America's Energy Straitjacket

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April 2006

Report Number E065

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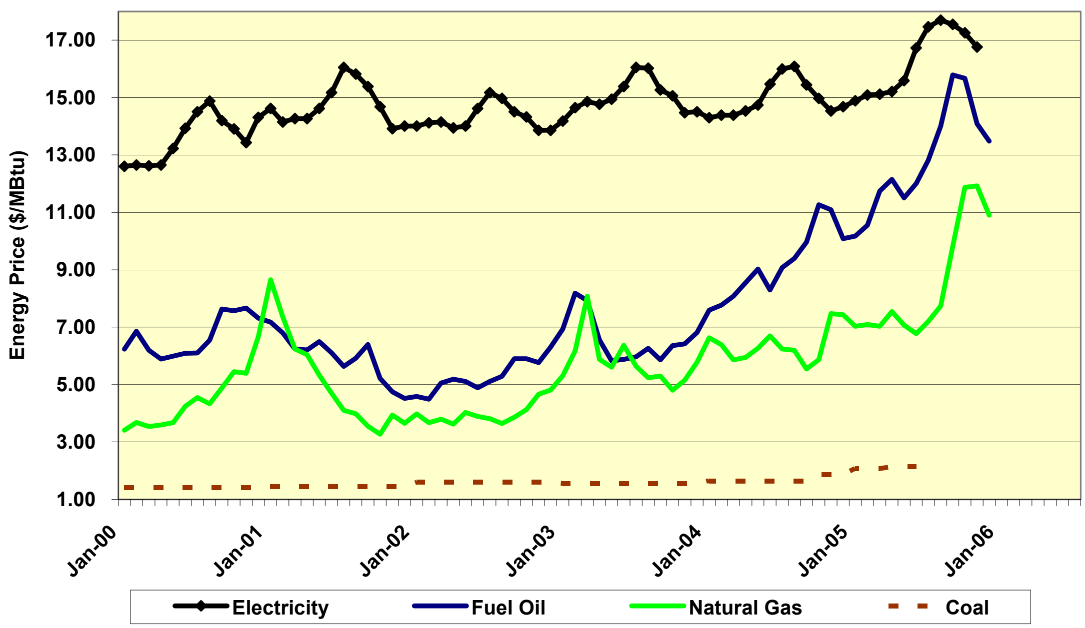
Acknowledgments

This report was funded through program support provided by the Energy Foundation and through internal ACEEE funding. Numerous individuals contributed to research that led to this study. In particular, the author acknowledges the significant contributions of his ACEEE colleagues Steven Nadel, Therese Langer, Harvey Sachs, and Bill Prindle; John A. "Skip" Laitner with the U.S. Environmental Protection Agency; and Joe Loper with the Alliance to Save Energy. The author would also like to thank Joel Bluestein and Kevin Petak, and their colleagues at Energy and Environmental Associates, Inc., for the education they provided on energy markets. In addition, Susanne Brooks and Renee Nida of ACEEE provided editorial assistance in the preparation of this manuscript.

Executive Summary

America is wrapped up in a chain of energy crises that are best described as a "straitjacket." There are no easy escapes from this situation, because our deeply interrelated energy problems cut across all major energy markets. With significant tightness in all markets, we are unable to get relief by turning to conventional energy alternatives as we have done in the past. In 2003, ACEEE responded to the tightening in natural gas markets with extensive research into the market impacts of energy efficiency and renewables. Since then, we have researched sources of strain in oil, coal, and electricity markets as well. These strains are manifested in increased energy prices (see Figure ES-1).

Figure ES-1. Nominal Average Monthly Industrial Energy Prices to the End-User



This report outlines the major problems related to the oil, natural gas, coal, electricity, and renewables markets, as well as the external factors that threaten the stability of these markets. In addition, the report analyzes the reasons why many of our energy problems have been hard to discern in the recent past and attempts to project what we can expect for the future.

The report focuses primarily on the near-term energy straitjacket and what can be done to ameliorate it. Energy efficiency is a proven energy resource and the only policy solution that could provide near-term relief. Energy efficiency can quickly and cost-effectively moderate energy demand growth, stretching available energy resources while providing price relief to consumers and reducing the risk that our energy straitjacket will derail the economic recovery.

A short-term, stop-gap approach to energy efficiency, however, is not enough to bring long-term balance and sustainability to America's energy policy. We are in an ongoing, long-term race to deliver enough energy, conventional or otherwise, to meet rising demands.

Conventional energy resources are becoming more difficult and expensive to bring to market, and clean-energy alternatives face their own cost and other constraints. Energy efficiency is thus the cornerstone of a sustainable energy policy; if demand grows too fast, no supply infrastructure will be able to keep up. This means that investing in energy efficiency resources is essential to moderating the need for new energy supplies, and we must act now to begin the efficiency investments needed to put America on a sustainable energy path. The resource decisions we make today will determine how painful our energy problems will be in the future.

To loosen America's energy straitjacket, the U.S. will need political leadership on energy efficiency and conservation at all levels of government. ACEEE recommends four immediate policy actions:

1. The President should call on governors, legislators, utility regulators, utility companies, and the energy efficiency industry to join him in a national campaign to action encouraging energy efficiency and conservation. This campaign should be funded through the $90 million per year public awareness campaign authorized in last year's Energy Policy Act (EPAct) legislation.
2. Funding for Energy Efficiency budgets cut in the FY 2007 budget request should be restored to FY 2002 levels, plus an additional 20%, to put total funding on track to meet EPAct authorizations by FY 2008.
3. An energy efficiency resource standard (EERS), as considered by the Senate in developing EPAct 2005, should be enacted.
4. Oil savings legislation with enforceable provisions should be enacted, designed to save at least 2.5 million barrels per day by 2015. This legislation should also affirm that the National Highway Traffic Safety Administration has authority over automotive fuel economy requirements.

While these measures may not enough by themselves to rebalance energy markets, they would make a substantial start, particularly if the states respond in kind.

Introduction

America is facing *two* energy crises: one in the near term and one in the long term. The near-term crisis is a result of our inability to deliver ever-increasing supplies of energy to meet surging energy demand. It is manifested in record-high energy prices that have drawn increasing public concern. This crisis is only in part connected to the long-term energy crisis relating to the availability of affordable energy supplies—recognition and discussion of this crisis has only just begun. In this report, we focus primarily on our near-term crisis as well as what can be done to ameliorate it. However, the reader should not assume that addressing the near-term deliverability problems will also solve the looming, longer-term energy supply crisis. Rather, the near-term strategies advocated later in this report are just stop-gap measures that will only delay future problems that will require years of planning to fully address.

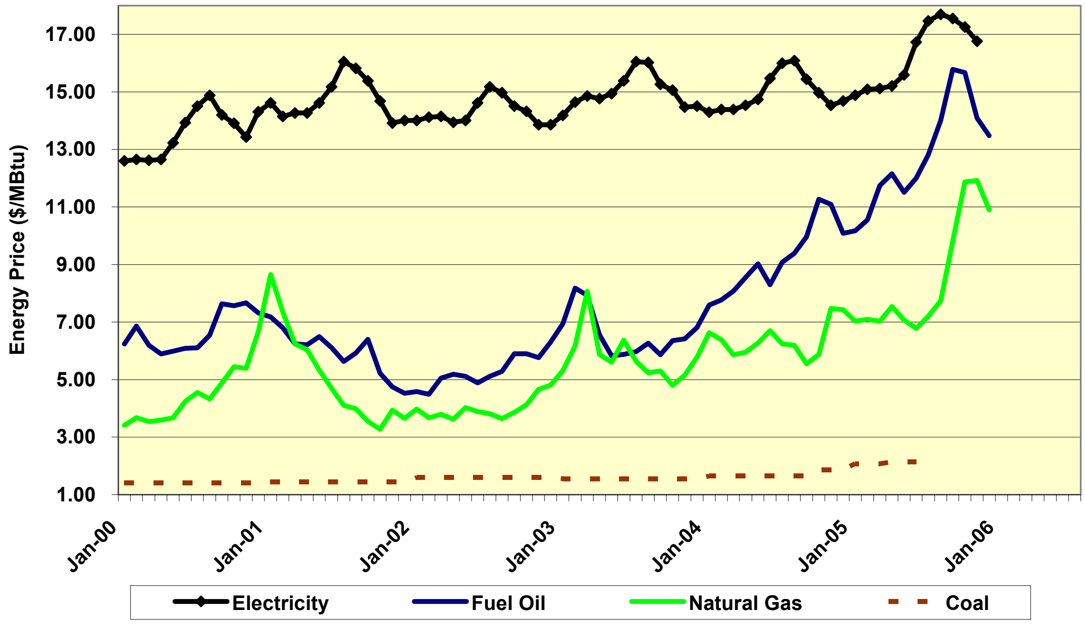
Over the past few years, we have seen the focus of energy consumers swing from fuel to fuel as prices have soared in each market. In 2003, natural gas was the focus of press coverage. The spring of 2006 has seen a shift of public attention to electric and gasoline pump prices. The reality is that our problems are not just related to a single fuel market. They are much deeper and more interrelated. Several years ago, ACEEE became alarmed about a tightening in natural gas markets and did some extensive research into market impacts.[1] More recently, we began seeing strains in oil markets and we are now seeing similar strains appearing in most other energy markets as well. These strains are manifested in increased energy prices that have been capturing press headlines (see Figure 1).

Over much of the past twenty-five years, our energy problems have tended to be related to a single energy source (gasoline, heating oil, natural gas, or electricity). This situation has allowed us to switch to those energy resources that, at the time, had sufficient flexibility to relieve the tightness in a single market. As a result, we have seen a single-fuel focus emerge among most market analysis, with few looking across markets and exploring the interactions among different energy markets. Today the United States faces a very different situation because there is a significant tightness in all major energy markets. As a result of this difference, many analysts missed the emerging trends. These circumstances have placed the country in an energy straitjacket, unable to turn to other conventional energy resources for relief as we have done in the past.

The good news is that there is a proven energy resource that could provide near-term relief. Energy efficiency and conservation represents a significant opportunity to quickly and cost-effectively reduce energy demand, thus allowing available energy resources to go further while also providing some price relief to consumers and reducing the risk that energy expenditures will derail the economic recovery.

[1] For a comprehensive overview of ACEEE natural gas analysis, visit http://aceee.org/energy/natlgas.htm.

Figure 1. Nominal Average Monthly Industrial Energy Prices to the End-User



Source: ACEEE from EIA data

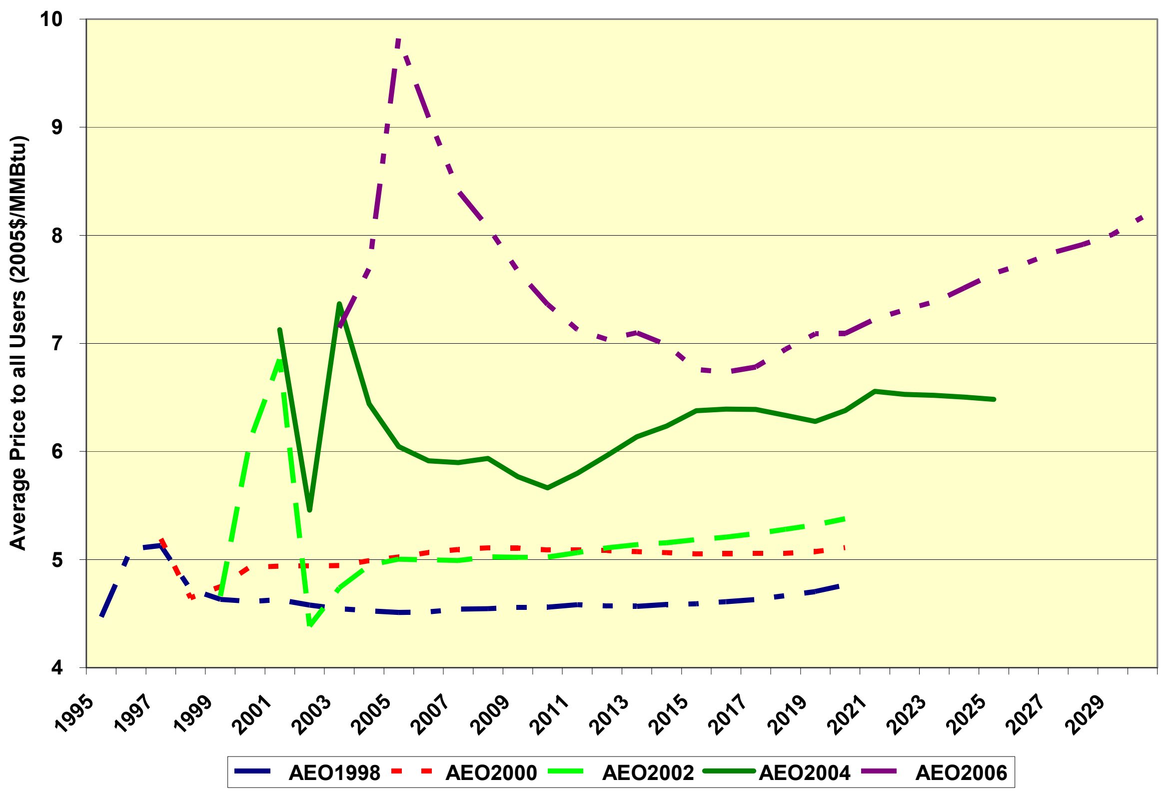
Status of North American Energy Markets

Our energy problems have been many years in the making and should not come as a surprise. Many of these problems have their roots in the energy crises of the 1970s, and while we made some modest accommodations to them by increasing energy efficiency, we never directly solved what would become a tightening straitjacket (Halberstam 1986). The markets initially became aware of impending energy problems in the winter of 2000–2001, when limited supplies of hydro-electric power and natural gas combined with a cold winter to force natural gas prices to record high levels and contributed substantially to shortages of electricity in California and other parts of the country during the hot summer that followed. While it is now clear that some players manipulated these tight markets to their advantage, it is also clear that tight supplies of natural gas combined with high demand for electricity created the conditions that allowed this manipulation to occur (FERC 2003). Recently, Cooper (2006) cited evidence of manipulation in natural gas markets. The Federal Energy Regulatory Commission (FERC) found errors in the analysis and reasserted its view that the high prices are a result of tight natural gas market fundamentals (O'Driscoll 2006).

In part, these tight markets resulted from a dramatic shift to natural gas-fired electric power generation, fueled by the low cost of gas for much of the 1990s, the low cost to build new natural gas fuel generation, the relative cleanliness of natural gas generation, and the prospects for continued plentiful supplies of low cost gas projected for the future (see Figure 2). This resulted in the construction of over 250,000 megawatts of new natural gas-fired generation in the 2000–2005 period—an unprecedented addition of new generation to the power base (EIA 2005b). While some of this capacity was highly efficient combined cycle units, a significant share was inefficient simple cycle turbines used for peaking. This new gas demand came during a period when increases in domestic production of natural gas slowed due to a maturing of existing gas fields and imports from Canada fell as its "gas bubble" was depleted (Elliott 2004). The increasing demand for natural gas exceeded the market's ability to deliver new supplies. All of these factors combined to fundamentally shift North American gas markets, leading to a dramatic and sustained increase in natural gas prices. While we saw imports of liquefied natural gas (LNG) surge as importation facilities built in the late 1970s were reactivated, this rapid increase was small and has not been sustained because the siting and construction of new LNG terminals takes years (Elliott 2004).

As natural gas prices have soared, electric power generators shifted their generation from natural gas to lower priced coal (Platt 2005; Smith and Machalaba 2006). This surging demand for coal put pressure on coal markets leading to a doubling of coal prices and in some markets outright shortages. These coal shortages in turn led to increased utility use of natural gas for power generation and by the summer of 2005, utilities were forced to shift back to natural gas to generate power, leading to a late-summer price spike (EEA 2005; Smith and Machalaba 2006). The coal shortage and surging coal prices led to surging electricity prices, which added insult to injury for consumers still reeling from the high natural gas prices (Smith 2006a, 2006b; Crutsinger 2006).

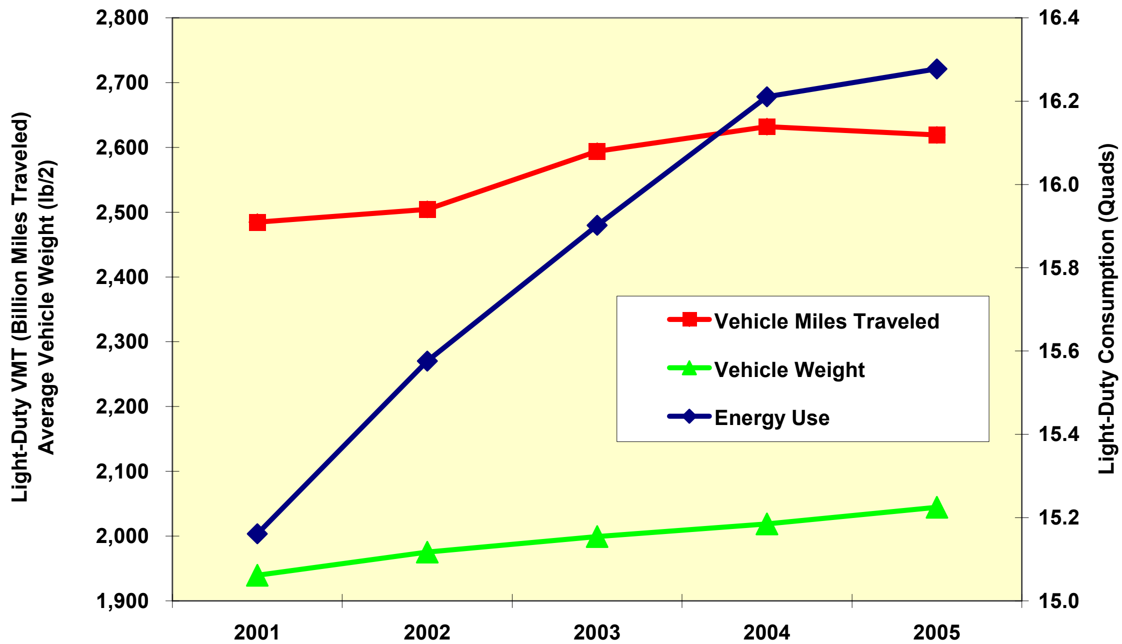
Figure 2. Natural Gas Price Forecasts from Various Annual Energy Outlooks



Sources: EIA (1997), (1999), (2001), (2004), (2006a)

During the same period, demand for gasoline surged at over 2% per year in the U.S and population grew at an annual rate of about 1%. This increase in fuel consumption resulted from a combination of consumers' shift to larger vehicles and an increase in vehicle miles driven (see Figure 3) (EIA 2006a; EPA 2005). This increased demand means that our refineries, in spite of making significant additions to production capacity in the past few years, find themselves pushing their production to levels they were not intended to maintain just to keep up. As demand has outstripped supplies of refined products, we have seen steadily increasing refined goods prices for the past few summers, and many analysts forecast continued tightness this summer (Cook 2005).

Figure 3. Level of Travel and Energy Consumption by Light-Duty Vehicles in the United States



Sources: EIA (2006a); EPA (2005)

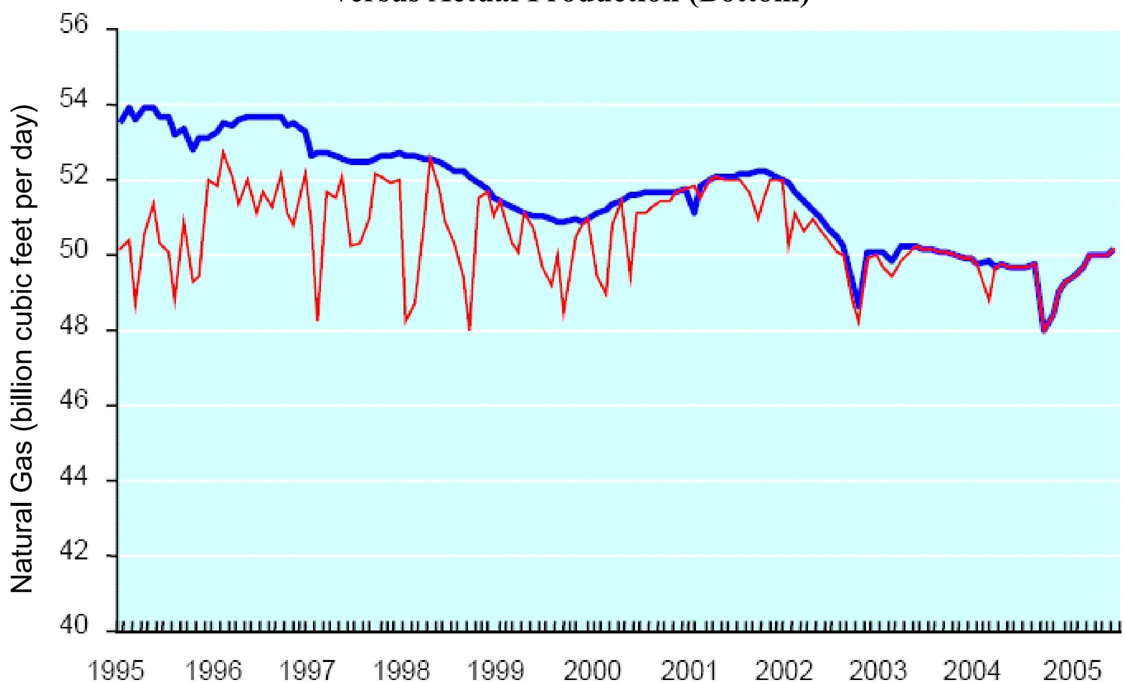
Under-Investment in Infrastructure

Many of our problems result from a chronic under-investment in our energy infrastructure over the past quarter century. We have seen the same pattern played out in other sectors of the economy as well. Over the past twenty-five years, the investment community has focused on return from net assets, rather than on expanding capital base. This investment perspective encourages greater economic efficiency by retiring older, less productive (and less efficient) capacity (Shipley and Elliott 2006) and increases the utilization of the best of the existing stock. However, this focus on returns has directed an expansion of the economic base at the expense of the nation's energy (and other) infrastructure. While a focus on productivity has resulted in low costs to the consumer and the greatest immediate returns for investors, it deprives the economy of the resilience to handle surges in demand resulting from disruptions, extreme weather, or increased economic activity.

Natural Gas

This trend toward reduced excess capacity is clear in the comparison between productive capacity and actual production in natural gas markets (see Figure 4). Natural gas wells have a fairly short life, so significant drilling activity is required to maintain production levels. During the late 1990s, low prices did not encourage drilling so productive capacity declined just as new natural gas-fired generation capacity came on line. The convergence of these two events led to the first of the natural gas "crises" in late 2000, when low hydro production due to lower than normal snowfalls in the West led to a spike in demand for natural gas to produce power to satisfy demand in California.

Figure 4. Natural Gas Productive Capacity (Top Line) versus Actual Production (Bottom)



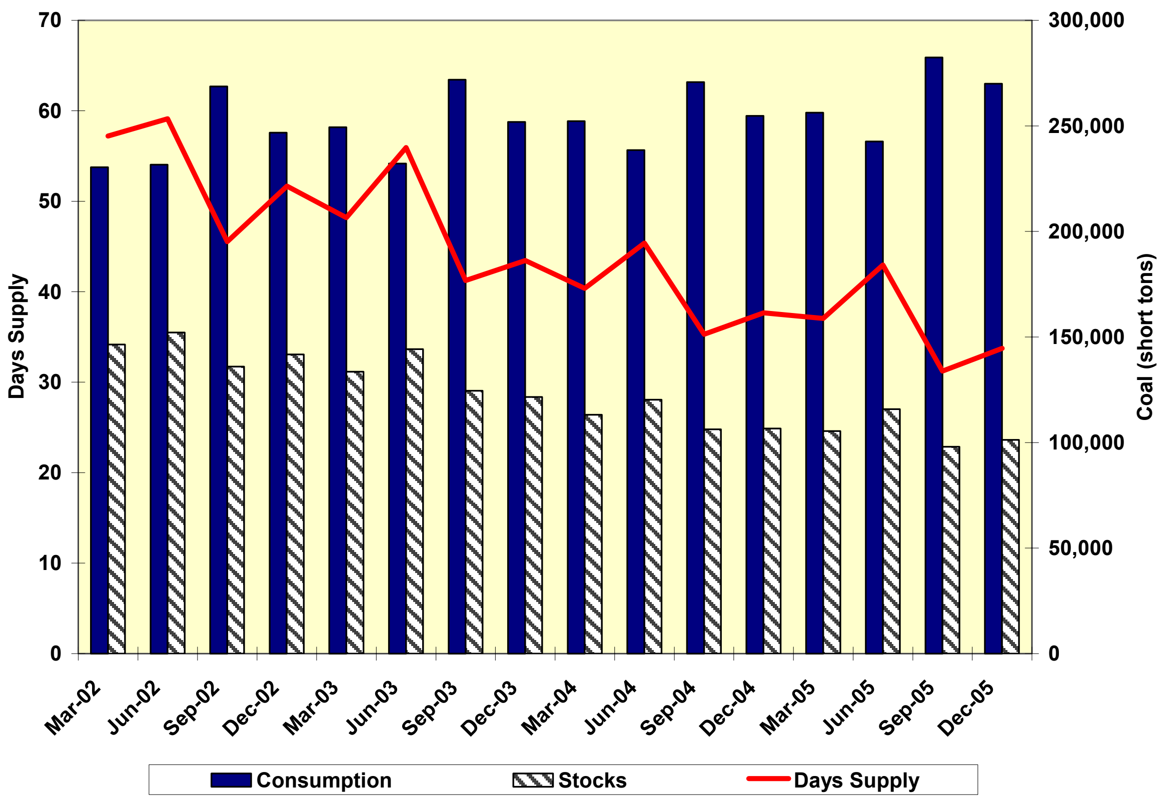
Source: Petak (2005)

While this price spike motivated renewed drilling activity, the last few years have seen the market unable to bring on sufficient new productive capacity to offset maturing fields and losses in imports from Canada (Zenker 2005). This situation was further exacerbated by the 2005 hurricane season, as will be discussed shortly. As a result, markets continue to be very tight (EEA 2005).

Coal

Coal is frequently cited as the fuel of the future for North America and is already our largest source of electric power generation. However, we have seen tightening coal markets over the past few years as demand for coal has soared—in large part as a result of increases in natural gas prices. After many years of low coal prices, we have seen a consolidation of the coal industry, the introduction of new mining technologies that require greater economies of scale, a decline in small mines, and an increase in the market share of public companies (i.e., traded on a stock exchange), which has resulted in a reduction in productive capacity. The industry saw little impetus to make major new investments in productive capacity (Platt 2005). However, as demand surged in the past two years, inventories for coal began to decline at electric power plants (see Figure 5). Later, winter snows in 2005 and shortages of rail capacity combined to reduce supplies even further in many Midwest regions. When late summer heat drove up electric demand, many plants had no reserve margins and generators were forced to turn to natural gas to generate power to meet customer demands. While production is anticipated to increase for the coming year, supplies are projected to remain tight until inventories at power plants can be rebuilt, which may take several years (Bellemare 2005; Silverstein 2006; Smith and Machalaba 2006).

Figure 5. Electric Power Coal Consumption, Quarter-End Stocks, and Days of Implied Supplies at Power Plants



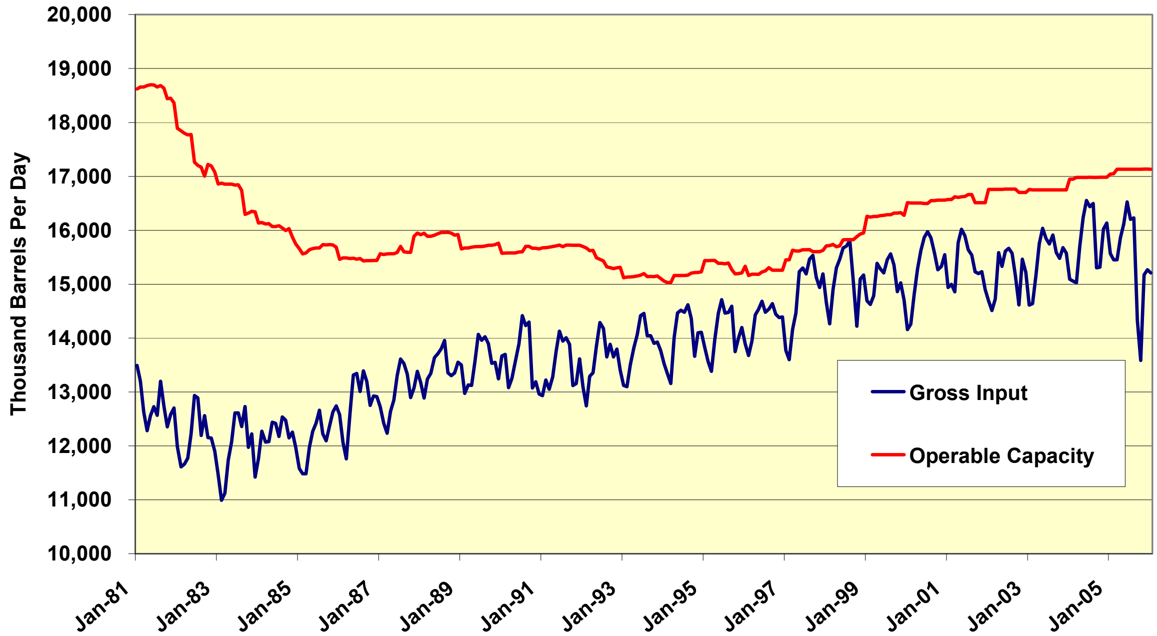
Source: ACEEE from EIA data

Oil Refining

Similarly, oil refining was for many years a low margin industry, so the industry saw little motivation to add excess capacity. Domestic petroleum refiners consolidated, bringing available productive capacity into line with consumer demand (see Figure 6). The balance in market requirements for refined products (e.g., gasoline, diesel fuel, and heating oil) was made up through imports. As demand increased and capacity utilization increased during the mid-1990s, the industry responded to the market signal by beginning to add new capacity.

Contradicting the widely held perception that the industry did not respond to the market signals, over 2,000,000 barrels per day of refining capacity were added since 1995 (EIA 2006b), but not by building new refineries, rather by enhancing the productive capacity at existing refineries. This approach was less costly and much quicker than beginning new refinery projects that can take a decade or more to plan, site, and build before they can begin showing a return. What has occurred is that demand has grown more rapidly than capacity could be added.

Figure 6. Operable Refining Capacity and Gross Refinery Input

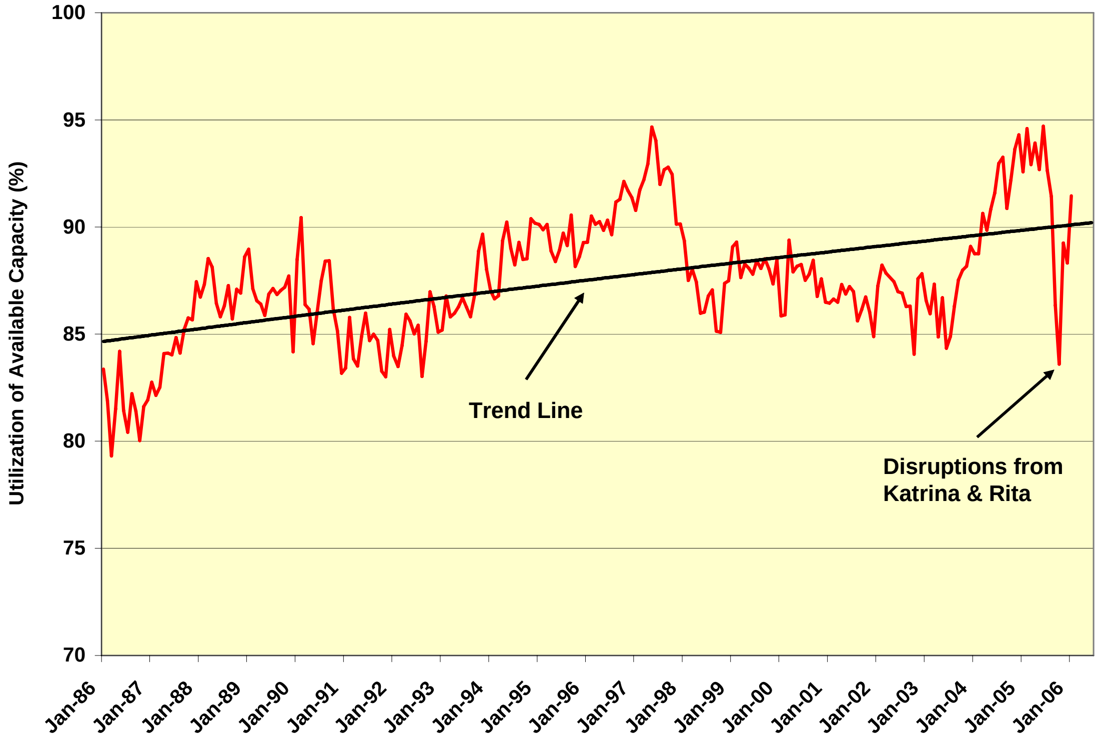


Source: ACEEE from EIA (2006d) data

Over the past few years, we have seen utilization of the installed capacity increase steadily (see Figure 7) as operators drove their capacity harder to produce refined products that were in short supply and thus commanded a market premium. As a result of this high demand (and resulting higher prices), refiners have shifted their limited production capacity to motor fuels during the late winter when they would normally be producing heating oil, meaning that fuel oil inventories fell during the summer. In the fall when refiners shifted to heating oil production, they had to try and catch up with demand to avoid shortages. In the last few years, the pressure to increase yields has resulted in the increased use of natural gas, both to displace refined goods that could be sold at higher prices and for the production of hydrogen to enhance gasoline production. Even though natural gas has been at historically high prices, this increase has occurred because the refiners have been able to sell the gasoline at such a premium.

As global demand for refined products increased, driven in large part by the emergence of China and India as large consumers, the option of importing to make up domestic refining shortfalls became more costly. The hurricanes of 2004 and 2005 further complicated matters for U.S. refiners because they caused interruptions in refinery operations due to damage to some refineries as well as disruptions in crude supplies, pipelines, and electric power.[2] ??? While imports of gasoline did increase following the 2005 hurricanes, they came at a high price and resulted in global increases in prices as well (Cook 2005).

Figure 7. Utilization of Domestic Refining Capacity



Source: ACEEE from Federal Reserve (2006) data

Electricity

While we have not experienced another spectacular electric power outage like the one that occurred on August 14, 2003, very few major new infrastructure investments that were the anticipated response to the 2003 outage have actually been made. We have seen minimal response by government and industry—most of the response has been confined to changes in regulation and increased oversight of the industry. The 2005 hurricane season left utilities further strapped. The utility industry remains concerned that the grid is increasingly stressed and that high demand resulting from extreme heat or some other weather-related event could result in major disruptions (Reuters 2005; NERC 2005).

Renewables

Similarly, with higher electricity prices, we see interest increasing in renewable generation. With higher conventional energy prices, many renewable energy sources are now increasingly competitive in the market, particularly since they do not expose the operator to

[2] Neither EIA nor the Federal Reserve removes capacity that is inoperable because of disruptions due to weather or operational events from the national refining base.

volatile fuel markets (Komor 2004). Unfortunately, this surging demand for renewable energy is increasing at a rate faster than the renewable energy industry can build new production capacity. Recent work by Wiser (2005) suggests that solar and wind power manufacturing is operating at full capacity, and several years will be required for additional manufacturing capacity to be built to meet the surging market demand. As a result, the ability of renewable energy manufactures to add the new capacity needed to meet increasing electricity demand will be limited for the next few years.

The Deliverability Crisis

What these individual fuel market situations suggest is that we have economy-wide energy problems. These current energy market challenges should be viewed as "deliverability" problems rather than supply shortages. The problems stem largely from insufficient capacity to deliver the ever increasing energy demanded by the U.S. economy. While eventually new capacity will be constructed to meet market demands for energy, this is likely to take years. A good example is the Alaska natural gas pipeline to the lower-48 states. The agreement is to design and seek permits for the pipeline, with actual construction to begin no sooner than 2008, and actual gas deliveries beginning no sooner than 2012 (Gold 2006). Similarly, new LNG production is likely to take years to reach significant levels. In addition, there are significant uncertainties about how much LNG will be available to the U.S. and at what price because of global competition (Nissen 2006). As these examples suggest, there may be significant factors—wild cards even—that will affect the actual markets. In the next sections we will explore several of these.

Impact of Weather on Energy Markets

Weather is one of the critical wild cards in energy markets. Weather can effect energy consumption by changing fuel demand, disrupting production, and disrupting infrastructure that is essential to process and deliver fuels.

We have seen all these effects in the past year. As natural gas prices continued to rise, electric generators turned increasingly to coal as their fuel of choice, leading to surging demand. While natural gas had taken over an increasing share of electric generation—both peak and intermediate load—at the end of the 1990s, the high gas prices encouraged generators to shift much of the intermediate and some of the peak to coal, leaving natural gas with only the marginal peak load (Smith and Machalaba 2006). This increased coal demand led to strains in coal markets as the demand exceeded the industry's ability to ramp up production. In addition, late-winter snows and rains led to derailments in the West, reducing the ability to get Powder River Basin coal to Eastern power generators, forcing generators to draw down coal supplies at power plants normally reserved to handle supply disruptions during extreme winter weather. As a late heat wave baked the country during the summer of 2005, generators were forced to turn to natural gas as their fuel of last resort. While the summer of 2005 seemed much hotter than normal, it was only 4% warmer than "normal," but was 75% warmer than 2004.[3]

As a result of these events, the U.S. found its inventories of natural gas, gasoline, heating oil, and coal at the end of August at levels well below those of recent years. Many energy experts became nervous that we were perilously close to shortages at those inventory levels as we moved into the heating season. Thus we saw run-ups in heating oil, coal, and natural gas prices for much of late July and August to nominal if not real record levels. At the same time, the summer demand for gasoline drove price to record levels.

Then the country was hit with Hurricanes Katrina and Rita. These storms disrupted energy production (see Figure 8), processing, and distribution infrastructure in the Gulf of Mexico on an unprecedented scale (EEA 2005; EIA 2005b). These disruptions came while the industry was still in the process of recovering from the "storm of the century," Ivan, from the previous year. The storms disrupted ongoing efforts to restore damage from Ivan and an early 2005 storm Dennis, while inflicting new damage across the region. The reduced production capacity has still persisted, with 6.6% of U.S. oil production and 3% of gas production still shut in at the time of this writing (March 2006). These Gulf production disruptions are anticipated to continue at least through the coming summer. In addition, Katrina and Rita disrupted natural gas processing,[4] oil refining, and pipeline operation to a degree not previously anticipated or experienced. This led to an immediate surge in gasoline prices to unprecedented levels, which were only moderated late in the fall by a flood of imported gasoline drawn by the high prices in the U.S.

While the 2005 hurricane season may have brought energy issues to the front pages, continuing unusually mild weather has actually masked the growing problems in energy markets for several years. The four winters beginning with 2001–2002 have been unusually warm, reducing demand for natural gas and heating oil. The three summers up until 2005 were unusually cool, reducing demand for electricity and for fuel to run power plants. As a result, demand has been lower than normal, which has prevented outright shortages from occurring in the marketplace. Natural gas market experts have become increasingly alarmed that we were but a hot summer or a cold winter away from not only market tightness, but acute shortages (CERA 2005; Zenker 2005). These underlying problems persist, and if we return to normal weather, we are likely to see future price spikes or potentially outright disruptions, as were forecast for the winter of 2005–2006 (Wright 2005).

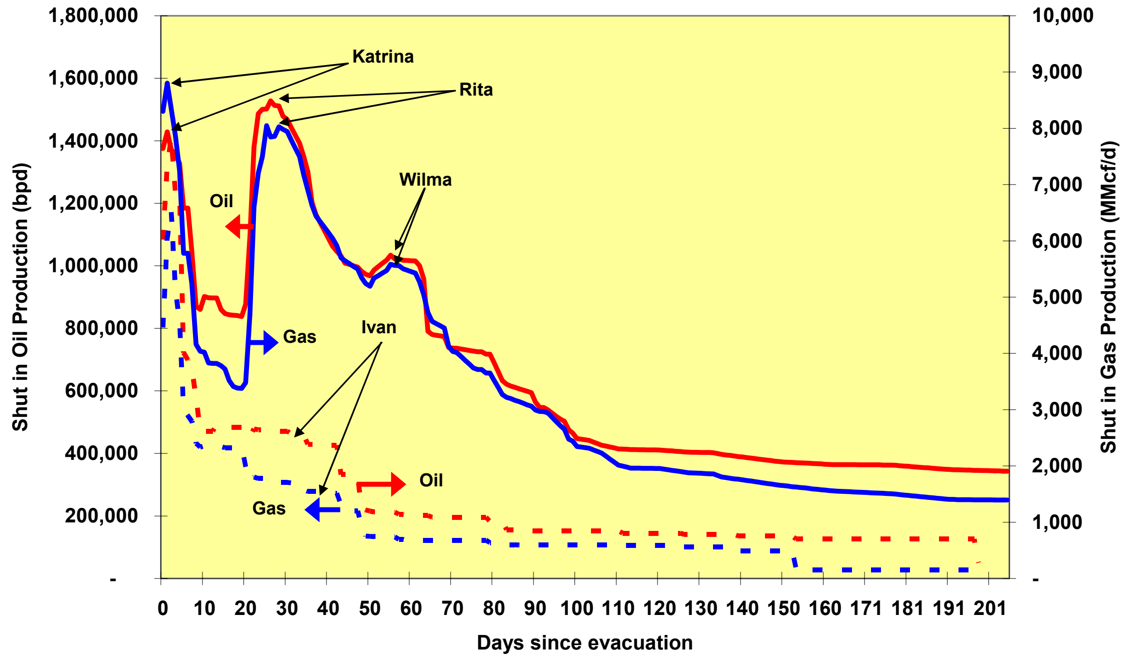
Many thought that the worst had come to pass when December 2005 started significantly colder than normal. Withdrawals from natural gas storage were the highest in history due to the heating demand coupled with continued reductions in Gulf production from the hurricanes (see Figure 9). However, January 2006 proved to be the warmest on record (see Figure 10) with withdrawals from storage the lowest in memory. As a result, by the end of

[3] As measured in national average cooling degree days, where a degree day is a quantitative index demonstrated to reflect demand for energy to heat or cool houses and businesses. For a more detailed explanation, see http://www.cpc.ncep.noaa.gov/products/analysis_monitoring/cdus/degree_days/ddayexp.shtml.

[4] Prior to shipment of natural gas to consumers, various impurities and heavier hydrocarbon molecules must be removed. The heavier hydrocarbons are sold as chemical feedstocks (see Elliott, Langer, and Nadel 2006). This process is performed at natural gas processing facilities, with the largest in the Gulf region being the Henry Hub.

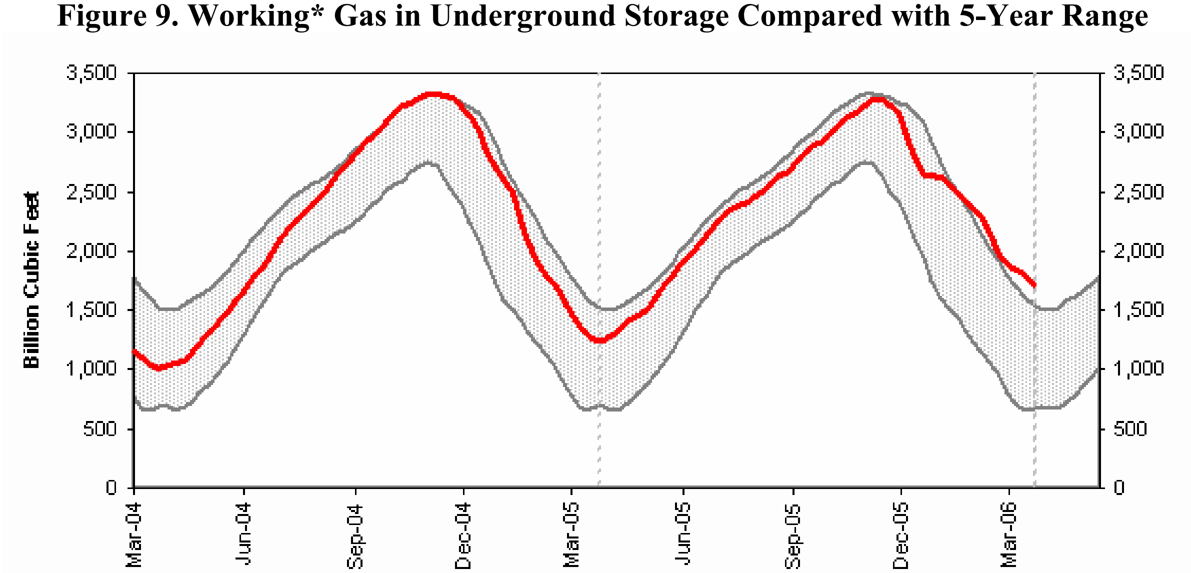
the month, storage levels were at record levels, leading to a rapid drop in natural gas prices (Jakab 2006). The winter has continued to be warm, with December through February being the fifth warmest on record (NOAA 2006).

Figure 8. Disruptions in Oil and Gas Production from Federal Waters in the Gulf of Mexico from 2004 and 2005 Hurricanes



Source: MMS 2006

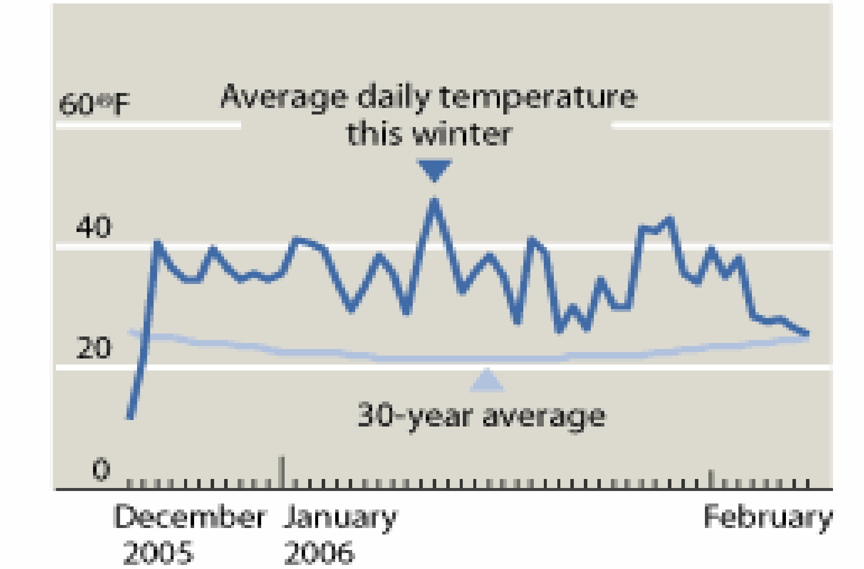
Figure 9. Working* Gas in Underground Storage Compared with 5-Year Range



Source: EIA (2006c)

* Working gas is defined as the fraction of total volume that can be recovered for use. See EIA (2003) for more information.

Figure 10. Chicago Average Daily Temperature Compared with 30-Year Average



Source: WSJ from AccuWeather.com (Jakab 2006)

Other Energy Wild Cards

In addition to weather, a number of other energy "wild cards" could affect energy markets in a profound way. Some have near-term impacts, while a number have longer-term ramifications. As mentioned earlier, global economic trends will be a major factor in energy markets for the foreseeable future. Increasingly, all energy markets are becoming global. Rapidly expanding markets such as India and China will be increasing their demands for energy, which will compete with the U.S. for imported supplies of energy.

Global geo-politics will also play an important role in driving energy markets. The decision by Russia on January 2, 2006 to suspend natural gas exports to the Ukraine sent shockwaves throughout the European Union, resulting in a strategic reassessment of energy supplies for the entire EU. The EU and its member countries are now considering expanding the role that LNG will play in their energy plan. Responding to these concerns, Spain bid away an LNG shipment from Trinidad originally destined for the LNG terminal at Everett, Massachusetts (Cooke 2006). Similarly, political unrest in some key oil-producing regions is creating significant unease in energy markets (Levine and Davis 2006).

On the national front, national and local politics also will play a key role in the direction markets will head. The Energy Policy Act of 2005 approved by the U.S. Congress contained many measures addressing longer-term energy needs. For example, the Alaska Gas Pipeline was a part of the Act. Experts anticipate that this pipeline will take a decade to build, if it is actually built. While petroleum companies have committed to studying the construction, whether the pipeline will actually begin delivering natural gas to the lower-48 states will remain largely a political decision, not a business decision (Gold 2006). Another example is the current plan to eliminate MTBE from gasoline and switch to ethanol as the oxygenate for emissions reduction purposes, largely sucking up all the available ethanol in the marketplace. "We're adding as much [production capacity] as we can, as fast as we can. But I don't think anybody anticipated refiners would be hemorrhaging MTBE as quickly as they are," stated Bob Dinneen, head of the Renewable Fuels Association (Wall Street Journal 2006). Thus the prospect of helping to ease tightness in gasoline supplies from expanded bio-fuels becomes an ethanol deliverability crisis.

Similarly at the more local level, concerns about the impact of LNG gas quality on distribution systems has led the local gas distribution company to oppose FERC's permit for expansion of the Dominion Cove Point LNG terminal (Rivera 2006). Similar opposition is building to construction of new LNG facilities on the West Coast (Hunt 2006).

Thus, many of the longer-term drivers of energy markets will result from external forces—local, national, and global—that are beyond the markets' control.

What Is Ahead?

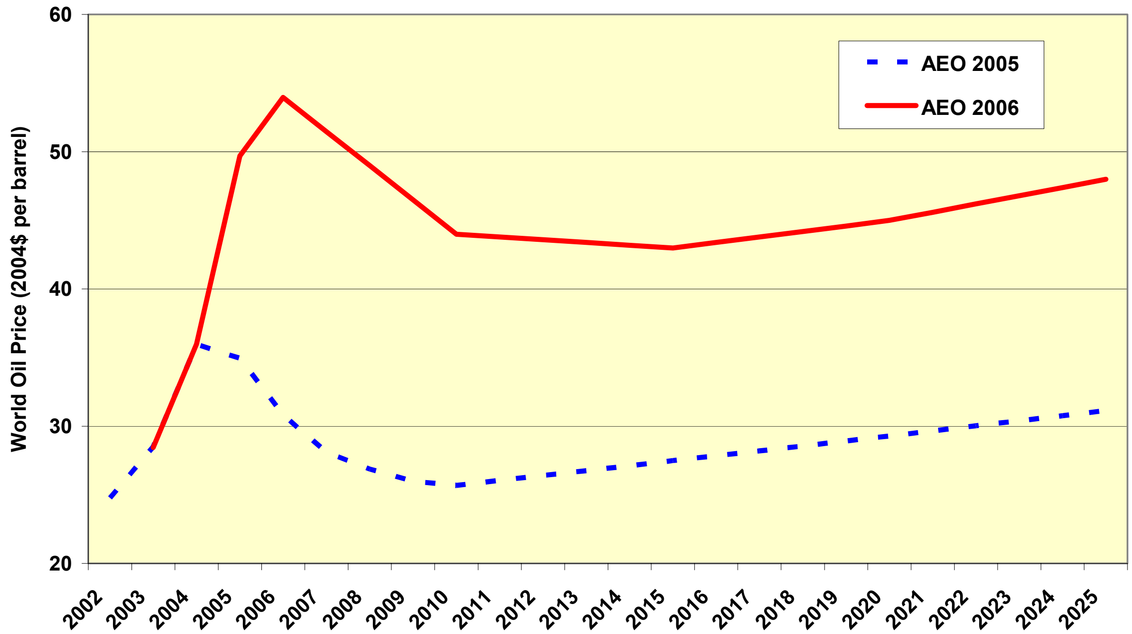
Energy market crystal balls are cloudy at best. Past experiences no longer provide reasonable indicators of future market behavior. The unusually mild weather we have been having for the past few years could continue deferring crises, or we could return to normal patterns leading to greater tightness in markets. Extreme weather could further disrupt energy production. For example, there are indications that we are entering a period of increased hurricane activity, which could result in significant disruptions, as we have seen over the past two years. Recent analyses suggest that global warming may result in hurricanes of greater intensity (Webster et al. 2005; Hoyos et al. 2006). Energy markets have taken note of this trend along with forecasts for an active 2006 hurricane season (Accuweather.com 2006) by increasing futures prices for refined products (Levin and Davis 2006).

Global oil prices are likely to continue to drive energy prices, since fuel oil to a great extent provides a price floor for natural gas (Petak 2005). Forecasts of oil prices are significantly higher today than they were just a year ago (see Figure 11). As a result, all our energy market prices and supplies will likely remain uncertain and highly volatile—battered by an array of unexpected "wild cards" or unanticipated disruptions or shocks that may yet emerge.

Long-Term Energy Trends

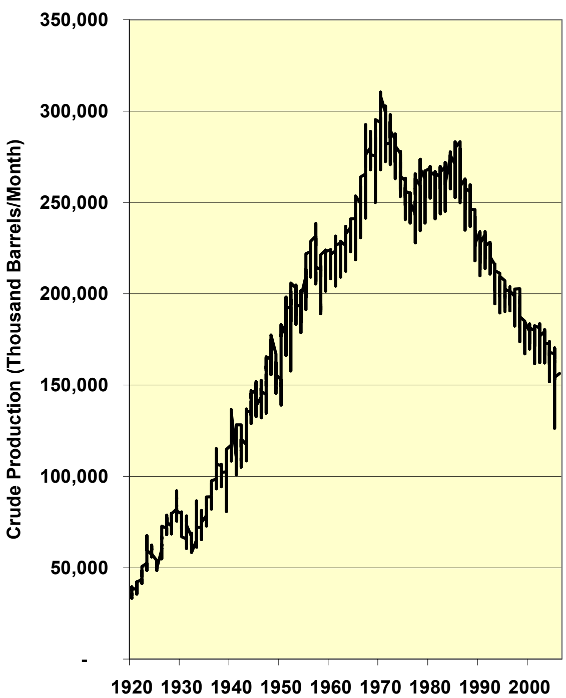
In the longer term, supply—at least at the domestic level—will become more of a concern. Domestic oil production peaked in 1972 and gas peaked in 1973 (see Figure 12). This phenomenon has been called the "peak" effect, after Hubbert's prediction of peak oil production (see Deffeyes 2001), with both a domestic aspect (that can be argued has passed already) and a global aspect. The implications of this theory are not that we will see an immediate shortage of supply when we reach the peak, but that we will see the supply becoming increasingly more difficult and expensive to produce. Some experts are arguing that we are beginning to see that effect (Zenker 2005; Paris 2006). While no one is contending we are running out of coal, the quality of coal is declining, which lead to a similar outcome (Smith and Machalaba 2006). As a result, the prospects are for more expensive, lower quality conventional resources, so market price pressures are likely to remain longer term.

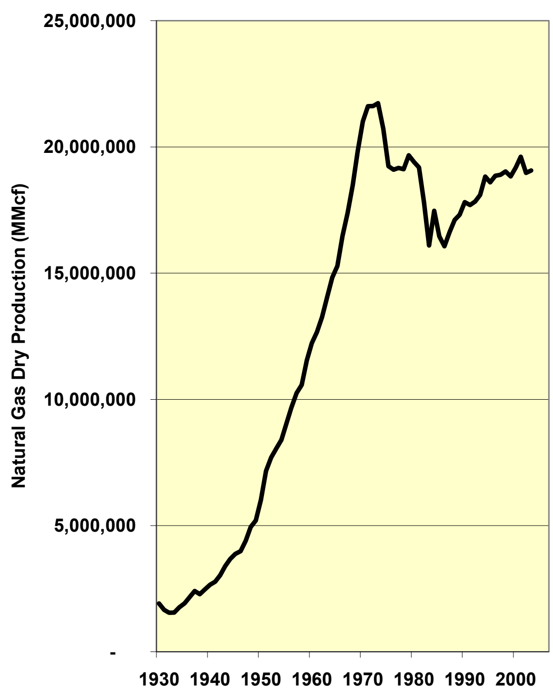
Figure 11. EIA World Oil Price Forecast



Sources: EIA 2005a, 2006a.

Figure 12. Domestic U.S. Oil and Gas Production





Source: ACEEE from EIA data (2006e and 2006f)

Role of Energy Efficiency Resources in Loosening the Straitjacket

The good news is that there are immediate options, which, if immediately deployed, can ease or loosen the energy straitjacket. These include a large array of both energy efficiency investments and conservation resources that can help stabilize and rebalance energy markets. Indeed, they may be the only short-term options that can do so. In contrast to various new supply resources, efficiency and conservation can be quickly deployed in many energy-consuming sectors. Energy efficiency is a quiet but effective energy resource, having contributed substantially to our nation's economic growth and increased standard of living over the past 30 years.

Energy efficiency and conservation, however, is not a panacea for America's energy problems. While it can help address the current deliverability problems, it will not solve our longer-term energy supply challenges. Rather, energy efficiency should be viewed as a strategy to buy time for the U.S. to invest in a portfolio of long-term strategies that will put the country on a more sustainable energy path (Elliott and Shipley 2005). These resources could include further use of energy efficiency and expanded renewable resources, complemented by more efficient use of domestic and imported domestic resources. The makeup of this portfolio will be a political decision, not just a market response to high prices.

Efficiency Potential

If the U.S. economy had used the same amount of energy per unit of GDP in 2004 as it did in 1973, U.S. energy use in 2004 would have been 90% higher.[5] In other words, efficiency and other energy-intensity improvements saved 90 quadrillion Btus in 2004, *which is more energy than we now get annually from domestic coal, natural gas, and oil sources combined.* While about one-third of this improvement is due to structural changes in the economy (such as a relative decline in products produced by energy-intensive industries), the remaining two-thirds is improvements in energy efficiency (Geller et al. 2006). Even with this adjustment, energy efficiency can rightfully be called our country's largest energy source (Laitner 2004; Laitner and Elliott 2006).

Although the United States is much more energy efficient today than it was 30 years ago, there is still enormous potential for additional cost-effective energy savings. Laitner (2006) noted, for example, that the equivalent of U.S. "energy efficiency reserves" could be almost twice those available from energy supply resources. Some newer energy efficiency measures have barely begun to be adopted. Other efficiency measures could be developed and commercialized in coming years, if they had the proper support (Laitner and Brown 2005).

The U.S. Department of Energy's (DOE) national laboratories estimated that increasing energy efficiency throughout the economy could cut national energy use by about 20% in 2020, with net economic benefits for consumers and businesses (Interlaboratory Working Group 2000). A just-published report for the Western Governors' Association reached the same conclusion (WGA 2006). These savings work out to be more than 1% each year. As the

[5] Calculated using data from EIA (2005a). Laitner (2006) also noted that energy efficiency has provided 75% of the nation's new demand for energy services since 1970, while new energy has supplied only 25%.

2005 study by ACEEE (Elliott and Shipley 2005) demonstrated, even these relatively small annual savings can have important impacts on tight energy markets.

The opportunity for saving energy is also illustrated by the experiences of California in 2001 (Global Energy Partners 2003). Prior to 2001, California was already one of the most efficient states in terms of energy use per unit gross state product (ranking 5th in 1997 out of 50 states). But in response to pressing electricity problems, California homeowners and businesses reduced energy use by 6.7% in the summer of 2001 relative to the year before (after adjusting for economic growth and weather), with savings costing an average of 3 cents per kWh (far less than the typical retail or even wholesale price of electricity).

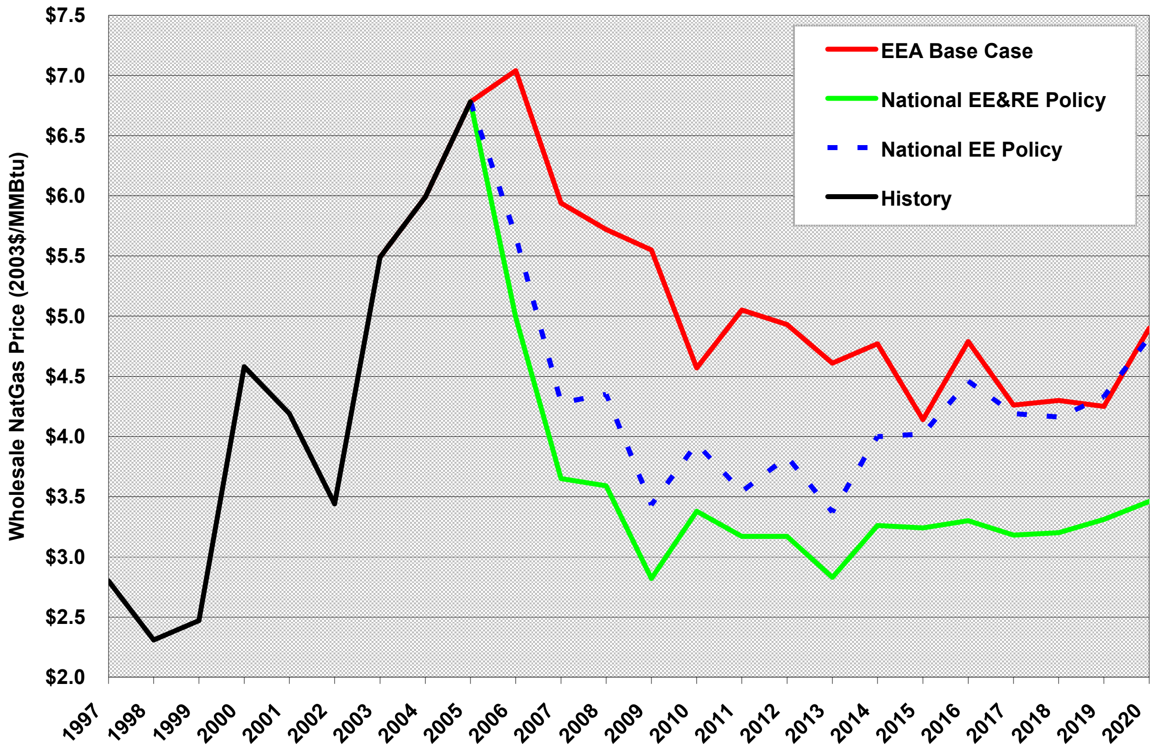
While these studies have focused on electricity and natural gas, there are important opportunities in the oil sector, and not just transportation, as laid out in a recent ACEEE report (Elliott, Langer, and Nadel 2006). While changes to fleet fuel economy may take years to have a major impact, petroleum use in other sectors may offer some near-term relief.

It is important to remember, however, that all our energy markets are interrelated, so energy efficiency and conservation cannot be about one fuel only (say natural gas) but rather must be deployed broadly to achieve significant market impacts. Reducing gasoline consumption frees up refining capacity to produce heating oil. Reducing electricity consumption reduces demands on coal and natural gas markets, allowing those markets to recover. Thus, a call to action on energy efficiency and conservation is sorely needed for *all* fuels.

Impact of Reduced Demand on Price

In addition to the direct benefits of reduced consumption on energy expenditures, small changes in consumption in tight markets can result in large changes in prices—both up and down. Beginning in 2003, ACEEE began looking at these effects in natural gas markets (Elliott et al. 2003). This analysis predicted significant price reduction effects from reduced consumption resulting from expanded energy efficiency and renewable energy. This analysis was updated in 2005 (Elliott and Shipley 2005) and expanded to consider energy efficiency alone (see Figure 13). In the past few months, we have seen this phenomenon with steep prices resulting from increased demand driven by electric power consumption during the late summer of 2005, and a rapid drop in prices resulting from the record warm January 2006.

Figure 13. Effects of Energy Efficiency and Renewable Energy on the Henry Hub Wholesale Price of Natural Gas



Source: Elliott and Shipley (2005)

While similar analyses have not been conducted on other energy markets, we would anticipate that we would see price effects as long as the markets remain tight, though we have no estimates how the impacts would compare with those seen in natural gas markets. This topic is an area that should receive significant future research attention.

Conclusions

The United States has entered a period of unprecedented energy risks. Our increasing demand for energy is outstripping energy markets' ability to deliver energy. While these energy supply infrastructure problems may be addressed in the future as markets come back into balance, it will take several years for these investments to take effect. For the near term, if we reduce the rate of demand growth, this would allow energy supply infrastructure to catch up sooner, resulting in lower and more stable energy prices.

Energy markets are increasingly interconnected. These linkages among energy markets create opportunities for policymakers. Taking policy action to reduce demand for one energy type reduces pressure on other energy markets. For example, the most effective way to reduce natural gas demand could be to reduce electricity consumption, because many electricity markets are driven by gas on the margin. It is thus important to continue research on energy markets and their interrelationships because we are likely to be in a period of tight markets for some time to come.

The nation's least expensive and most rapidly deployable policy solution is a broad-based effort to ramp up efficiency and conservation programs, as California pursued in 2001 to resolve its electricity crisis. Such an effort would loosen our straitjacket, providing our energy markets with breathing room.

A short-term, stop-gap approach to energy efficiency, however, is not a viable policy solution. We are in an ongoing, long-term race to deliver enough energy, conventional or otherwise, to meet rising demands. Conventional energy resources are becoming more difficult and expensive to bring to market, and alternatives face their own cost and other constraints. Energy efficiency is thus the cornerstone of a sustainable energy policy; if demand grows too fast, no supply infrastructure will be able to keep up. This means that investing in energy efficiency resources is essential to moderating the need for new energy supplies, and we must act now to begin the efficiency investments needed to put America on a sustainable energy path. The resource decisions we make today will determine how painful our energy problems will be in the future.

To loosen America's energy straitjacket, the U.S. will need political leadership on energy efficiency and conservation at all levels of government. ACEEE recommends four key immediate actions:

1. The President should call on governors, legislators, utility regulators, utility companies, and the energy efficiency industry to join him in a national campaign to action encouraging energy efficiency and conservation. This campaign should be funded through the $90 million per year public awareness campaign authorized in last year's Energy Policy Act (EPAct) legislation.
2. Funding for Energy Efficiency budgets cut in the FY 2007 budget request should be restored to FY 2002 levels, plus an additional 20%, to put total funding on track to meet EPAct authorizations by FY 2008.
3. An energy efficiency resource standard (EERS),[6] as considered by the Senate in developing EPAct 2005, should be enacted.
4. Oil savings legislation with enforceable provisions should be enacted, designed to save at least 2.5 million barrels per day by 2015. This legislation should also affirm that the National Highway Traffic Safety Administration has authority over automotive fuel economy requirements.

While these measures may not enough by themselves to rebalance energy markets, they would make a substantial start, particularly if the states respond in kind.

[6] For more information on EERS, see Nadel (2006).

References

AccuWeather.com. 2006. *Threat of Major Hurricane Strike Grows for Northeast: AccuWeather.com Warns That "Weather Disaster of Historic Proportions" Could Strike as Early as This Year*. New York, N.Y.: AccuWeather.com.

Bellemare, Bob. 2005. "Coal Shipments Derailed." *UtiliPoint Daily IssueAlert,* August 30.

[CERA] Cambridge Energy Research Associates. 2005. *North American Natural Gas Watch, Winter 2005.* Cambridge, Mass.: Cambridge Energy Research Associates.

Cook, J. 2005. "Oil Markets After the Hurricanes: Reversion to the Mean or Return to Recent Trend?"http://www.eia.doe.gov/pub/oil_gas/petroleum/presentations/2005/macroadvisers/index.html. Presented at *Macroeconomic Advisers Quarterly Meeting December 2005*, Dec. 14, Washington, D.C.

Cooke, R.R. 2006. "The 2006 Economic Forecast: Oil Remains a Wildcard,. *Energy Pulse*, Feb. 7.

Cooper, M.N. 2006. *The Role of Supply, Demand and Financial Commodity Markets in the Natural Gas Price Spiral*. Prepared for Midwest Attorneys General Natural Gas Working Group (Illinois, Iowa, Missouri, and Wisconsin). Washington, D.C.: Consumer Federation of America.

Crutsinger, M. 2006. "Surging Energy Costs Push Inflation Up," Associated Press, February 22.

Deffeyes, K.S. 2001. *Hubbert's Peak: The Impending World Oil Shortage*. Princeton, N.J.: Princeton University Press.

[EEA] Energy and Environmental Analysis, Inc. 2005. *Hurricane Damage to Natural Gas Infrastructure and its Effect on the U.S. Natural Gas Market*. Arlington, Va.: Energy and Environmental Analysis, Inc.

[EIA] Energy Information Administration. 1997. *1998 Annual Energy Outlook*. Washington, D.C.: U.S. Department of Energy.

———. 1999. *2000 Annual Energy Outlook*. Washington, D.C.: U.S. Department of Energy.

———. 2001. *2002 Annual Energy Outlook*. Washington, D.C.: U.S. Department of Energy.

———. 2003. *U.S. LNG Markets and Uses,* http://www.eia.doe.gov/pub/oil_gas/natural_gas/feature_articles/2003/lng/lng2003.pdf. Washington, D.C.: U.S. Department of Energy.

———. 2004. *2004 Annual Energy Outlook*. Washington, D.C.: U.S. Department of Energy.

———. 2005a. *2005 Annual Energy Outlook*. Washington, D.C.: U.S. Department of Energy.

———. 2005b. *Hurricane Impacts on the U.S. Oil and Natural Gas Markets*. http://tonto.eia.doe.gov/oog/special/eia1_katrina.html. Washington, D.C.: U.S. Department of Energy.

———. 2006a. *2006 Annual Energy Outlook*. Washington, D.C.: U.S. Department of Energy.

———. 2006b. *Petroleum Refining and Processing: Weekly Inputs, Utilization & Production*. http://tonto.eia.doe.gov/dnav/pet/pet_pnp_wiup_dcu_nus_w.htm. Washington, D.C.: U.S. Department of Energy.

———. 2006c. *Weekly Natural Gas Storage Report For the Week Ending March 10, 2006.* http://tonto.eia.doe.gov/oog/info/ngs/ngs.html. Washington, D.C.: U.S. Department of Energy.

———. 2006d. *Natural Gas Gross Withdrawals and Production*, http://tonto.eia.doe.gov/dnav/ng/ng_prod_sum_dcu_NUS_m.htm. Washington, D.C.: U.S. Department of Energy.

———. 2006e. *Petroleum*: *Crude Oil Production*, http://tonto.eia.doe.gov/dnav/pet/pet_crd_crpdn_adc_mbbl_m.htm. Washington, D.C.: U.S. Department of Energy.

———. 2006f. *Petroleum: Weekly Inputs, Utilization & Production*. http://tonto.eia.doe.gov/dnav/pet/pet_pnp_wiup_dcu_nus_w.htm. Washington, D.C.: U.S. Department of Energy.

Elliott, R.N. 2004. *ACEEE Fall 2004 Update on Natural Gas Markets.* ACEEE White Paper. http://aceee.org/energy/fall04ngmkt.pdf. Washington, D.C.: American Council for an Energy-Efficient Economy.

Elliott, R.N., T. Langer, and S. Nadel. 2006. *Reducing Oil Use through Energy Efficiency: Opportunities Beyond Cars and Light Trucks.* http://www.aceee.org/pubs/e061.pdf. Washington, D.C.: American Council for an Energy-Efficient Economy.

Elliott, R.N. and A.M. Shipley. 2005. *Impacts of Energy Efficiency and Renewable Energy on Natural Gas Markets: Updated and Expanded Analysis.* http://www.aceee.org/pubs/e052full.pdf. Washington, D.C.: American Council for an Energy-Efficient Economy.

Elliott, R.N., A.M. Shipley, S. Nadel, and E. Brown. 2003. *Natural Gas Price Effects of Energy Efficiency and Renewable Energy Practices and Policies.*

http://www.aceee.org/pubs/e032.htm. Washington, D.C.: American Council for an Energy-Efficient Economy.

[EPA] U.S. Environmental Protection Agency. 2005. *Light-Duty Automotive Technology and Fuel Economy Trends: 1975 through 2005*. EPA420-R-05-001. Washington, D.C.: U.S. Environmental Protection Agency.

Federal Reserve. 2006. *Federal Reserve Statistical Release G.17: Industrial Production and Capacity Utilization.* http://www.federalreserve.gov/releases/g17/. Washington, D.C.: Federal Reserve

[FERC] Federal Energy Regulatory Commission. 2003. *Report on the Natural Gas Price Spike of February 2003.* Staff Investigating Team Report, July 23. Washington, D.C.: Federal Energy Regulatory Commission

Geller, H., P. Harrington, A.H. Rosenfeld, S. Tanishima, and F. Unander. "Policies for Increasing Energy Efficiency: Thirty Years of Experience in OECD Countries," *Energy Policy*, 34 (2006): 556-573.

Global Energy Partners. 2003. *California Summary Study of 2001 Energy Efficiency Programs.* Final Report. Lafayette, Calif.: Global Energy Partners.

Gold, R. 2006. "Alaska Reaches Gas-Pipeline Deal with Exxon, BP, ConocoPhillips." *Wall Street Journal*, February 22: A3.

Halberstam, D. 1986. *The Reckoning*. New York, N.Y.: William Morrow and Company, Inc.

Hoyos, C.D., P.A. Agudelo, P.J. Webster, and J.A. Curry. 2006 "Deconvolution of the Factors Contributing to the Increase in Global Hurricane Intensity." *Science*, Published online March 16.

Hunt, T. 2006. "We Don't Need LNG in California." *Energy Pulse*, Feb. 1.

Interlaboratory Working Group, 2000, *Scenarios for a Clean Energy Future*. Washington, D.C.: Interlaboratory Working Group on Energy-Efficient and Clean-Energy Technologies, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy.

Jakab, S. 2006. "Natural Gas Rides a Roller Coaster: Prices Are on a Downturn amid Fears of Oversupply; Shortage Woes Evaporate." *Wall Street Journal*, February 21: C5.

Komor, P. 2004. *Hedging Energy Price Risk with Renewables and Energy Efficiency*. Boulder, Colo.: E Source.

Laitner, J.A. 2004. "How Far Energy Efficiency?" In *Proceedings of the 2004 ACEEE Summer Study on Energy Efficiency in Buildings.* Washington, D.C.: American Council for an Energy-Efficient Economy.

———. 2006. "Preliminary Assessments of U.S. Energy Efficiency Reserves." February 9, Washington, D.C.: U.S. Environmental Protection Agency, Office of Atmospheric Programs.

Laitner, J.A. and M. Brown. 2005. "Emerging Industrial Innovations to Create New Energy Efficient Technologies." In *Proceedings of the 2005 ACEEE Summer Study on Energy Efficiency in Industry.* Washington, D.C.: American Council for an Energy-Efficient Economy,

Laitner, J.A. and R.N. Elliott. 2006. "Energy Efficiency's Role in Getting America Out of Its Energy Straightjacket." http://www.engr.umd.edu/~sgabriel/Other/Jan_27_2006_Neal_Elliot.pdf. Presentation to the East Coast Energy Group, January 27, Washington, D.C.

Levine, S. and A. Davis. 2006. "Gasoline Prices Cling to Gains amid Supply Fears." *Wall Street Journal,* March 28: A2.

[MMS] Minerals Management Service. 2006. *Hurricane Katrina/Hurricane Rita Evacuation and Production Shut-in Statistics.* http://www.mms.gov/. Washington, D.C.: U.S. Department of the Interior.

Nadel, S. 2006. *Energy Efficiency Resource Standards: Experience and Recommendations.* http://aceee.org/pubs/e063.htm. Washington, D.C.: American Council for an Energy-Efficient Economy.

Nadel, S. and H. Geller. 2001. *Smart Energy Policies: Saving Money and Reducing Pollutant Emissions through Greater Energy Efficiency.* www.aceee.org/energy/reports.htm. Washington, D.C.: American Council for an Energy-Efficient Economy.

[NERC] National Electric Reliability Council. 2005. *2005 Long-Term Reliability Assessment: The Reliability of Bulk Electric Systems in North America.* ftp://www.nerc.com/pub/sys/all_updl/docs/pubs/LTRA2005.pdf. Princeton, N.J.: National Electric Reliability Council.

Nissen, D. 2006. Presentation to the East Coast Energy Group, January 27, New York, N.Y. http://www.engr.umd.edu/~sgabriel/Other/LNG%20AEMG_Nissen.pdf.

[NOAA] NOAA/National Climatic Data Center. 2006. *U.S. National Overview February and Winter 2006*. http://www.ncdc.noaa.gov/oa/climate/research/2006/feb/national.html. Ashville, N.C.: NOAA/National Climatic Data Center.

O'Driscoll, M. 2006. "FERC Contests State AGs' Report on Market Manipulation." *Greenwire*, March 16.

Paris, J.A. 2006. "What Markets Are Telling Us about Future Energy Prices." *European Tribune*, March 26.

Petak, K. (Energy and Environmental Analysis, Inc.). 2005. Personal communication. October.

Platt, J. 2005. "Today's High Coal Prices: Correction or Crisis?" *Power Magazine*, June: 36–39.

Rivera, Ray. 2006. "Planned Expansion Stirs Fury: Fearing Leaks, Washington Gas Fights Increase in Imports." *Washington Post*, March 27: B06

Reuters. 2005. "Blackouts May Grow as Utility Investment Stalls-Price Waterhouse Coopers," April 17.

Shipley, A.M. and R.N. Elliott. 2006. *Ripe for the Picking: Have We Exhausted the Low-Hanging Fruit in the Industrial Sector?* Forthcoming ACEEE Report IE061. Washington, D.C.: American Council for an Energy-Efficient Economy.

Silverstein, K. 2006. "Stormy Forecast for Coal?" *EnergyBiz Insider*, January 20.

Smith, R. 2006a. "TXU Posts Profit amid High Electricity Prices." *The Wall Street Journal,* February 3: A2.

———. 2006b. "Energy Prices Soar at State Auction: In Closely Watched Sale, New Jersey's Utilities to Pay Up to 55% More for Power." *The Wall Street Journal,* February 10: A2.

Smith, R. and D. Machalaba. 2006. "Taking Lumps As Utilities Seek More Coal, Railroads Struggle to Deliver." *Wall Street Journal*, March 15: A1.

Wall Street Journal. 2006. "The Gasoline Follies." March 28: A20.

Webster, P.J., G.J. Holland, J.A. Curry, and H.R. Chang. 2005. "Changes in Tropical Cyclone Number, Duration, and Intensity in a Warming Environment." *Science*, 16 September (309): 1844.

[WGA] Western Governors' Association. 2006. *Clean and Diversified Energy Initiative Energy Efficiency Task Force Report*, http://www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency-full.pdf. Denver, Co.

Wiser, R. (Lawrence Berkeley National Laboratory). 2005. Personal communication. October.

Wright, P.D. 2005. Testimony on Energy and Resources on behalf of the Interstate Natural Gas Association of America before the U.S. House Committee on Energy and

Commerce, Subcommittee on Energy and Air Quality. http://energycommerce.house.gov/108/Hearings/11022005hearing1697/Wright.pdf. November 2, Washington, D.C.

Zenker, Michael. 2005. Testimony before the U.S. House Committee on Government Reform, Subcommittee on Energy and Resources. http://reform.house.gov/UploadedFiles/9.14.05%20Zenker%20Testimony.pdf. September 14, Washington, D.C.