reasonably priced access to transmission grids, while providing for the establishment of mandatory reliability rules for the electric system. In order to further reduce costs and increase reliability, the Act repealed the Public Utility Holding Company Act (PUHCA), which restricted the ability of regulated utilities to invest in electricity infrastructure, and amended the Public Utility Regulatory Policies Act (PURPA) to allow utilities greater flexibility to purchase wholesale electricity from producers with lower costs. The Energy Policy Act of 2005 improves market competition by promoting the dissemination of information about the availability and prices of wholesale electricity and transmission services. The Act also protects consumers by banning market manipulation, unauthorized disclosure of consumer information, and unfair trade practices, such as changing the electricity service providers chosen by consumers without their consent.

Conclusion

Today, most of our energy comes from petroleum, coal, and other fossil fuels. There are constraints on supplies of these resources in the short term. Increased scarcity and rising prices over time will encourage conservation, increase incentives for exploration, and stimulate the development of new, energy-efficient technologies and alternative energy sources. In the near term, unexpected disruptions to energy supply and distribution networks may continue to impact consumers and businesses. The recent hurricanes Katrina and Rita demonstrated that competitive markets play a central role in allocating scarce energy resources, especially during times of natural disaster or national emergency. The continued expansion of energy markets through regional and global trade can further increase our resilience to energy supply disruptions. Finally, individual energy market participants do not always have an incentive to tackle problems associated with the production and consumption of energy, such as environmental damage or the potentially damaging effects of energy price spikes on the U.S. economy. Policies that reduce U.S. vulnerability to supply disruptions, encourage energy efficiency, and protect the environment can therefore be beneficial supplements to markets. Policymakers can design these policies to be more effective and less costly by harnessing the power of economic incentives and aiming to minimize distortion of normal market forces.