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ELECTRICITY PRICES AND THE FUEL FUNCTION

An Empirical & Global Analysis

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Table of Contents

List of Charts and Tables

Executive Summary

Electric companies are not just producers of energy but consumers of it, too. The price of fuel is a major determinant of the price of electricity. This study zooms in on six factors affecting energy prices: 1) domestic supply and demand; 2) monetary policy; 3) global supply and demand, 4) commodity speculation, 5) cartel activity, and 6) geopolitical risk.

U.S. labor productivity will take improving if the economy is to bear the burden of baby boom retirement. The first boomers turn 65 in 2011. A declining ratio of working age adults to the elderly – and the young – means workers will have to produce more in less time. That will take more laborsaving devices and, in turn, more electricity, the silent partner in the economy’s effort to boost labor productivity.

The recent energy price rises that overwhelmed consumers in 2005-2006 weren’t the result of a domestic supply-demand imbalance. Neither were they caused by monetary mismanagement by the U.S. Federal Reserve. Globalization, especially the rise of populous China and India, have put strong upward pressure on commodities prices, partly resulting in the energy price surge of the past few years. China alone accounted for an estimated one-third of global energy demand growth in 2003-2005. Subsequent investment in exploration and development has seen new sources of oil and natural gas coming on stream, ameliorating the recent price upturn. Cartel activity by OPEC has added to the upward pressure on prices, although attempts to limit exports usually erode over time as OPEC members vie for increased market share. Commodity speculation, too, has contributed to the hike in energy prices.

But probably the single biggest factor affecting the price of fuel has been geopolitical risk. Ever since the tragic events of 9/11 and the later U.S. invasions of Afghanistan and Iraq, global markets have become acutely aware of the potential dangers posed by terrorism and the risk of instability in the oil-rich Persian Gulf. Vital commodities such as oil and safe havens like gold have, not surprisingly, become particularly sensitive to geopolitical risk. Experience has shown, though, that geopolitical risk factors can disappear as quickly as they appear, meaning the potential for a price correction is ever-present.

So, of the six possible factors affecting fuel prices, two (i.e., domestic supply and demand, and monetary policy) are non-starters, while four (i.e., globalization, speculation, cartel activity and geopolitical risk) have clearly put upward pressure on energy prices of all sorts.

U.S. electricity consumption is projected to increase steadily between now and 2030 at an average 1.5-percent rate, according to the Department of Energy's Energy Information Administration. That would be considerably slower than past growth rates ranging between 2.3 percent and 4.2 percent in the 1970s, 1980s and 1990s. The projections, however, may be giving insufficient weight to the demand for electricity expected to be imposed by baby boom retirement and the need for more labor productivity gains. Increased electric power generation is likely to be fueled by increased coal use and more nuclear power. Natural gas used for electricity generation is expected to grow more slowly than previously forecast because of high prices in the decade of the 2020s. High energy prices will help the case for renewables and could stimulate production at marginal oilfields and make unconventional sources viable (e.g., oil sands and ultra-heavy oils), potentially jeopardizing OPEC's dominance.

Internationally, growth in the developing world is likely to see a sharp rise in electricity use, especially as poor populations gain access to electric lighting, refrigeration, air-conditioning and electronic home entertainment for the first time. This, however, could put these emerging economies – notably China and India – on a collision course with the opponents of global warming, who seek to cap so-called "greenhouse" gas emissions.

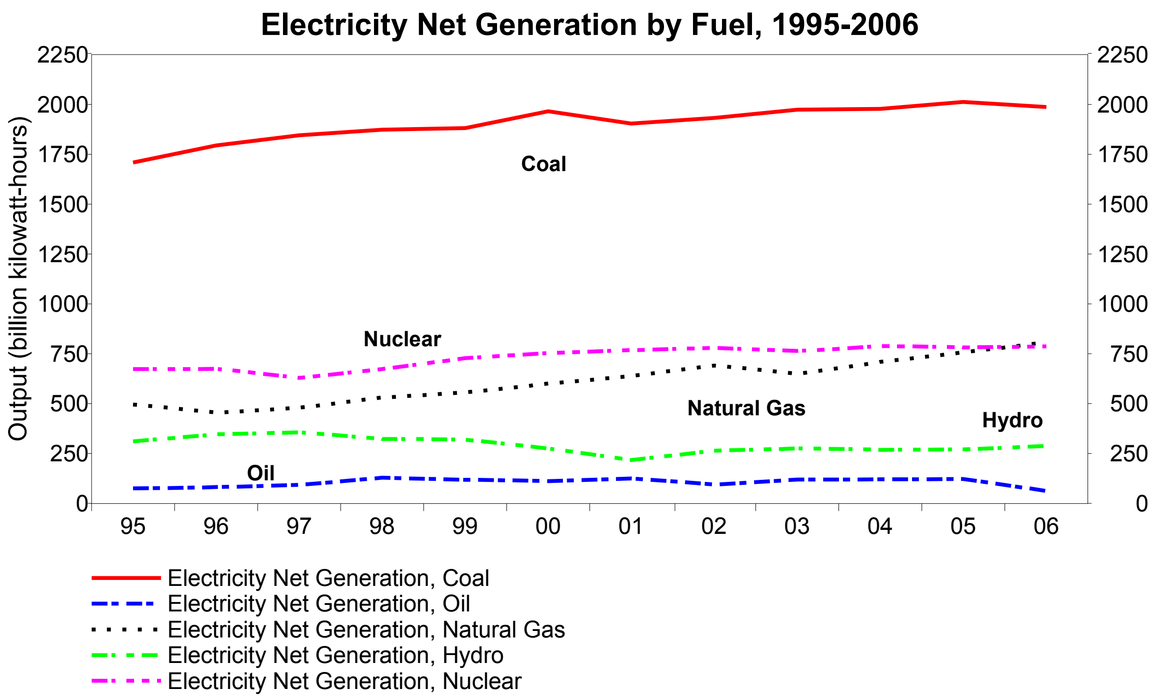
The solution to high energy prices in the long run must be two-pronged: Increased capital investment and technological innovation. To attract more investment capital and more intellectual know-how, it is imperative that electricity prices be set in the competitive market. The solution to high electricity prices in the end is a simple one: Let electric power companies do their job, unfettered by overly intrusive or misguided regulation. Whatever regulators do, they mustn't turn the electric power debate into a political football or "Californize" the issue by trying to have it both ways – i.e., regulating and deregulating prices at the same time. There's no reason regulators can't act responsibly and help lay the foundation for a stronger, more productive economy.

Introduction

No price better summarizes all of the forces at play in the U.S. energy market than does the price of electricity. Why electricity? Because it is the only form of energy that embodies within itself all other forms of consumable energy – specifically, fossil fuels, such as coal, oil and natural gas, hydroelectric and nuclear power, renewables, including solar, biomass, geothermal and wind, and also co-generation. There probably isn't a single category of energy that in one way or another doesn't contribute to the electric power supply.

A price, any price – including the price of electricity – is a sum of information. In economics, it is customarily illustrated by the intersection of the familiar supply and demand curves at the equilibrium point, where the two lines cross. In reality, a price reflects every bit of information, however miniscule or seemingly innocuous, available to the market at any given time. Time is critical. As new information becomes available to the marketplace, prices change. The information may include government statistics, industry data, news reports, public announcements, speeches, events – both planned and unplanned – rumors, gossip and even erroneous material. The point is, prices are complex – more complex, in fact, than many of us realize. And the price of electricity is no exception.

This study zooms in on what is surely the single most significant influence on the price of electricity – namely, the cost of the fuels used to generate power. We call this the "fuel function." Sure, there are many other influences affecting the price of electric power, but fuel is the biggest factor driving the cost – and therefore the price – of electricity. It is also an item over which electric power companies have very little control, apart from their ability to switch fuels (e.g., natural gas and oil) at a relatively small number of generating plants. If we can understand why fuel costs act as they do, we will better understand the reasons for the rise and fall of electricity prices, and, more important, we can fashion solutions with the potential to keep electric power prices as low as possible and reliability as high as possible.



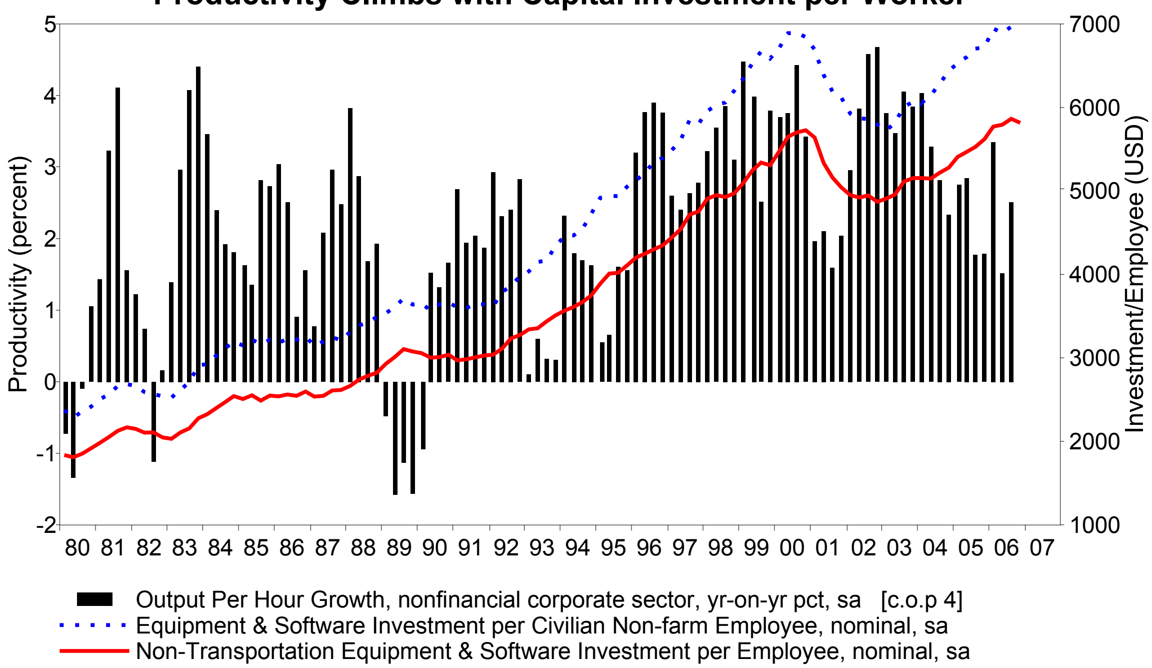
Six factors affecting energy prices warrant special attention: 1) domestic supply and demand; 2) dollar monetary policy; 3) global supply and demand, 4) commodity speculation, 5) cartel activity, and 6) geopolitical risk.

Labor Productivity

First, though, before assessing these factors, it is imperative to explain why electricity is so vital to the economy. Some reasons are obvious: Electricity lights, heats and cools our homes, offices, factories and institutions, and it also powers such devices as refrigerators, medical equipment, televisions, computers, robots and the like – devices upon which we have come to depend at home and at work. Other reasons are less obvious but equally important: Electricity notably is a silent partner in the economy's effort to raise what is known as productivity – or, more precisely, labor productivity. This is the amount of goods and services produced per hour of work. The more output per hour, the higher the level of labor productivity.

Productivity is important because it represents one of only two ways of increasing GDP, or gross domestic product, the nation's total supply of goods and services. The first way of boosting output is to add more workers to the economy. The other is to increase the amount of output produced by existing workers. This is called labor productivity, and the easiest way to raise it is to increase the ratio of financial capital to labor capital. By expending funds on new and better plant, equipment, technology and know-how, companies can improve their rates of productivity – and profitability, as well. The new devices – especially, nowadays, information technology – allow workers to turn out higher quality goods, operate more nimbly and quickly, offer better quality services and problem-solve easier.

Productivity Climbs with Capital Investment per Worker

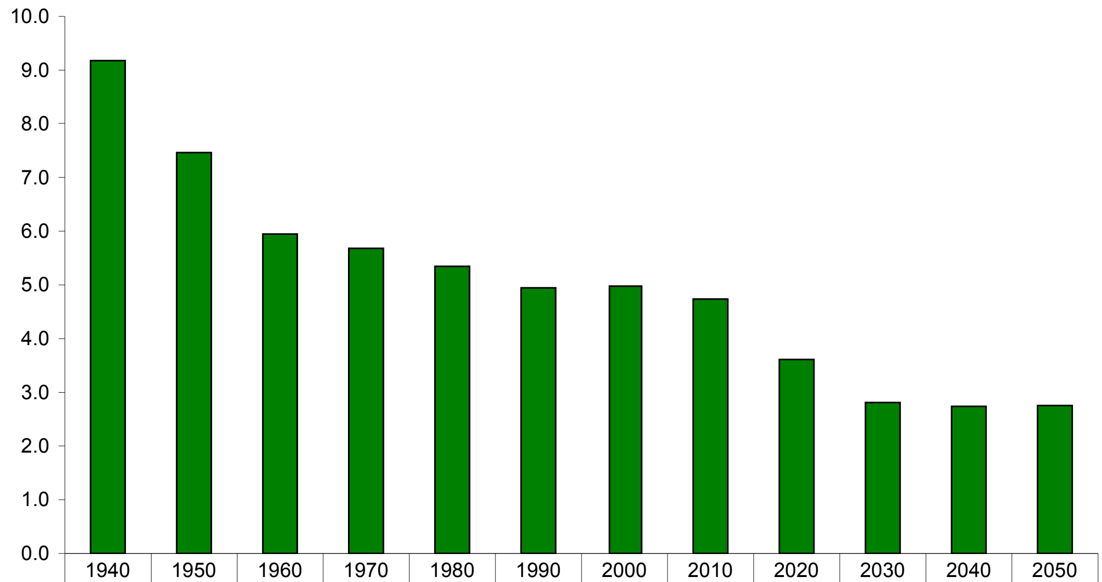


Labor productivity improvements also raise the nation's standard of living. This happens in two ways: First, productivity gains eventually translate into higher wages and salaries. Second, productivity enhancements usually make the goods and services produced better and cheaper, meaning consumers end up purchasing more for less. So, productivity increases pay and also makes pay go further in terms of the price and quality of goods and services for sale to consumers.

The laborsaving devices upon which productivity gains depend have one thing in common: electricity. Electricity does the work that people used to. Laborsaving devices raise output per hour by substituting artificial intelligence for human intelligence and artificial energy for human energy. Indeed, the Information Technology Revolution, with the proliferation of computers and peripherals, the advent of the Internet and email, and now the stunning breakthroughs in handheld devices, has been predicated on the widespread availability of reliable sources of electricity. So it is electric power that ultimately drives labor productivity improvements. And as more electricity is used to generate GDP, the economy's so-called "energy intensity" strengthens. It is therefore vital that the U.S. maintains in good order its topnotch electric power grid. Reliability is as important as availability, because high-tech equipment demands a steady, uninterrupted, unvarying stream of high-quality electricity in order to operate without fault or failure. To achieve such high levels of power reliability going forward will require further capital investment by the nation's electricity companies. (Drucker, 1998)

Technological considerations aside, there is another all-important reason for the U.S. to maintain a first-rate electrical system: Demographics demand it. The need for enhanced labor productivity in the U.S. – as well as in graying Japan and the aging parts of Europe – is becoming more acute with the approach of baby boom retirement. The first members of this immense, post-World War II generation, born between 1946 and 1964, turn 65 in 2011, less than four years away. The number of Americans age 65 and older will rise from about 35 million in 2000 to nearly 40 million in 2010 and then jump to almost 54 million in 2020 and to more than 70 million by 2030. It will be a vast demographic transformation without precedent in America as the number of seniors doubles over a period of just 30 years. (US Census)

Worker-Retiree Ratio: Ratio of Working Age Persons (18-64 Years) to Those 65 and Older

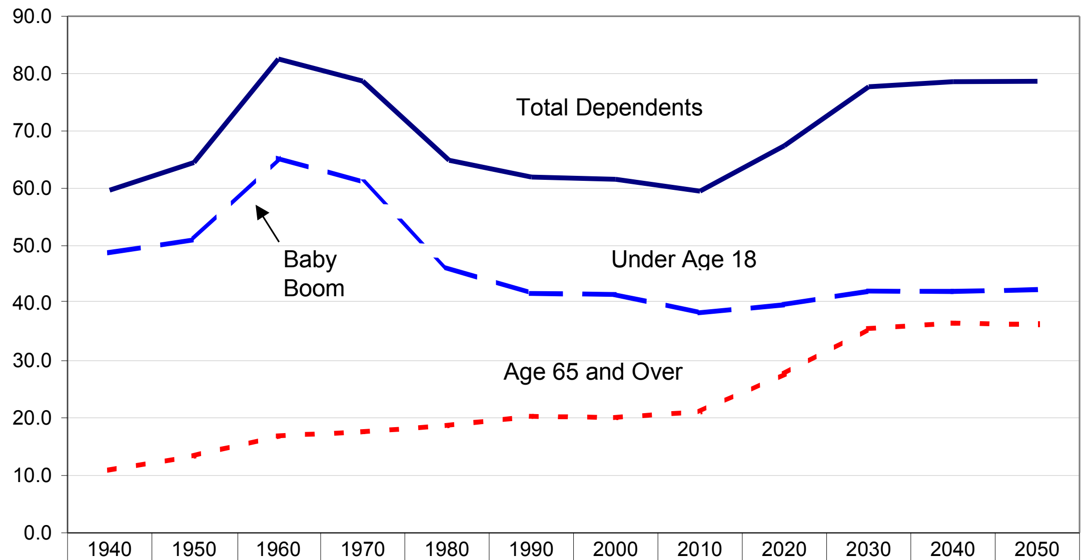


	1940	1950	1960	1970	1980	1990	2000	2010	2020	2030	2040	2050
Ratio	9.2	7.5	5.9	5.7	5.3	4.9	5.0	4.7	3.6	2.8	2.7	2.8

This wouldn't be a major economic problem if baby boomers had procreated at the same rate as prior generations had, but they didn't. Boomers tended to marry later in life and also had fewer children, meaning this generation procreated at a less-than-replacement rate. And this is why the worker-retiree ratio (i.e., the number of persons of working age 18 to 64 years versus those 65 and older) is slated to drop sharply over the next three decades. The worker-retiree ratio was 7.5 to 1 in 1950 and slipped to 5.3 to 1 by 1980. In 2000, the ratio stood at 5.0 to 1 and is expected to be at 4.7 to 1 in 2010. After the first boomers turn 65, the picture will changed dramatically. By 2020, the worker-retiree ratio will dip to 3.6 to 1, and come 2030, it will be down to 2.8 to 1 (barring any unexpected change in legal immigration, that is). From 2040 to 2100, the ratio is projected to range from 2.8 to 2.4 to 1 (US Census)

The worker-retiree ratio, though, is not the only looming demographic factor weighing on the economy. There are children to consider. When persons under 18 and those over 64 are combined, you get what's known as the "dependency ratio." And that also is projected to change dramatically in coming years. In 2000, there were 61.6 youngsters and seniors for every 100 Americans of working age. The number is expected rise to 67.5 by 2020 and 77.7 in 2030. Then, in 2040 to 2100, the dependency ratio is due to climb from 78.7 to 84.2. (US Census) That is approaching a 1-to-1 ratio between dependents and workers. How will America cope?

Dependents per 100 Persons Age 18-64 Years



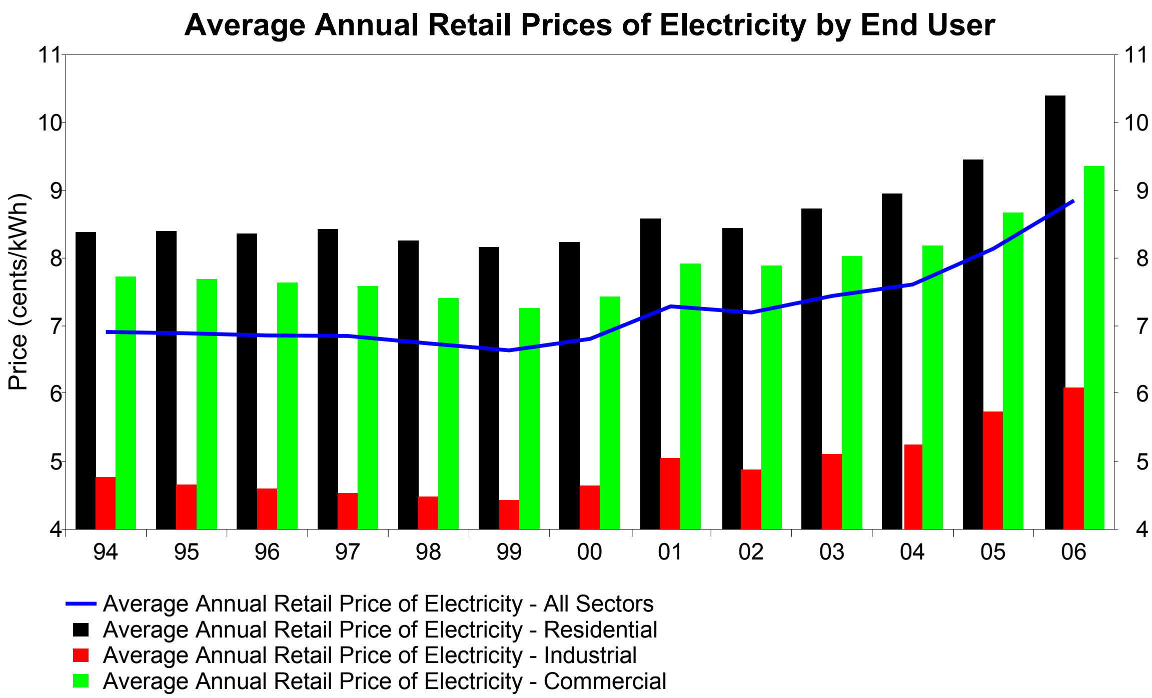
	1940	1950	1960	1970	1980	1990	2000	2010	2020	2030	2040	2050
All	59.7	64.5	82.2	78.7	64.9	62.0	61.6	59.5	67.5	77.7	78.6	78.7
<18	48.8	51.1	65.3	61.1	46.2	41.7	41.5	38.3	39.8	42.1	42.1	42.4
>64	10.9	13.4	16.9	17.6	18.7	20.3	20.1	21.1	27.7	35.6	36.5	36.3

At the very least, America's workers will be hard-pressed to provide for the needs of these dependents, young and old. Besides the provision of real goods and services, there also will be fiscal consequences, affecting both tax receipts and government outlays – notably for medical services and long-term care for the sick and elderly. These fiscal difficulties will be compounded by the fact that Americans on the whole are healthier and thus can be expected to live longer than previous generations. That means more government spending.

The only solution is to raise labor productivity by increasing the ratio of financial capital to labor capital. Investment in new laborsaving technologies and equipment will in turn demand more electricity. Electricity's role as the economy's silent partner will thus grow in importance over time as baby boom retirement inspires innovative responses to keep the American way of life going.

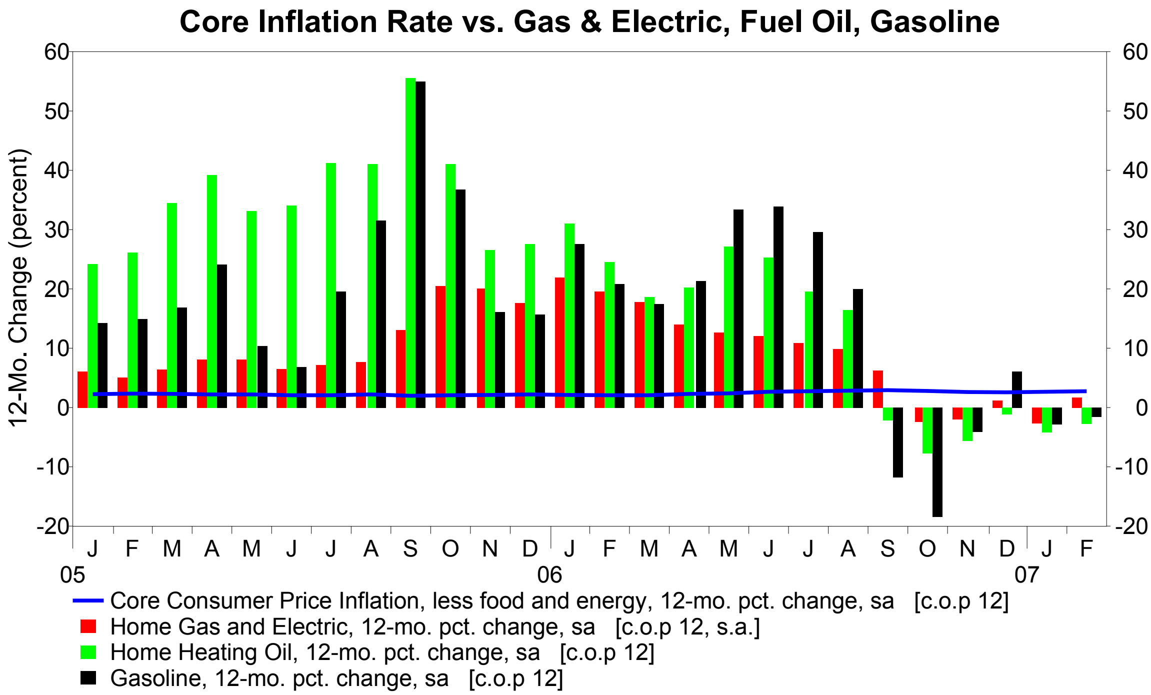
Energy Prices

The last few years have been doozies when it comes to energy prices. The average price of residential electricity, for instance, rose 95 cents per kilowatt-hour (kWh), or 10.1 percent, last year following a 50-cent, or 5.6-percent, increase the year before. In comparison, residential electricity prices increased by just 23 cents a kWh, or 2.6 percent, in 2004 and by 28 cents, or 3.3 percent, in 2003. (EIA, Feb. 2007a; EIA Feb. 2007d)



January 2005 to mid-2006 was a particularly tough time. The rapidity of the energy price increases was breathtaking. Take by way of example the energy components of the Consumer Price Index (CPI), which measures the nation's rate of inflation. The energy items rose a total of 33.8 percent, or more than one-third, during the 20 months ended August 2006. Among the various CPI energy components, household gas and electric bills increased a cumulative 21.6 percent. That was modest compared with an extraordinary 44.0-percent surge in home heating oil and a 51.0-percent hike in gasoline. In contrast, the core rate of inflation (i.e., all items less energy and food) rose by just 4.2 percent over the same 20-month period. (BLS)

Consumers probably remember most the soaring prices for unleaded gasoline and No. 2 heating oil. On the New York Mercantile Exchange (NYMEX), prices started 2005 at around $1.10 to $1.15 a gallon for both fuels. By September, prices had hit $2.90 – and that was on the futures trading floor! Retail prices for gasoline and heating oil were a lot higher. The fall and winter saw prices moderate, only to run up again in the spring and summer of 2006.



During the subsequent five months to January 2007, most energy prices retreated, actually falling below their levels of a year earlier, with the exception of natural gas. Unusually warm winter weather reduced energy demand and put downward pressure on prices. (EIA, Feb 2007a) Then came February, with yet another energy-price shock. The consumer price index for fuels and utilities increased a whopping 1.2 percent following a 0.3-percent rise in January because of big increases in fuel and natural gas prices. Fuel oil went up 0.5 percent after declining 5.6 percent in January, and natural gas soared 5.0 percent after a 3.0-percent drop a month earlier. Electricity prices, thankfully, were practically unchanged in February after advancing 2.0 percent in January. The energy index itself rose 0.9 percent in February following a 1.5-percent decline a month before, but the core inflation index was up just 0.2 percent versus January's 0.3 percent.

A note on peakers: When it comes to electricity, a lot of press attention is paid to what is known as "peaking power." That is power generated at periods of peak electricity use – notably, on very hot days in the summertime when air-conditioners are cranking. Peakers, which is the name given to the small power plants that get switched on only a few times a year to produce peakload power, often resemble little more than jet engines, their turbines typically fired by natural gas. Because these plants operate so infrequently and often burn fuel purchased on the spot market, their cost of operation is terribly high. And that is why they usually make headlines. Viewed in context, however, peak power is a small price to pay for maintaining electric system reliability – and staying cool – when those scorchers hit. See "Appendix B: Wholesale Day-Ahead Prices at Selected Hubs" for additional information.

Average Retail Price of Electricity to Ultimate Customers by End-Use Sector
(Cents per kilowatthour/kWh)

Period	Residential	Commercial	Industrial	Transportation	Other	All Sectors
1994	8.38	7.73	4.77	NA	6.84	6.91
1995	8.40	7.69	4.66	NA	6.88	6.89
1996	8.36	7.64	4.60	NA	6.91	6.86
1997	8.43	7.59	4.53	NA	6.91	6.85
1998	8.26	7.41	4.48	NA	6.63	6.74
1999	8.16	7.26	4.43	NA	6.35	6.64
2000	8.24	7.43	4.64	NA	6.56	6.81
2001	8.58	7.92	5.05	NA	7.20	7.29
2002	8.44	7.89	4.88	NA	6.75	7.20
2003	8.72	8.03	5.11	7.54	NA	7.44
2004	8.95	8.17	5.25	7.18	NA	7.61
2005	9.45	8.67	5.73	8.57	NA	8.14
2006	10.40	9.36	6.09	9.06	NA	8.85

Source: Energy Information Administration

Domestic Supply & Demand

The torrid energy price history of 2005-2007 wasn't the result of a sudden shortfall in energy supplies or an equally dramatic surge in demand. In terms of electricity, total net generation and retail sales in 2006, for example, were little changed from a year earlier, with a 0.1-percent decline in generation and a 0.1-percent increase in retail sales. For the year, the average retail price of electricity was 8.7 percent higher than in 2005. And, except for natural gas, generation by all major fuel categories fell, with coal down 2.8 percent, petroleum liquids down 73.4 percent, nuclear down 1.7 percent and hydroelectric down 1.1 percent. Natural gas generation, though, was up 3.8 percent year over year, thanks partly to increased exploration, development and production, helping to bring prices down. (EIA, Feb. 2007a)

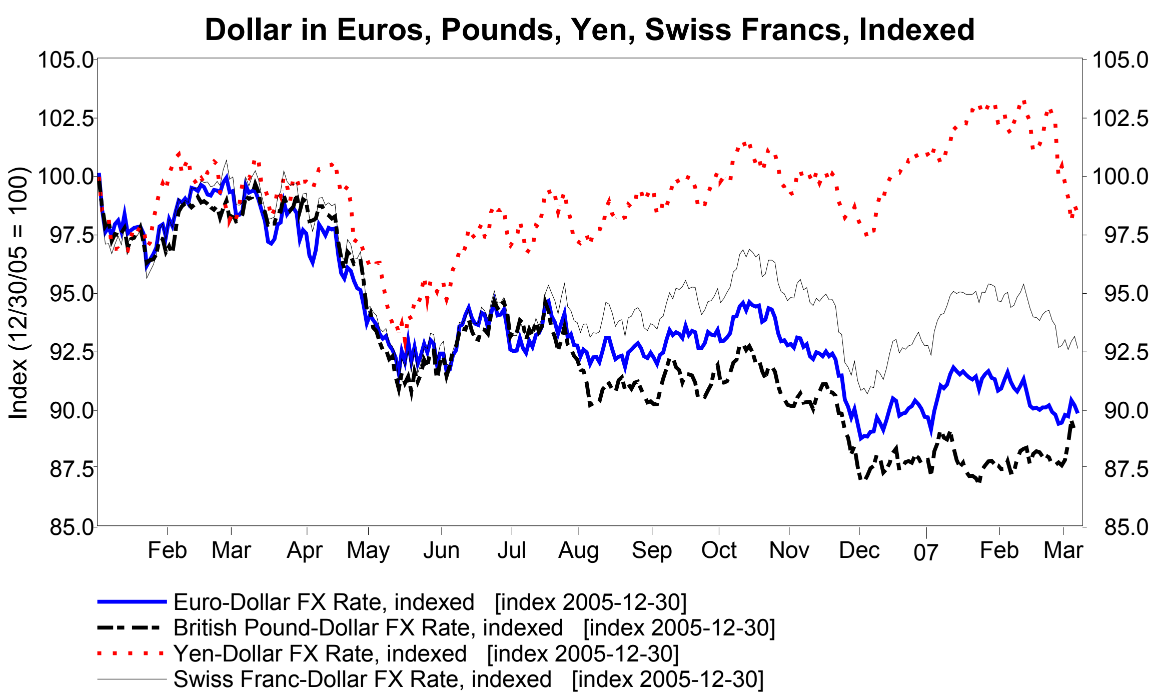
Total Net Generation (All Sectors)					
Net Generation (thousand megawatthours)	**Dec-06**	**Dec-05**	**% Change**	**Nov-06**	**% Change**
Coal	173,072	177,987	-2.8%	159,349	8.6%
Petroleum Liquids	2,991	11,242	-73.4%	3,292	-9.1%
Natural Gas	55,776	53,738	3.8%	52,655	5.9%
Nuclear	70,490	71,735	-1.7%	61,392	14.8%
Hydroelectric Conventional	21,905	22,141	-1.1%	20,892	4.8%
All Other	11,498	11,258	2.1%	11,261	2.1%
Total (All Energy Sources)	335,731	348,101	-3.6%	308,841	8.7%

Source: Energy Information Administration

The National Oceanic and Atmospheric Administration (NOAA) Climatic Data Center reports 2006 as the warmest year on record for the contiguous United States, with *El Niño* – the Pacific Ocean temperature inversion – contributing to milder winter temperatures. NOAA also reports that December 2006 was the fourth warmest December since 1895. As a consequence of the warm weather, December power generation lagged behind year-earlier levels by 3.6 percent, although it increased 8.7 percent from November 2006. December 2006 retail sales of electricity similarly were up 8.4 percent from November 2006 but were down 2.5 percent from December 2005. Reflecting weaker seasonal demand for electricity, the average U.S. retail price of electricity in December 2006 declined 1.0 percent from November 2006. For the year, however, the average retail price of electricity was 8.7 percent higher than in 2005. (EIA, Feb. 2007a)

Oil & the Fed

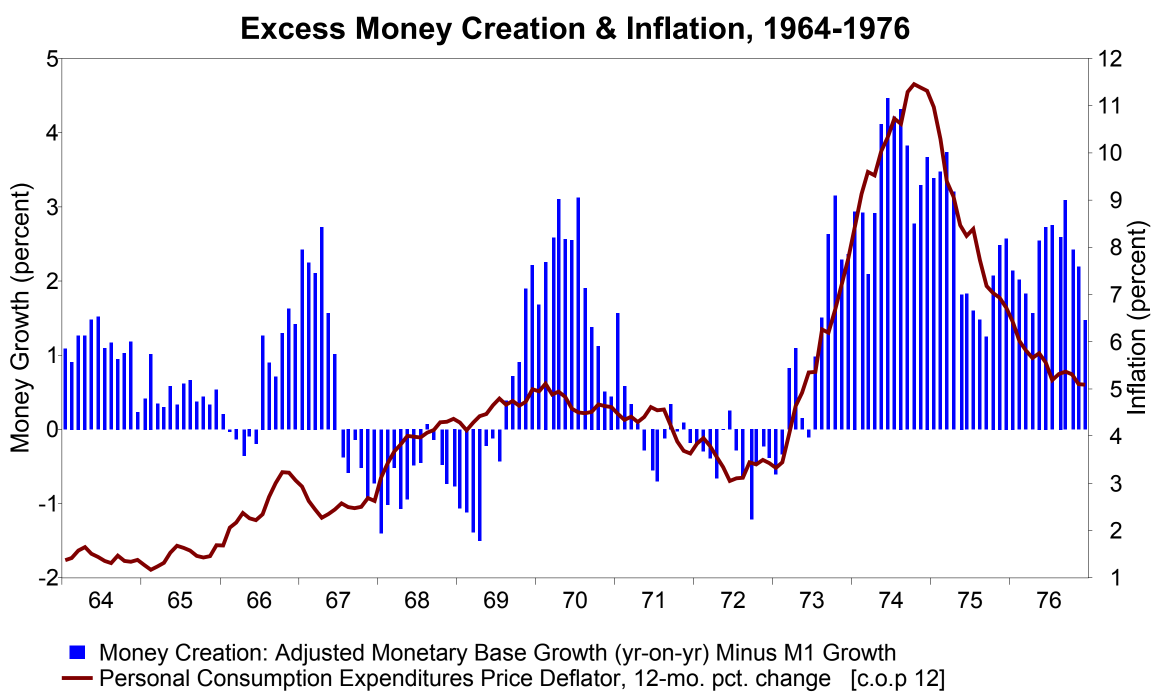
The recent energy price numbers tell us several important things. First and foremost, the data show that there was no runaway inflation caused by an excess of dollars. Had the Federal Reserve, the nation's central bank, not been doing its job properly in containing money creation, the price hikes of 2005-2007 wouldn't have been limited to the energy sector but rather would have been widespread, extending to all manner of consumer goods and services. The relatively narrow scope of the price increases, confined as they were to energy items, meant this was not a monetary or broad inflationary phenomenon. The U.S. dollar, in short, was not to blame. The numbers further suggest that certain exogenous factors – i.e., factors outside the normal range of influences on U.S. consumer prices – were at work. But more about that later.



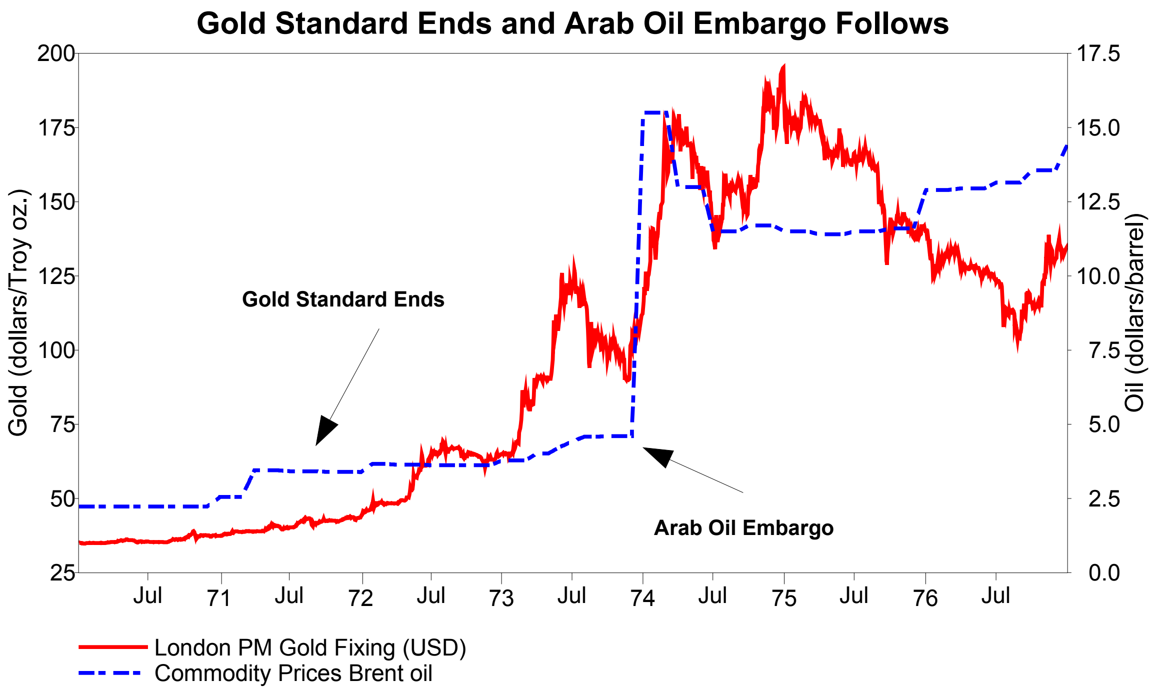
This is not to say, however, that monetary factors haven't been affecting the dollar. Against the world's other major currencies, the dollar has lost ground versus the pound, euro and Swiss franc but not against the yen. This indicates that the money policies of Europe's central banks have been tighter than the Fed's. As the nearby chart depicts, the dollar has declined by 7 percent against the Swiss franc since the end of

2005, 10 percent against the euro and 11 percent against the British pound. However, it is not so much that the dollar is weakening but that the currencies of Europe are strengthening. In terms of energy, this means that Europeans are benefiting from cheaper prices for oil, gasoline, diesel and other fuels. The dollar-yen exchange rate, by comparison, has held steady, implying that the Fed and the Bank of Japan are on similar monetary policy paths.

The U.S. Federal Reserve, of all the world's many central banks, plays a unique role in the international energy market. That is because crude oil is universally denominated in greenbacks. Whether it is extracted from the Gulf of Mexico or the tundra of Alaska, the sands of Saudi Arabia or the Niger Delta, crude oil trades in U.S. dollars. As it moves downstream toward end users, turning into gasoline, heating oil, diesel and various byproducts, petroleum is eventually priced in local currencies. And this is where the role of the Federal Reserve, the keeper of U.S. monetary policy, becomes crucial. If the Fed mismanages the dollar by either weakening or strengthening it, the effect reverberates around the world. And nowhere is the effect felt more than in the energy industry.

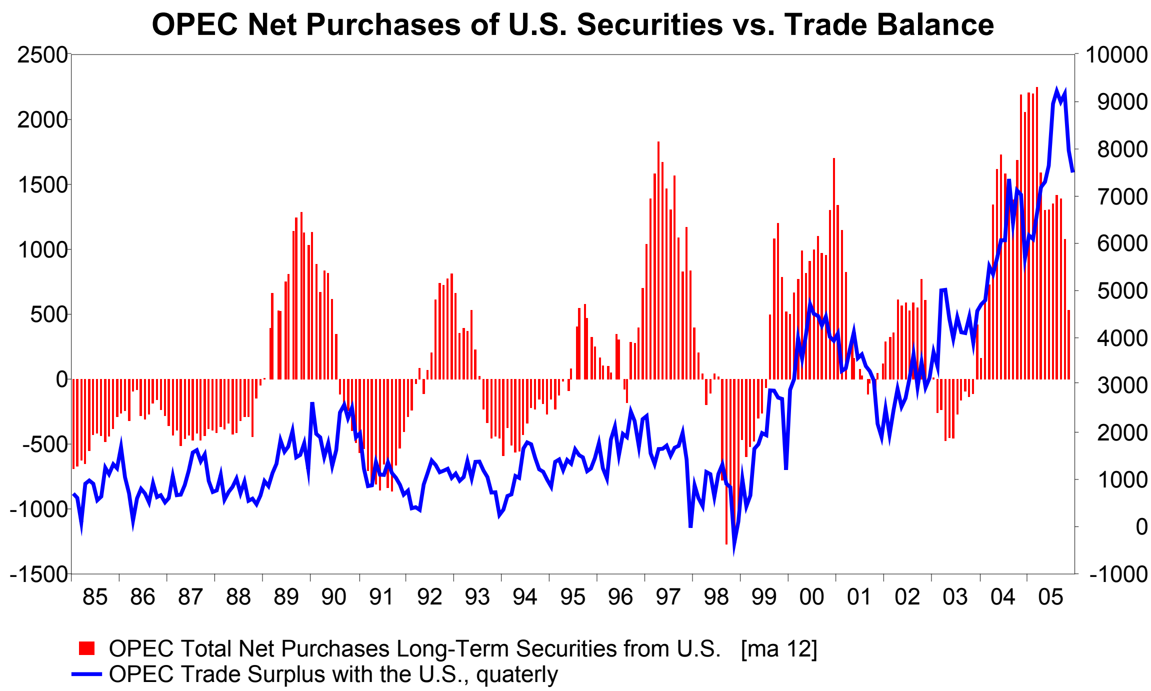


Take the ascendancy of the Organization of Petroleum Exporting Countries (OPEC), Originally founded in 1960, its rise to prominence in the early 1970s was partly Washington's fault. The U.S. began running a guns-and-butter budget – and an accommodative monetary policy to match – under the fiscal strain of the Vietnam War and the cost of Great Society social welfare programs. Excess dollar creation resulted in rising inflation and a weakened currency. Finally, in the summer of 1971, President Richard M. Nixon did the unthinkable and loosed the U.S. from the gold standard that had provided the world with international currency stability and low inflation since the end of World War II.



Under the so-called Bretton Woods accord, which went into effect in 1945, the dollar was to maintain a fixed value of $35 the ounce of gold, while all other participating currencies would trade at fixed exchange rates with the dollar. The system worked marvelously well for more than 25 years, helping the world to recover from the scourge of the Second World War. But once the Federal Reserve abrogated its responsibilities under the charter by failing to maintain a stable dollar, the whole system went to pot. President Nixon finally declared the system of fixed exchange rates dead on August 15, 1971, officially taking the dollar off the gold standard and ushering in the floating exchange rates that continue to this day.

The dollar's subsequent loss of value hit the world's oil producers hard, for not only was their production priced in dollars but their accumulated wealth also tended to be held in dollar-denominated assets. Thus oil exporters saw both their current incomes and their net worth decline simultaneously. Then, infuriated by the foreign assistance supplied to Israel during the Yom Kippur War, some OPEC members set up the Arab Oil Embargo on Oct. 17, 1973 against the United States and Western Europe. The embargo pushed oil prices through the roof and drove the world's economies into the cellar. (EIA, Aug. 2006; Wikipedia)



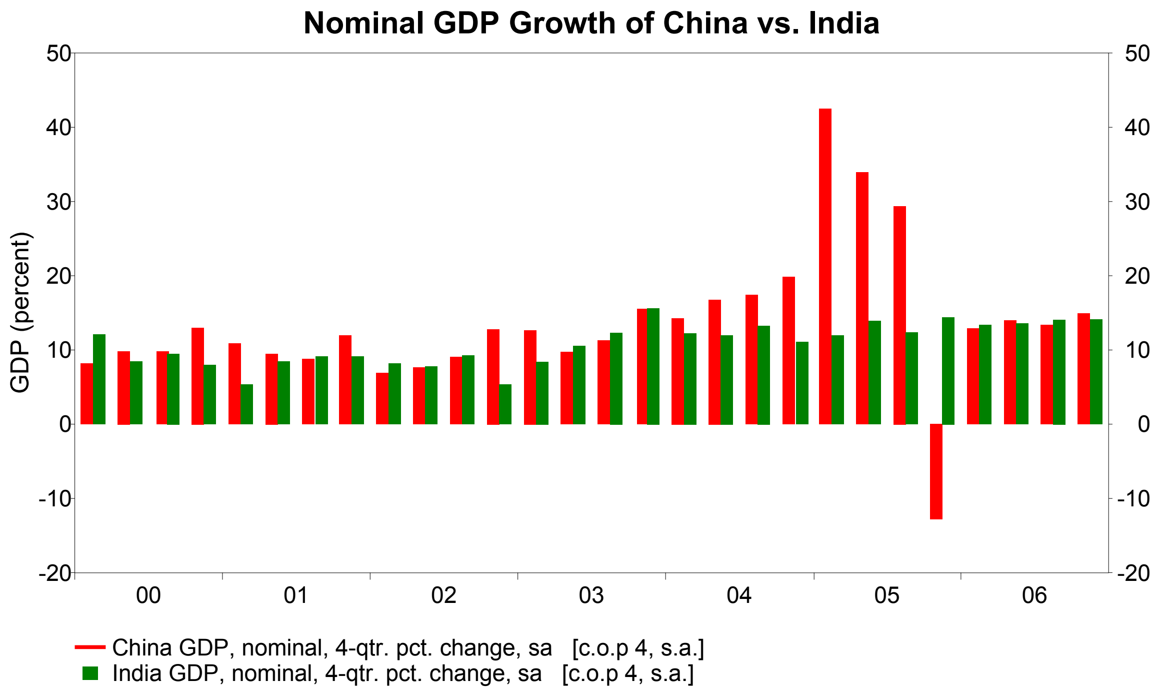
Interestingly, the 1973 embargo renewed interest in America's vast coal reserves as an alternative to foreign crude. It showed how high prices can be an inducement to new investment. The number of coal mines and new mining capacity surged between 1973 and 1976 as coal production increased 14.4 percent. The Power Plant and Industrial Fuel Use Act of 1978 – signed by President Jimmy Carter – even mandated conversion of most existing oil-burning power plants to coal or natural gas (although the authority wasn't much used). Research on coal liquefaction and gasification technologies was aimed at replacing imported petroleum and supplementing domestic gas supplies. Those high-cost projects were put on hold, however, after crude oil prices fell several years later, making synthesized coal liquids and gases uneconomic. (EIA, Oct. 2006a) The episode goes to show how high energy prices tend to contain the seeds of their own destruction. Investors are attracted by above-average rates of return, but once these new investments start producing new energy, the additional supply acts as a damper on prices. And who says the free market doesn't work?

More recently, another form of monetary management affected energy prices – this time, lowering them. A Fed policy that was too tight in the mid- to late 1990s failed to supply growing world demand for dollars, especially after the Asian money meltdown of 1997. Too few dollars led to deflation (the opposite of inflation) as prices of many commodities actually declined. Another, smaller round of dollar deflation followed the Y2K scare, causing unleaded gasoline prices, for example, to dip below $1 a gallon in 2001. In pendulum fashion, these spells of dollar price deflation were followed in 2001-2005 with a period of dollar price reflation that affected most every commodity, including oil. Point is, monetary factors directly impinge on energy prices – notably, oil prices – and thus indirectly affect the electric power industry.

Even more recently, gasoline sold at the pump for more than $3.50 a gallon. This, however, wasn't the result of dollar mismanagement. Again, it is important to stress that had the Fed made a policy mistake, the rate of inflation would have soared across the economy, but it didn't. There has been no appreciable rise in the rate of core consumer or producer price inflation when energy prices are excluded. The phenomenon of rising energy prices seems to be isolated. Why is that?

Globalization

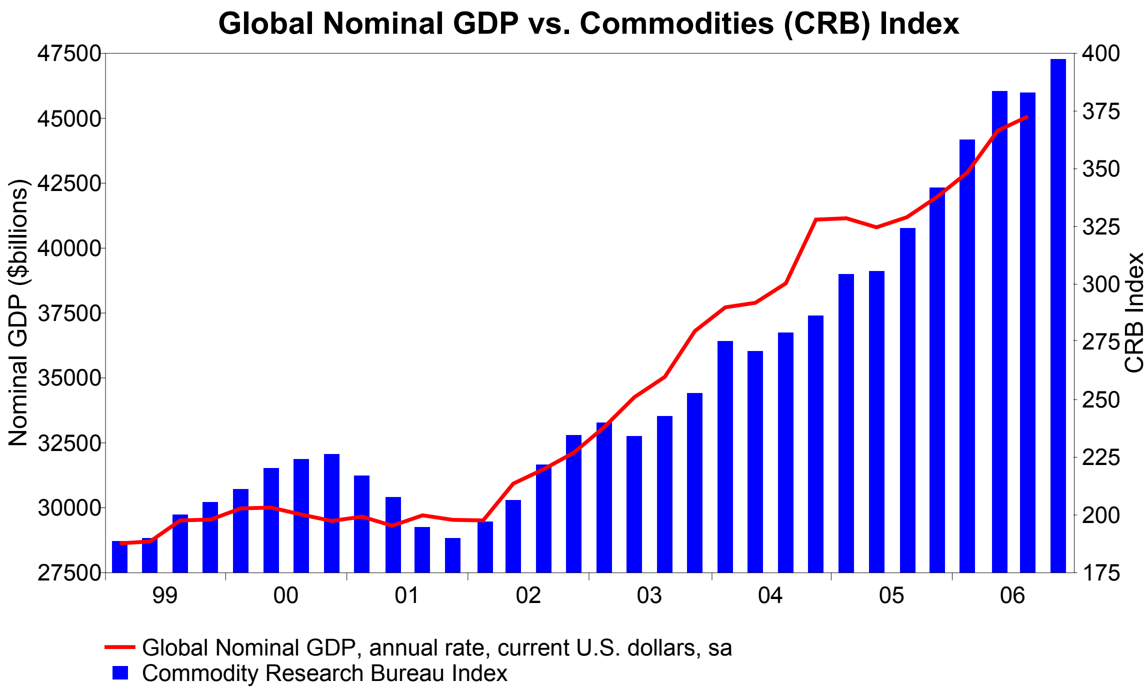
Part of the answer can be found in the burgeoning global economy. Many former underdeveloped nations are fast becoming developed ones, with rising industrial bases and booming standards of living that demand more energy. Rising energy use worldwide, in other words, contributed to the increase in energy prices internationally in 2005-2006. The world already operates a virtually borderless economy. International economic expansion, particularly the rise of such new powerhouses as China and India, has had an unmistakable effect on every country in world, and one of the most significant effects has been on commodity prices. Commodities, for the most part, represent the raw materials of industrialization. It is not surprising then that they could be in hot demand during a period of rapid global expansion.



Moreover, other commodities – notably precious metals and particularly gold – have risen in tandem as burgeoning middle classes in India, China and other parts of the heretofore Third World acquire wealth and choose to store it in the form of inflation-proof precious metals. Since 1999, for instance, China's slice of the global economic pie has expanded from 3.7 percent to 6.4 percent and India's share has gone from 1.3 percent to 1.7 percent in nominal U.S. dollar terms. The Chinese economy grew by a stunning 10.7 percent in 2006, representing the fastest annual growth rate since 1995.

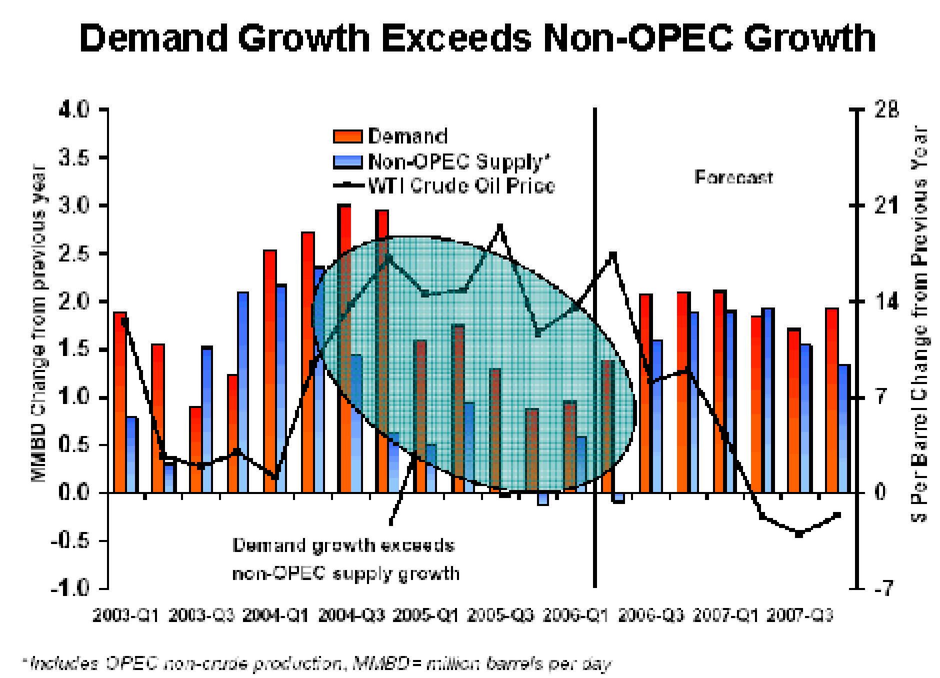
The global economy – as represented here by 49 countries, accounting for approximately 95 percent of total world economic output – grew 9.4 percent in the 2006 third quarter from a year before in nominal, non-inflation-adjusted terms and translated into current U.S. dollars. That was the fastest rate of global growth since the fourth quarter of 2004.

The latest data further reveal another very distinct and all-important development – namely, that global GDP growth is driving commodity prices higher. Why is this important? Because it shows once again that the recent sharp upturn in commodities wasn't due to excess dollar creation. Rising commodity prices are often associated with inflation, but not in this case. Today, strong demand – the result of strong economic growth – is causing commodities to rise in price. The connection is unmistakable. Indeed, linear regression analysis shows that 93.0 percent of the time since 1999, the rise in the Commodity Research Bureau Index (CRB), perhaps the world's most respected commodity-price gauge, directly correlated with an expansion in the global economy. Such numbers suggest a very strong correlation indeed between commodity prices and globalization. (EIA, Oct. 2006b)



Supply, moreover, is failing to keep up with demand. According to the U.S. Department of Energy's Energy Information Administration (EIA), a clearinghouse of data and information, oil demand growth continues to outstrip non-OPEC supply growth as non-OPEC new production fails to meet expectations. Increases in global oil production capacity are struggling to keep pace with rapidly growing demand, particularly in China and the other emerging economies of Asia, as well as the United States. China accounted for an estimated one-third of the world's demand growth in 2003-2005, and this trend is expected to continue. By 2030, worldwide demand for oil is projected to grow by nearly half (47 percent), and the developing nations of Asia, including China and India, are expected to account for more than two-fifths (43 percent) of the increase. (EIA, Oct. 2006b)

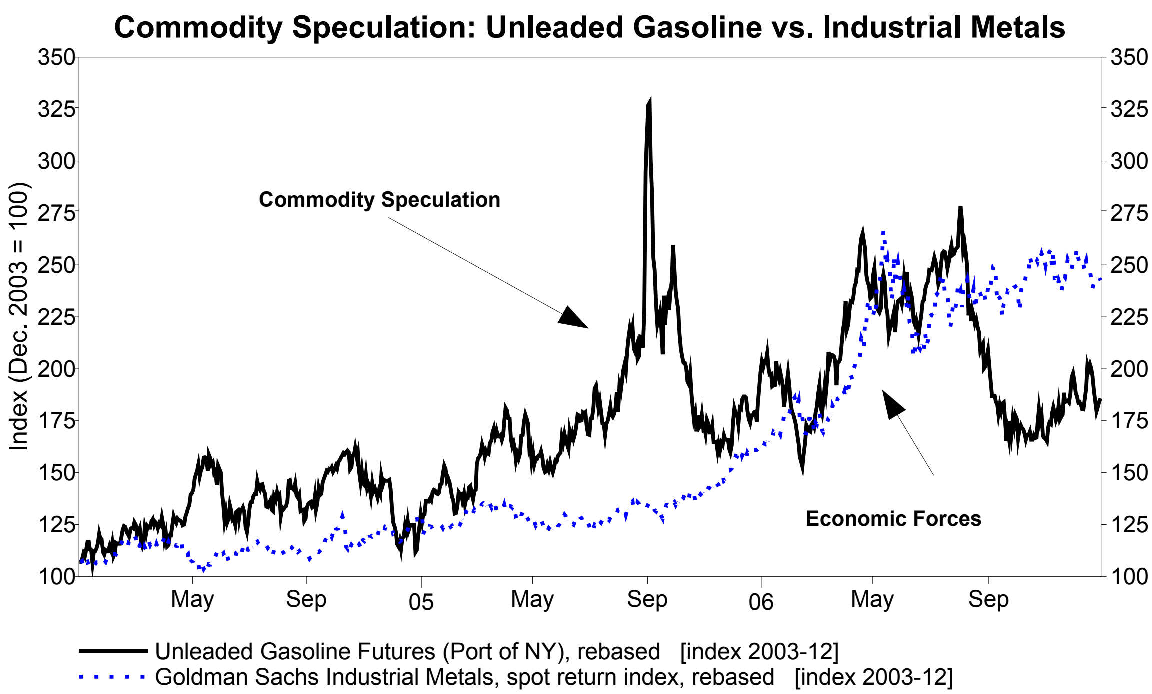
Despite oil price increases in recent months, oil demand growth in major consuming countries hasn't slowed down as much as many had expected. Consumers have largely taken the higher oil prices in stride, which raises questions regards past assumptions about energy price elasticity. (That is, it was assumed that consumers used less energy when prices rose and more when prices fell; the new data suggest consumers are less inclined to alter their energy use when prices change.) Annual demand growth in 2004 was 2.7 million barrels per day (bbl/d), well over the previous five-year average. Even as prices continued to rise in 2005, annual demand growth totaled 1.4 million bbl/d. Oil demand continues to grow in response to continued worldwide economic growth, particularly in China and the United States. (EIA, STEO Supplement)



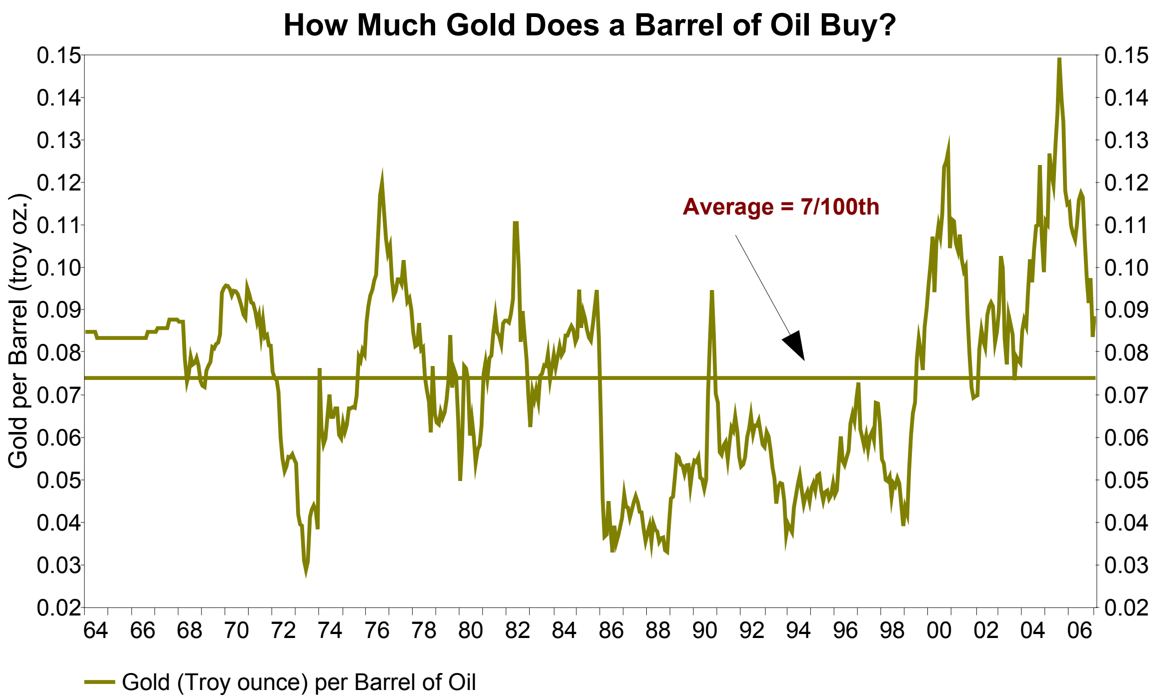
In 2005-2006, on the supply side, Hurricanes Katrina and Rita, among others in the Gulf of Mexico, cut an average of 450,000 bbl/d of federal offshore production from the world oil market in addition to damaging key refineries. Prudhoe Bay pipeline problems removed as much as 400,000 bbl/d from the market. In the rest of the world, pronounced declines in the North Sea and non-OPEC Middle Eastern countries, delays in project start times and unplanned field maintenance muted the small growth in non-OPEC supply in 2005 and 2006. Russian production was one of the major drivers of non-OPEC supply growth during the early 2000s. As the investment climate worsened and oil prices rose, the Russian government raised oil export fees and extraction taxes, adversely affecting production growth. (EIA, STEO Supplement)

Commodity Speculation

Vital commodities, such as oil, gasoline and heating oil, have become victims of commodity speculation in recent years. By way of illustration, compare the futures price for unleaded gasoline landed in the Port of New York and the less volatile Goldman Sachs Industrial Metals Spot Return Index. In the third quarter of 2005, the unleaded gasoline market went ballistic, with prices rising from around $1.35 a gallon in mid-May to $1.95 by mid-August, a 44 percent increase, and then to a peak of $2.90 at the beginning of September, a further 49-percent increase. All told, in just three and a half months, unleaded gasoline futures soared $1.55, or 148 percent. Then, after more than doubling in price, gasoline futures returned to square one at $1.50 by late October.



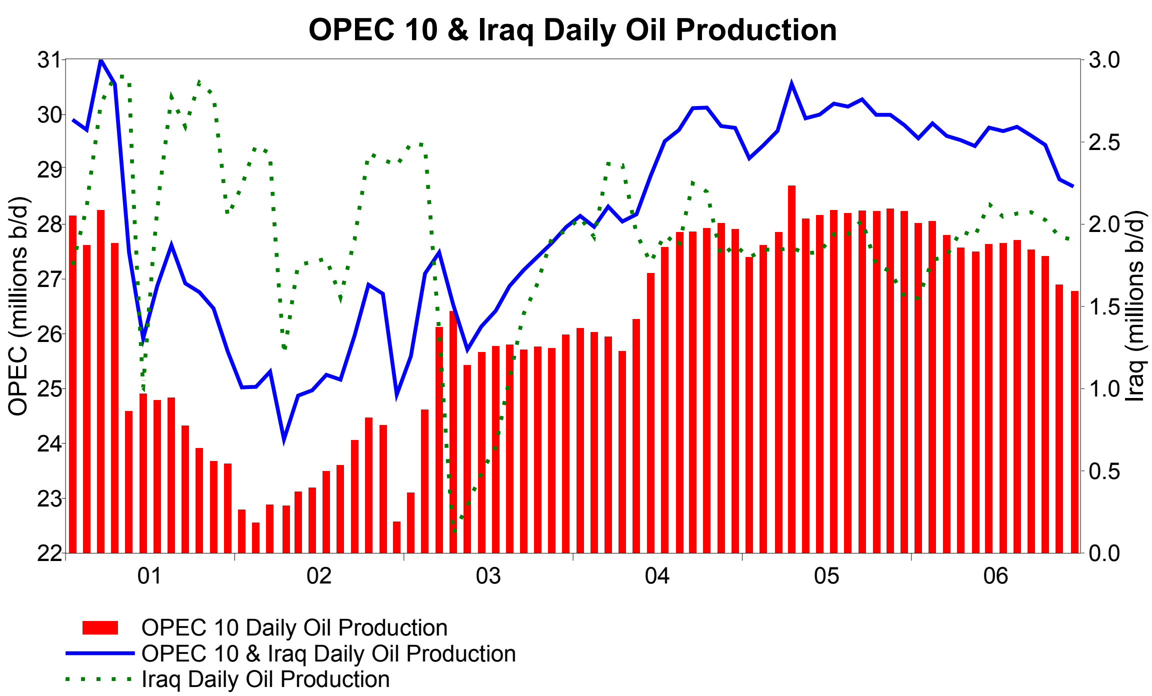
During this frenzied period, the industrial metals index barely budged, rising from 224 in mid-May to 249 by mid-August and then to 250 at the start of September, a 12-percent jump. By late October, it was at 255, for a total gain of 14 percent. Clearly, if there had been any substance to the speculation that rocked unleaded gas, the prices of industrial metals would have risen sharply, too. The divergence between the two sets of prices is indicative of a rush of commodity speculation. In contrast, the prices for unleaded gas and industrial metals moved in tandem in March-July 2006, suggesting the price movement was the result of economic forces, not speculative ones. (The nearby chart of unleaded gasoline versus industrial metals rebases the indices, putting them on a level footing in order to make comparisons between the two visually easier.)



Finally, to see just how speculative the price of oil had become, consider how much gold a barrel of oil buys. It began 2005 buying about 7/100th of an ounce of gold – the historical average – and rose to 11/100ths by mid-October, only to plunge back to the 7/100th level by early December. Oil then went on an eight-month tear, peaking at the end of August at 14/100th a ounce per barrel, or double its value compared with the start of 2005. Since the summer of last year, oil has been on a downslope against gold, now buying just 9/100th an ounce per barrel. A look at the price data dating back to 1964 reveals oil trading at a 42-year average of 7/100ths an ounce of gold. Tellingly, by mid-1973, two years after the end of the gold standard and just prior to the Arab Oil Embargo of October 1973, a barrel of oil fetched a modern record low of less than 3/100ths an ounce of gold.

Cartel Activity

Throughout history, efforts to institute commodity cartels of one type or another usually founder because of a lack of discipline. Members dissatisfied with their market share seek to boost their incomes by going around the cartel's restrictions and selling beyond their allotted quotas. Soon other members retaliate and before you know it, no more cartel. OPEC has shown more discipline than most. Though it is far from a perfect cartel, it has managed to maintain enough control over its members to keep the organization viable. However, OPEC is clearly not responsible for the recent run-up in oil prices, its members having tended to exceed their production quotas on numerous occasions over the period.



OPEC has plenty of excess capacity – upwards of 3 million barrel a day (bbl/d), according to the latest estimates – and if this came to market, oil prices would drop like a stone. OPEC's resolve does, in fact, help to keep prevailing prices high. But it hasn't exercised the power – even if it had such power – to trigger the mighty surges in energy prices witnessed in 2005-2006. (EIA, March 2007b)

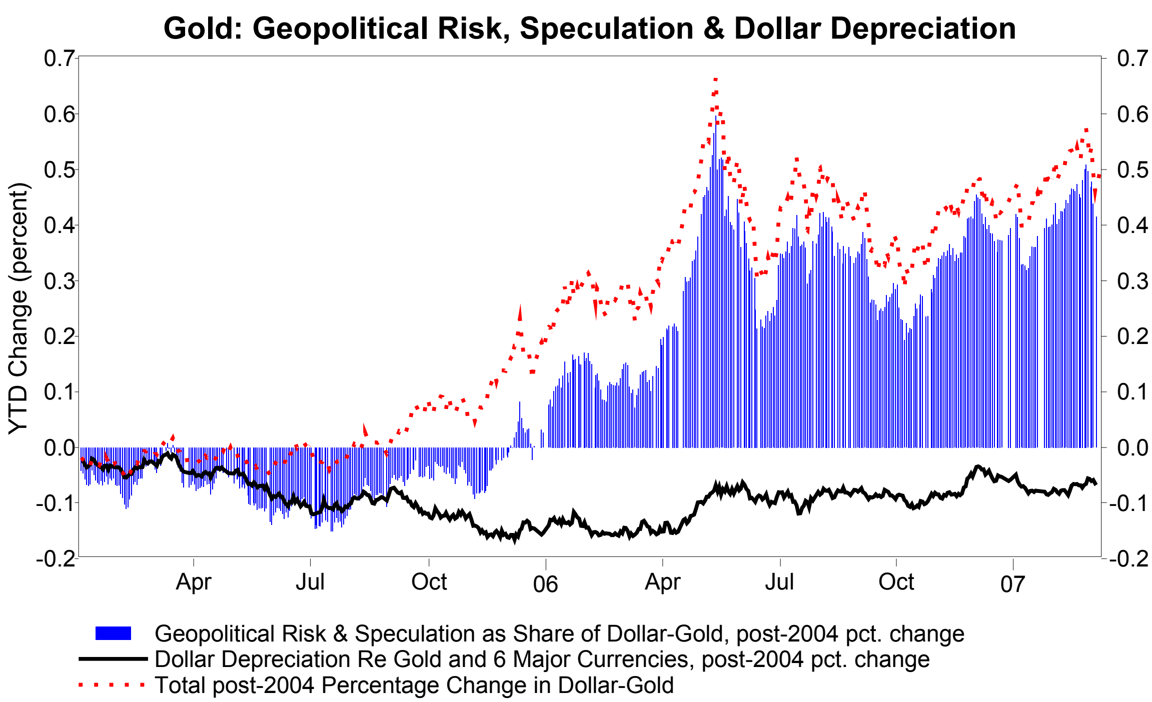
In 2006, for instance, OPEC member states exceed their 26-million-barrel-a-day quota by around 2 percent. In January 2007, according to U.S. Department of Energy data, OPEC's 10 main members, excluding Iraq, produced at a rate of 26,600,000 bbl/d. By February, output was down to 26,455,000 bbl/d – this even though a Dec. 14, 2006 OPEC policy meeting called for a 500,000-bbl/d production cut as of Feb. 1, 2007. .(EIA, March 2007a, EIA March 2007b) In the past four years, OPEC has voted to change its production quotas at least a dozen times, with the total varying between and 23 million and 28 million bbl/d. (EIA, Aug. 2006a)

Furthermore, the EIA's newly published *Annual Energy Outlook, 2007 (AEO2007)* anticipates substantial increases in conventional oil production in several OPEC and non-OPEC countries over the next 10 years, as well as substantial development of unconventional production over the next 25 years. Prices are also expected to be high enough to trigger entry into the market of some alternative energy supplies that are expected to become economically viable in the range of $25 to $50 per barrel. They include oil sands, ultra-heavy oils, gas-to-liquids (GTL), and coal-to-liquids (CTL). (EIA, Feb. 2007b) Additional alternative oil supplies would, of course, further weaken OPEC's already loose grip on the world oil market.

Finally, it is worth noting that Saudi Arabia is spending an estimated $31 billion this year on capital investment in its oil infrastructure. Its rig count has gone up from up from 20-30 to well over 100. Still, Saudi Arabia's well density (i.e., wells per square mile) is a mere 1/64th of the density found in the United States at the peak of its production. The Saudis are acting now in order to preserve their market share. In the past, whenever it cut production, no one else in OPEC would – at least not for long – resulting in a loss of Saudi market share. (Bernstein, 2007)

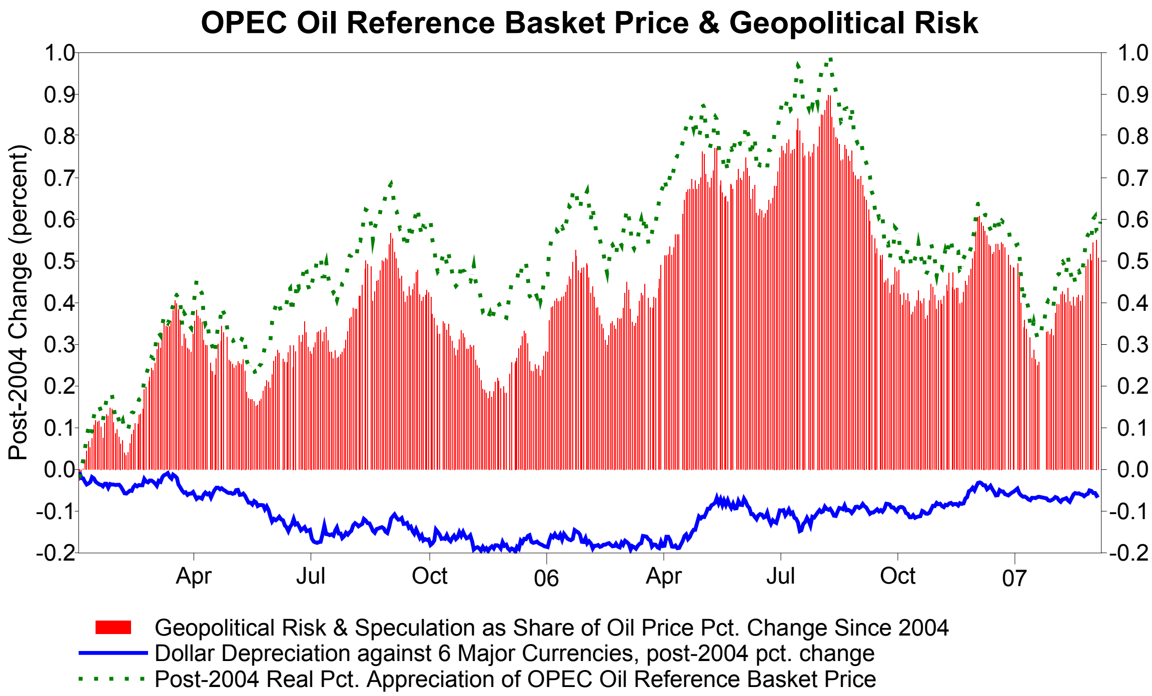
Geopolitical Risk

Geopolitical risk is a financial premium placed on prices in competitive markets by investors and speculators, who see the potential for harm stemming from different political scenarios that could play out around the world. Nowadays, the Persian Gulf – the source of much of the world's oil – is a particular favorite, what with the presence of U.S. and other allied forces in Iraq and Afghanistan and efforts by Islamic insurgents to disrupt the region and possibly even replace the heads of states in such monarchical countries as Saudi Arabia. Then, too, there is the lingering effect of the tragedy of Sept. 11 and the ever-present threat of terrorism. The Israeli-Arab dispute has also been a source of tension, as have North Korea and Iran due to their nuclear-weapons aspirations. And this is to name but a few sources of geopolitical risk.



Gold, importantly, gives us the ability to quantify this risk in the volatile commodities markets. By calculating the gold price using a weighted value for the dollar against other major currencies, the price of gold can be broken into two component parts: one that reflects currency depreciation (i.e., monetary conditions) and the other that shows the effects of speculation and geopolitical risk. Of late, the latter has far outweighed the former, with risk and speculation mainly responsible for driving up the price of gold. This formula then can be applied to such prices as oil to distinguish between that portion of a price increase reflecting supply and demand and those reflecting risk, speculation and currency depreciation.

With gold up 48 percent in U.S. dollar terms since the end of 2004, 6 percentage points of the increase are due to currency depreciation (as measured by a weighted average against the currencies of Canada, eurozone, Japan, Sweden, Switzerland and the United Kingdom) and 42 percentage points can be attributed to geopolitical risk, commodities speculation and gold hoarding.* The point is it is easy to misread gold's recent price rise, mistaking the escalation in risk premiums and speculation for a steep increase in excess dollar liquidity. Fact is, gold isn't signaling a horrendous upturn in U.S. inflation. It is instead mostly a reflection of international tensions and risk premiums. These are the same factors that have helped to drive up energy prices, notably oil.



The OPEC Oil Reference Basket Price has appreciated by 57 percent over the same period. The difference between the two measures – i.e., gold and OPEC oil – of 9 percentage points represents, at minimum, real demand growth for oil. As noted above, 6 percent of the rise in gold (and also oil) can be attributed to dollar depreciation. In terms of oil, that leaves a difference of 51 percentage points. If we assume the same risk

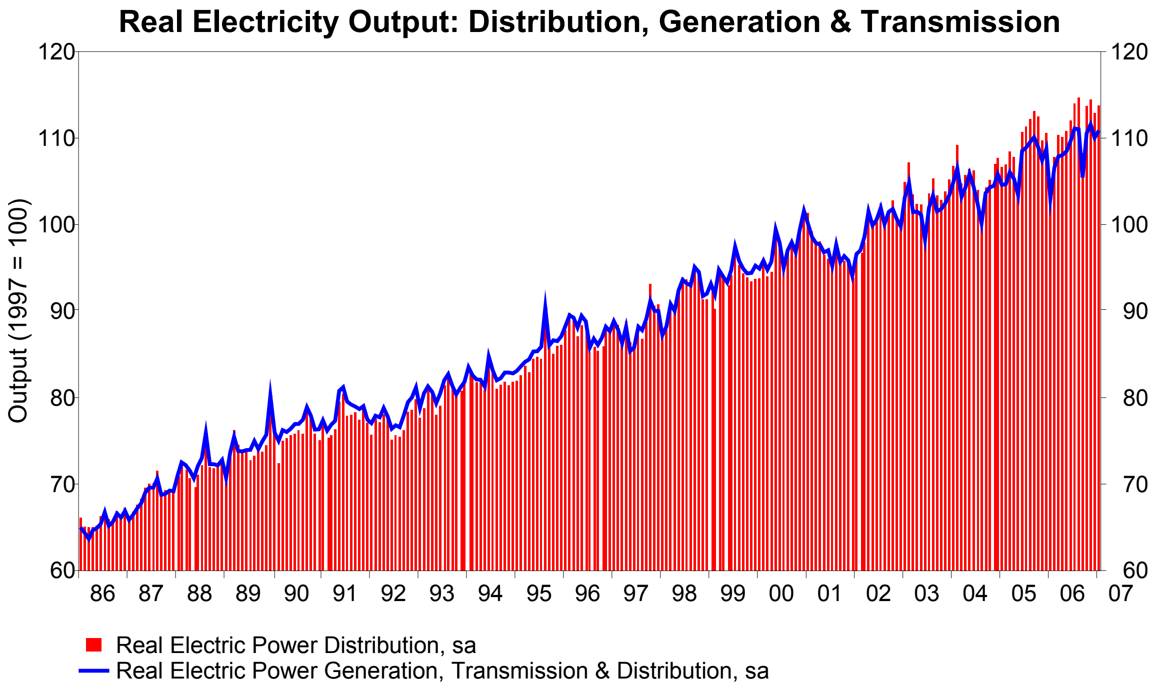
* The last trend, gold hoarding, shouldn't be underestimated or dismissed. Newly formed middles classes in China and India see financial security in owning hard assets and physical valuables, such as jewelry, gold coins and the like. Such items are generally inflation-proof (and also can be hidden from authorities in bad times). This has an effect on the percentage of the gold price rise attributable to risk and speculation. It also, in turn, affects the estimate for the growth in demand for oil, likely underestimating it to a degree. Therefore, the true and accurate demand growth estimate for oil likely is above our 9-percent figure.

and speculative factors affect gold and oil, then it is fair to say that around 42 percentage points of oil's 51-percent appreciation is due to these influences. This results in a residual of 9 percentage points, which can be attributed to growth in real demand for oil around the world. The estimate is rough, of course. But it provides a sense of how big a role geopolitics and speculation play in pricing petroleum. Nota Bene: Geopolitical risk factors can disappear as quickly as they appear, so the potential for a price correction is ever-present.

Having conducted a broad assessment of energy prices, it is worth taking a closer look at individual fuel types, discussing recent trends and analyzing the prospects for the future. Here, a very valuable and authoritative guide has just been published: *Annual Energy Outlook, 2007*, *With Projections to 2030* from the Energy Information Administration, Office of Integrated Analysis and Forecasting, U.S. Department of Energy, issued February 2007. The authors explain: "The projections in the *Annual Energy Outlook 2007 [AEO2007]* are not statements of what will happen but of what might happen, given the assumptions and methodologies used. The projections are business-as-usual trend estimates, given known technology and technological and demographic trends." (EIA, Feb. 2007b) *AEO2007*, as well as several other annual, quarterly and monthly energy assessments, will form the basis of the following discussion of the outlook for oil, natural gas, coal, nuclear energy and renewables. Finally, the study will conclude with solutions for the high price of energy.

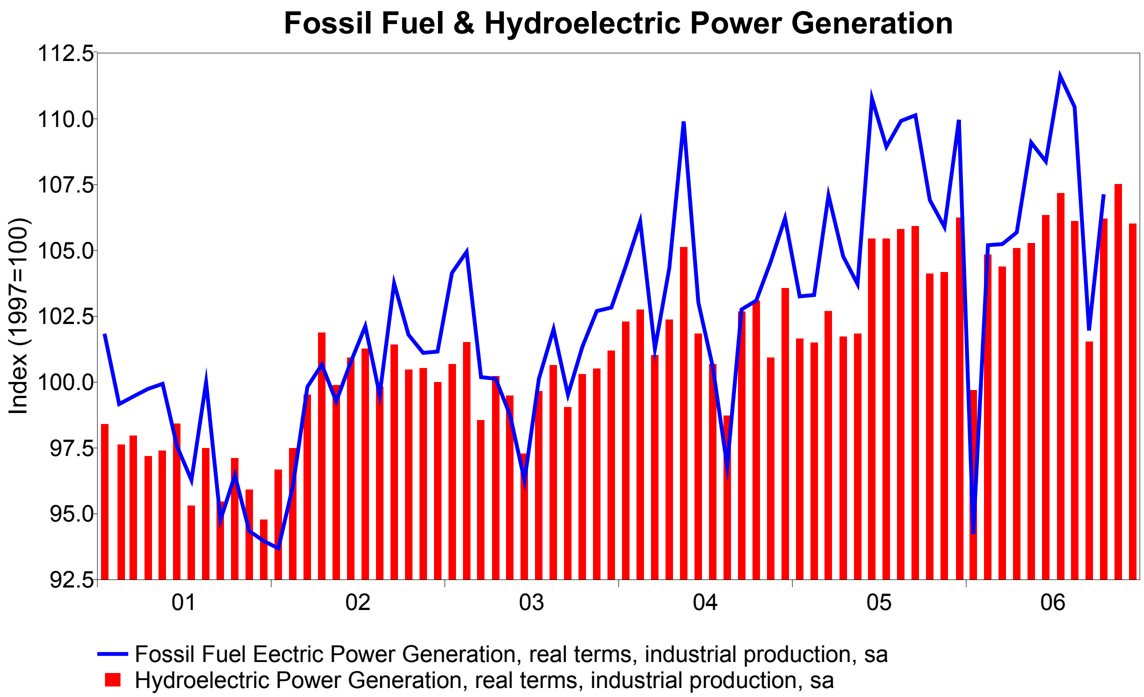
Electricity Projections

U.S. electricity consumption — including purchases from electric power producers and on-site generation — is projected to increase steadily at an average rate of 1.5 percent per year over the next decades. In comparison, electricity consumption grew by annual rates of 4.2 percent, 2.6 percent, and 2.3 percent in the 1970s, 1980s, and 1990s, respectively. Total electricity consumption, including both purchases from electric power producers and on-site generation, is projected to grow from 3,821 billion kWh in 2005 to 5,478 billion kWh in 2030, increasing at an average annual rate of 1.5 percent. A large portion of the projected growth in electricity use for computers, office equipment, and a variety of electrical appliances is offset by improved efficiency in those and other, more traditional electrical applications. The largest electric power capacity additions are expected in the Southeast, including Florida, one of the nation's fastest-growing states, and in the West, including California, the most populous state with a notorious shortage of in-state generating capability. (EIA, Feb. 2007b)



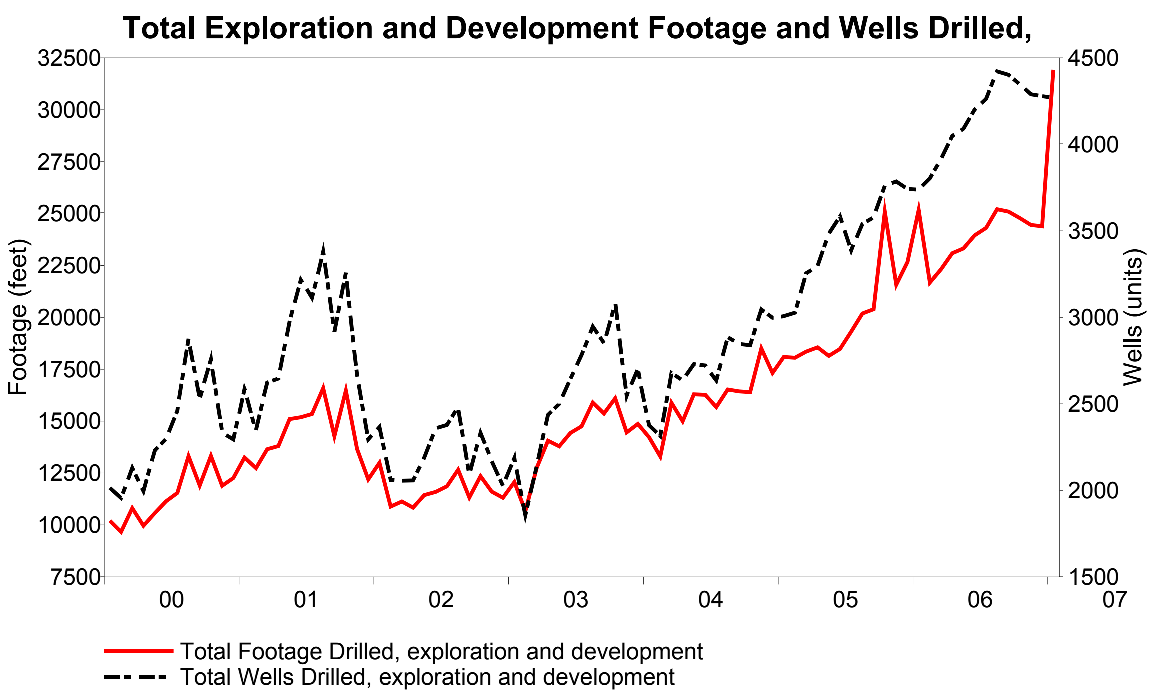
EIA may be underestimating future electricity demand, however, by failing to take fully into account the effect on the economy of baby boom retirement and a rising dependency ratio (as discussed above) and the attendant need to raise labor productivity. Laborsaving devices are the only way to do this. And that will take money and, importantly, more electricity, America's silent partner in the effort to boost output per hour.

Electricity generation from natural-gas-fired power plants is projected to increase from 2005 to 2020 as recently built plants are used more intensively to meet growing demand. Coal-fired generation is projected to increase less rapidly than was projected earlier. After 2020, however, generation from new coal and nuclear plants is expected to displace some natural-gas-fired generation. About 937 billion kilowatthours (kWhs) of electricity is projected to be generated from natural gas in 2030, 6 percent less than a previous estimate of 993 billion kWhs. (EIA, Feb. 2007b)



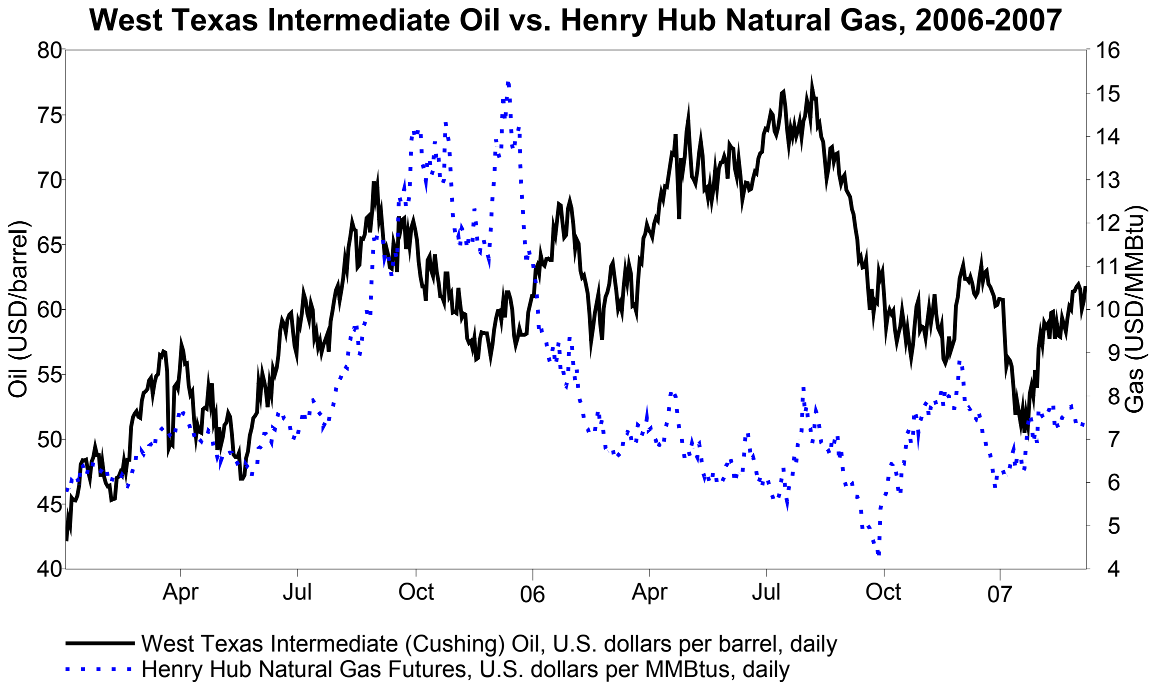
The natural gas share of electricity generation is projected to increase from 19 percent in 2005 to 22 percent in 2016, before falling to 16 percent in 2030. The coal share is projected to decline slightly, from 50 percent in 2005 to 49 percent in 2020, before increasing to 57 percent in 2030. Additions to coal-fired generating capacity are projected to total 156 gigawatts from 2005 to 2030 (as compared with 174 gigawatts previously), including 11 gigawatts at coal-to-liquids (CTL) plants and 67 gigawatts at integrated gasification combined-cycle (IGCC) plants. Given the assumed continuation of current energy and environmental policies in the reference case, carbon capture and sequestration (CCS) technology isn't projected to come into use during the projection period. Nuclear generating capacity is expected to increase from 100 gigawatts in 2005 to 112.6 gigawatts in 2030. The increase includes 12.5 gigawatts of capacity at newly built nuclear power plants (more than double the 6 gigawatts of new additions projected in the *AEO2006* report) and 3 gigawatts expected from uprates of existing plants, offset by 2.6 gigawatts of retirements. Total electricity generation from nuclear power plants is projected to grow from 780 billion kWhs in 2005 to 896 billion kWhs in 2030, accounting for about 15 percent of total generation in 2030. (EIA, Feb. 2007b)

The use of renewable technologies for electricity generation is projected to grow, stimulated by improved technology, higher fossil fuel prices and extended tax credits. Total renewable generation is projected to grow by 1.5 percent per year, from 357 billion kWhs in 2005 to 519 billion kWhs in 2030. Projected emissions of sulfur dioxide (SO^2) from electric power plants in 2030 are 64 percent lower, emissions of nitrogen oxides (NOx) are 37 percent lower, and emissions of mercury are 70 percent lower than their 2005 levels. The reductions are about the same as those projected in 2006 by the EIA. (EIA, Feb. 2007b)



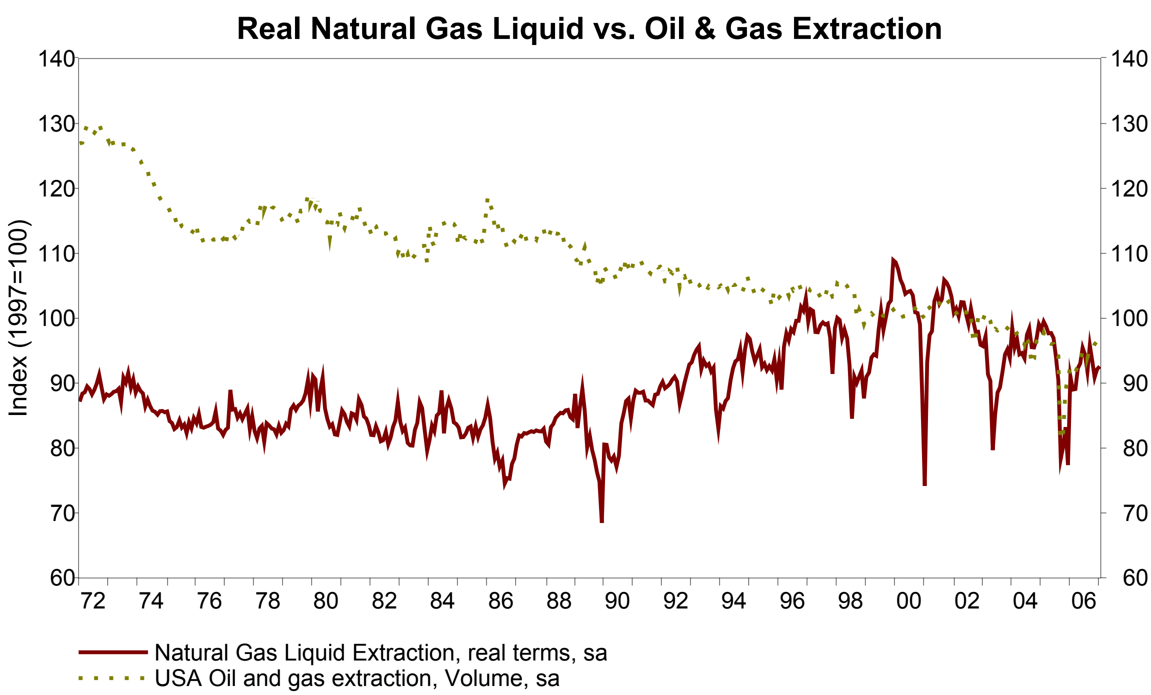
Oil

Oil prices are currently above EIA's estimate of long-run equilibrium prices, a situation that could persist for several more years, it says. Temporary shortages of experienced personnel, equipment and construction materials in the oil industry, political instability in some major producing regions and recent strong economic growth in major consuming nations have combined to push oil prices well above equilibrium levels. (EIA, Feb. 2007b)



Even though oil plays a relatively small role nationally as a primary fuel for electricity generation, it has a much greater influence in terms of fuel pricing for it is the fuel from which most other forms of energy wheel. Take the relationship in the U.S. between the prices of natural gas and oil. The correlation between Henry Hub natural gas and West Texas Intermediate (WTI) crude oil is undeniable. Linear regression analysis reveals a 70.8-percent correlation between the times the price of oil changes and the price of natural gas follows. (For further discussion on this topic, see “Appendix A: The Oil-Natural Gas Price Correlation.”) The correlation isn’t 100 percent, nor should it be expected to be, for natural gas is principally an indigenous commodity, while oil is an international one. Oil’s international character, matter of fact, exposes it to greater geopolitical risk and speculation. The customer base for oil is also different than that for natural gas (Brattle, 2006), meaning the two fuels have different rates of price elasticity (or customer responses to price changes). Although efforts are afoot to introduce more foreign-made liquefied natural gas into the U.S. (Jensen, 2003), most natural gas consumed here is still domestically produced. Most petroleum, in contrast, is imported. (EIA, Feb. 2007b)

The EIA sees the average world crude oil price declining slowly in real terms (2005 dollars) from a 2006 average of more than $69 per barrel ($11.56 per million Btu, or British thermal unit) to just under $50 per barrel ($8.30 per million Btu) in 2014 as new supplies enter the market; then the price rises slowly to about $59 per barrel ($9.89 per million Btu) in 2030. It expects OPEC to increase production at a rate that keeps average prices in the range of $50 to $60 per barrel (in 2005 dollars) through 2030. Prices could move outside the $50-to-$60 range for short periods. EIA is of the belief that OPEC will recognize it isn't in its members' interests to allow oil prices to exceed the $50-to-$60 level for extended periods, because to do so could lower exporters' long-run profits by encouraging more investment in non-OPEC conventional and unconventional supplies and discouraging consumption of petroleum liquids worldwide. (EIA, Feb. 2007b)

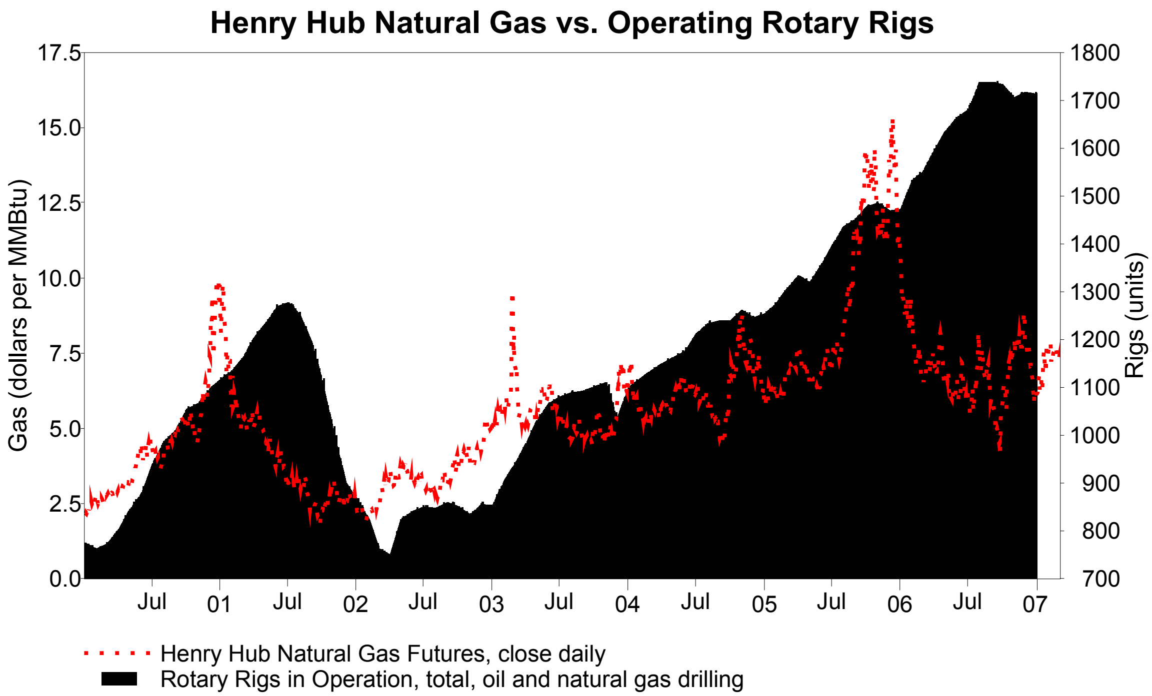


OPEC is likely in for a run for its money, nevertheless. The high prices of crude are attracting competitors from around the world. Marginal oil fields become profitable when prices rise. EIA in its International Energy Outlook 2006 (IEO2006) says that to meet a projected increase in world oil demand case, total petroleum supply in 2030 will need to increase by 38 million barrels per day to 118 million barrels per day, up from the 2003 level of 80 million barrels per day. OPEC producers are expected to provide 14.6 million barrels per day of the increase. Higher oil prices cause a substantial increase in non-OPEC oil production — 23.7 million barrels per day, which represents 62 percent of the increase in total world oil supplies over the projection period. The estimates of production increases are based on current proved reserves and a country-by-country assessment of ultimately recoverable petroleum. (EIA, June 2006)

Natural Gas

Since mid-December 2005, oil and natural gas have moved in opposite directions for much of the time, counter to historic trend. The price of oil over the period rose 16.5 percent from about $61.30 a barrel to $71.40 a barrel, while natural gas fell 55.3 percent from $15.40 per millions of British thermal units (MMBtus) to $6.88 per MMBtus. There are two principal explanations for the divergence: First, most of the natural gas used in the United States is produced indigenously, while most oil is imported. Oil is thus more vulnerable to international influences that go beyond mere supply and demand. Geopolitical risk and speculation may affect the oil price, for instance. Indeed, there is reason to believe that that is precisely what has been happening in the market for petroleum (and other commodities) in the past 18 months. Second, natural gas's more indigenous character means that domestic forces (e.g., capital investment, exploratory drilling, enhanced recovery techniques, etc.) have a greater impact on supply – and, therefore, price. Here, historically high levels of natural gas exploratory drilling and development have been bringing more gas online, helping to ameliorate the recent price upturn. This, however, didn't stop natural gas from rising by 5.0 percent in February (following a 3.0-percent drop in January) in the latest Consumer Price Index release. (BLS)

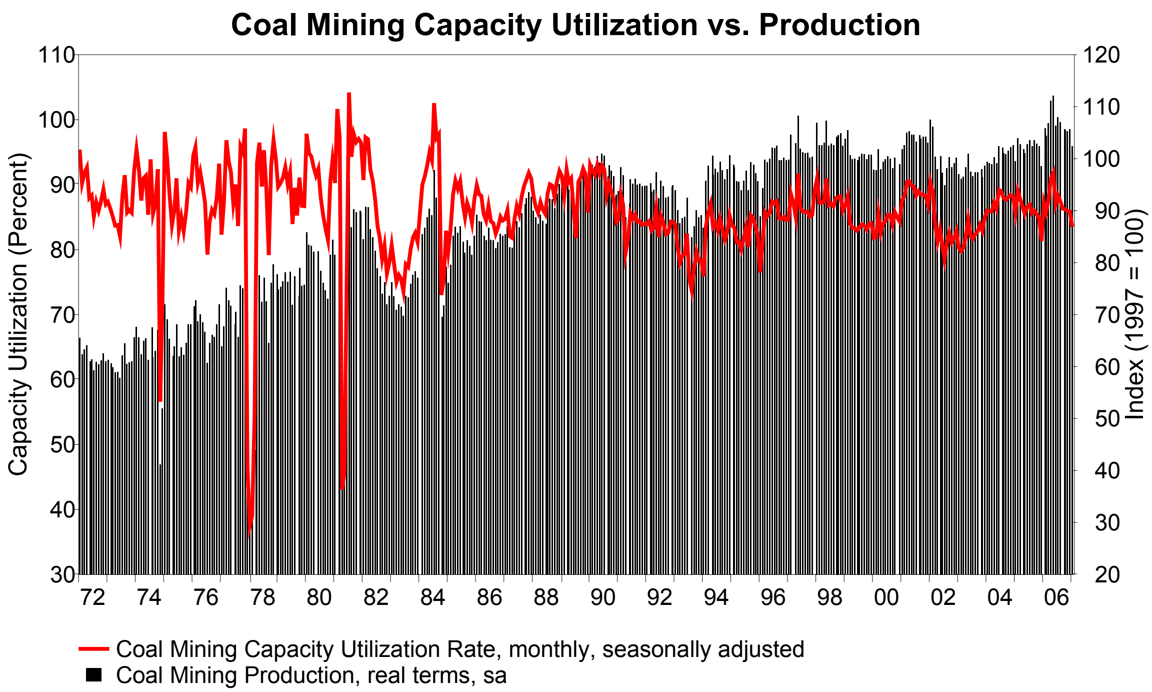
The price of natural gas delivered to electric power plants is projected to drop to $5.50 per million Btu in 2013, then rise to $6.33 per million Btu in 2030. With coal prices staying relatively low (peaking in 2010 at $1.71 per million Btu, then easing to $1.69 per million Btu in 2018 and remaining at that level through 2030), coal generated power is expected to one-up natural gas in the 2020s due to its price advantage. (EIA, Feb. 2007b)



Natural gas consumption is projected by the EIA to grow at a much slower pace than had been previously estimated. The new estimate for 2030 consumption is 26.1 trillion cubic feet. That is down from the projection of 26.9 trillion cubic feet in 2030 in the *AEO2006* and well below the projections of 30 trillion cubic feet or more included in *AEO* projections of only a few years ago. The generally higher natural gas prices now being projected result in lower projected growth of natural gas use for electricity generation in the 2020s. Total natural gas consumption is almost flat from 2020 through 2030, when growth in residential, commercial and industrial consumption is offset by a decline in natural gas use for electricity generation as a result of greater coal use. (EIA, Feb. 2007b) There is a sound logic to this assessment. Natural gas is after all a much more versatile fuel than is coal. So it makes perfect sense to burn more coal to produce electricity, while saving natural gas for other uses for which coal is not an option.

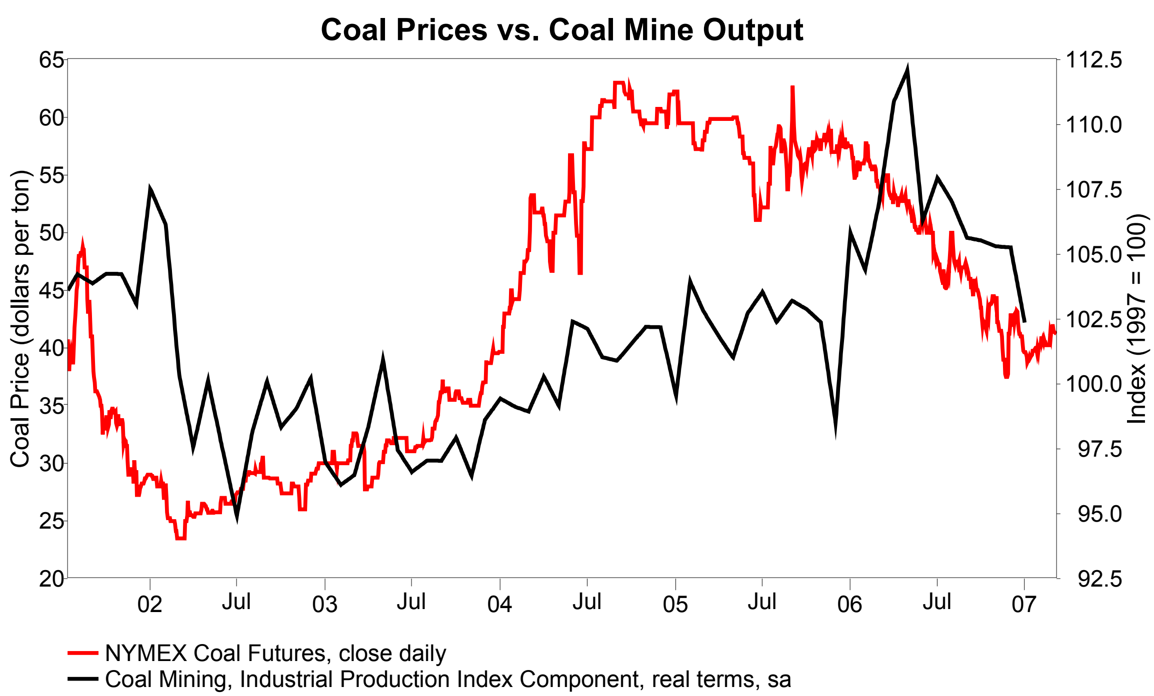
Coal

Coal is America's energy ace in the hole. In the United States today, coal demand is driven by the electric power sector, which accounts for 90 percent of consumption, compared to the 19 percent it represented in 1950. Coal already plays a large role in the electric power sector, producing more than 51 percent of the nation's power, and its role is expected to get even larger. By 2030, coal is projected to supply upwards of 57 percent of net generation. This assumes, however, that environmental laws and regulations don't stymie the construction of new coal-fired plants.



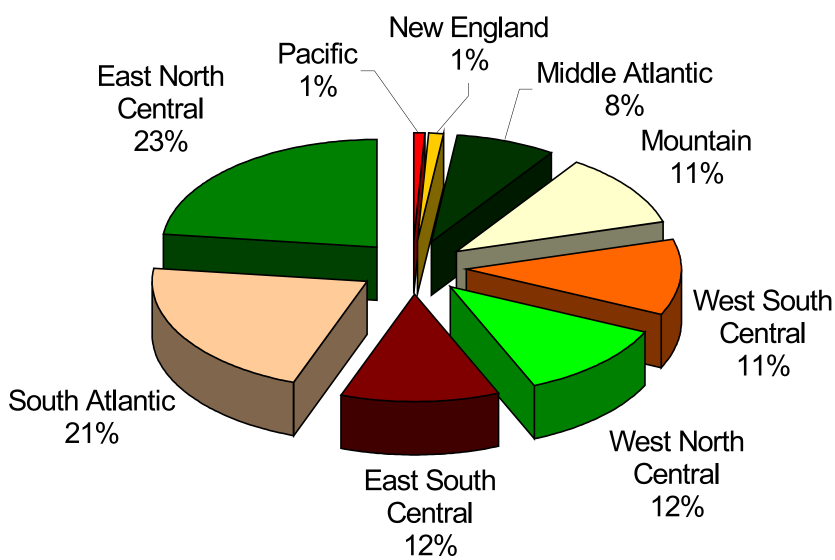
Coal consumption is projected to increase from 22.9 quadrillion Btu (1,128 million short tons) in 2005 to more than 34 quadrillion Btu (1,772 million short tons) in 2030, with significant additions of new coal-fired generation capacity over the last decade of the projection period, when rising natural gas prices are projected. The projections for coal consumption are particularly sensitive to the underlying assumption that current energy and environmental policies remain unchanged. (Read: global warming.) Recent EIA reports have shown that steps to reduce greenhouse gas emissions through the use of an economy-wide emissions tax or cap-and-trade system could have a significant impact on coal use. (EIA, Feb. 2007b)

Annual production is expected to increase by 1.1 percent a year between 2005 and 2015 and then speed up to 1.8 percent a year from 2015 to 2030, as substantial numbers of new coal-fired generating plants are added and several coal-to-liquids units come on line. (EIA, Feb. 2007b) Coal production in the U.S. set a record in 2005, ending the year at 1,131.5 million short tons, up 19.4 million tons, or almost 2 percent, according to the latest available annual data. Coal consumption by the electric power industry increased by 2.1 percent, largely due to stronger economic growth. And, for the second consecutive year, coal prices of all sorts rose, with electricity utilities paying 14.4 percent more per short (2,000-pound) ton (EIA, Oct. 2006b)



Western coal output is likely to grown steadily, and eastern power plants are expected to use more western coal. (EIA, Feb. 2007b) The shift of coal production from traditional eastern coalfields to the western United States was, in fact, the most important development affecting coal markets in the last 30 years. Thick beds of low-sulfur coal with low mining cost are extensive in the Northern Great Plains states of Wyoming, Montana and North Dakota. As demand for electricity grew, demand for coal to generate it rose and resulted in increasing coal production. There were years in which coal production declined from the prior year but, excluding years affected by a major unionized coal strike, annual increases in coal production between 1950 and 2003 outnumber decreases by almost two to one. Growth in surface coal mining was accompanied by a second trend: the accelerated application of surface mining technology in large-scale area mines in the western region. The third technological trend for the 1973-2003 period was the shift within underground mining from conventional room-and-pillar mining to longwall underground mining. (EIA, Oct. 2006a)

Coal-Generated Electric Power by Region, 2005



The correlation between the spot prices of coal and oil isn't very strong. Linear regression analysis shows that coal responds to a change in the oil price less than half the time (that is, 48.4 percent of the time). Coal of course isn't really a substitute for oil, except in certain limited cases. The absence of a substitution effect clearly would tend to reduce any price correlation between the two fuels. Over the longer haul, however, coal prices will tend to track oil, just as any fuel would, because they all serve similar purposes.

Coal slurry pipelines are an idea that should be tried again. The majority of coal in the U.S. moves by rail. (EIA, Oct.

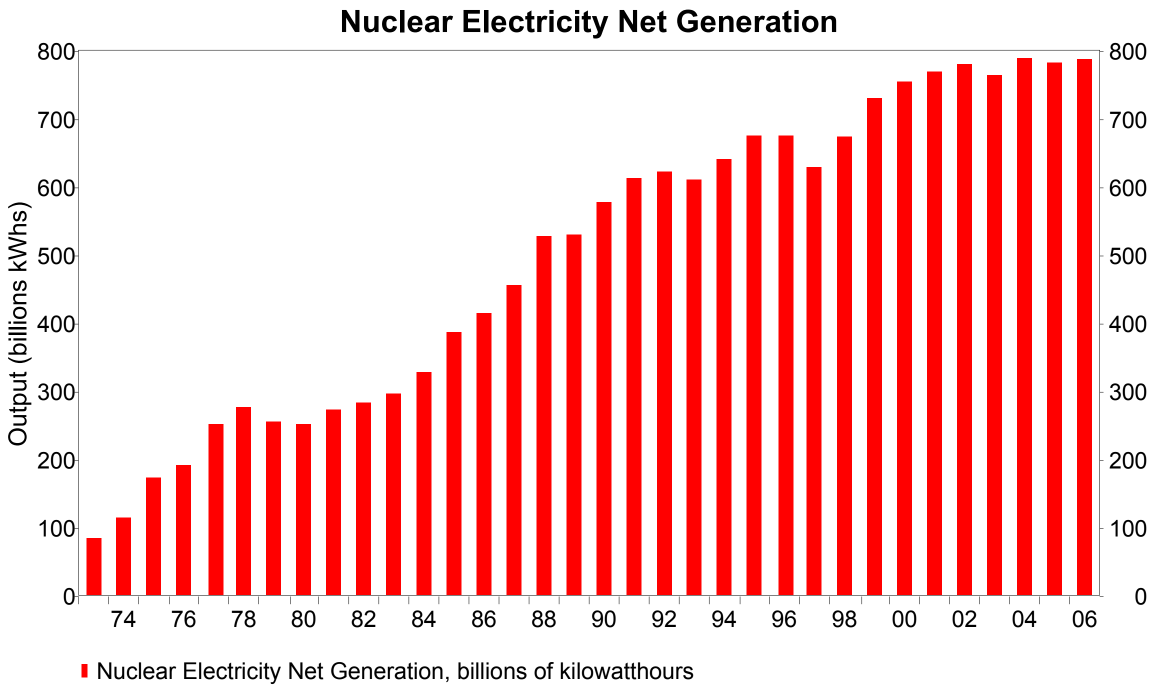
2006b) Railway opposition to the granting of rights of way scuttled an effort in the 1980s to build slurry pipeline from mine mouths to electric power plants. The EIA's list of recent coal transportation woes should be enough to convince anyone that slurry pipelines ought to be given a try:

> The overriding issue for the U.S. coal industry in 2005 was transportation of coal from the mines to the consumers. The majority of coal in the United States is moved by railroads exclusively or in multi-modal service with another method of transportation. Other modes of coal transport are barges, trucks, tramways, and conveyors. In 2005, flooding on the major waterways, along with river lock repairs and sunken barges during the winter, as well as low water levels on some major river systems during the summer, contributed to the transportation problems. In addition, three major hurricanes hit the United States in 2005 (Dennis, Katrina, and Rita) causing numerous problems for the coal industry including flooding, disruptions in deliveries, closed deep-water ports, and offline power plants. However, the one transportation issue that most affected the coal industry in 2005 was the disruption of rail traffic from the Powder River Basin (PRB) due to track maintenance. In mid-May of 2005, there were two train derailments on the southern PRB joint line, caused in part by severe weather and coal dust on the rails. (EIA, Oct. 2006b)

Nuclear Power

Because no new nuclear plant has been ordered in the U.S. since 1997, no one knows what a new one might cost. The EIA’s latest annual review hearteningly finds that nuclear plants can be competitive with other forms of generating plants, so long as costs are kept reasonably low. (EIA, Feb. 2007b)

The U.S. operates 104, or 23 percent, of the world’s 443 nuclear power reactors. Net generation of America’s plants totals 782.0 billion kWhs, representing 21 percent of the country’s total electric generation. A big advantage of nuclear power is low fuel cost. The process begins by buying uranium ("yellowcake"), typically from an overseas supplier, and then processing it into a more refined substance used in nuclear fuel rods to drive a chain reactor that heats water, generating steam and turning electric power turbines. The fuel cost for nuclear plants is 45 cents per kWh versus 2.18 cents per kWh for fossil fuel steam-generating plants. Uranium expenditures per year come to a mere $133.5 million – a literal drop in the bucket compared with the costs of other electricity-generating fuels. (EIA, Oct. 2006c)



The last new nuclear generating unit brought on line in the United States began operation in 1996. Since then, changes in U.S. nuclear capacity have resulted only from uprating of existing units and retirements. The EIA projects total operable nuclear generating capacity of 112.6 gigawatts in 2030, including 3 gigawatts of additional capacity uprates, 9 gigawatts of new capacity built primarily in response to new tax credits, 3.5 gigawatts added in later years in response to higher fossil fuel prices, and 2.6 gigawatts of older plant retirements. As a result of the growth in available capacity, total nuclear generation is projected to grow from 780 billion kWhs in 2005 to 896 billion kWhs in 2030. Even with the projected increase in nuclear capacity and generation, however, the nuclear share of total electricity generation is expected to fall from 19 percent in 2005 to 15 percent in 2030. (EIA, Feb. 2007b)

U.S. Nuclear Reactors by License Year						
Year	Reactors Licensed	Share of Reactors	Closed Reactors	Share of Reactors	Operable Reactors	Share of Reactors
1968-1974	38	33.6%	6	66.7%	32	30.8%
1975-1978	23	20.4%	3	33.3%	20	19.2%
1979-1996	52	46.0%	0	0.0%	52	50.0%
Total	113	100.0%	9	100.0%	104	100.0%

*Includes only light water reactors beginning commercial production in 1968 or later.

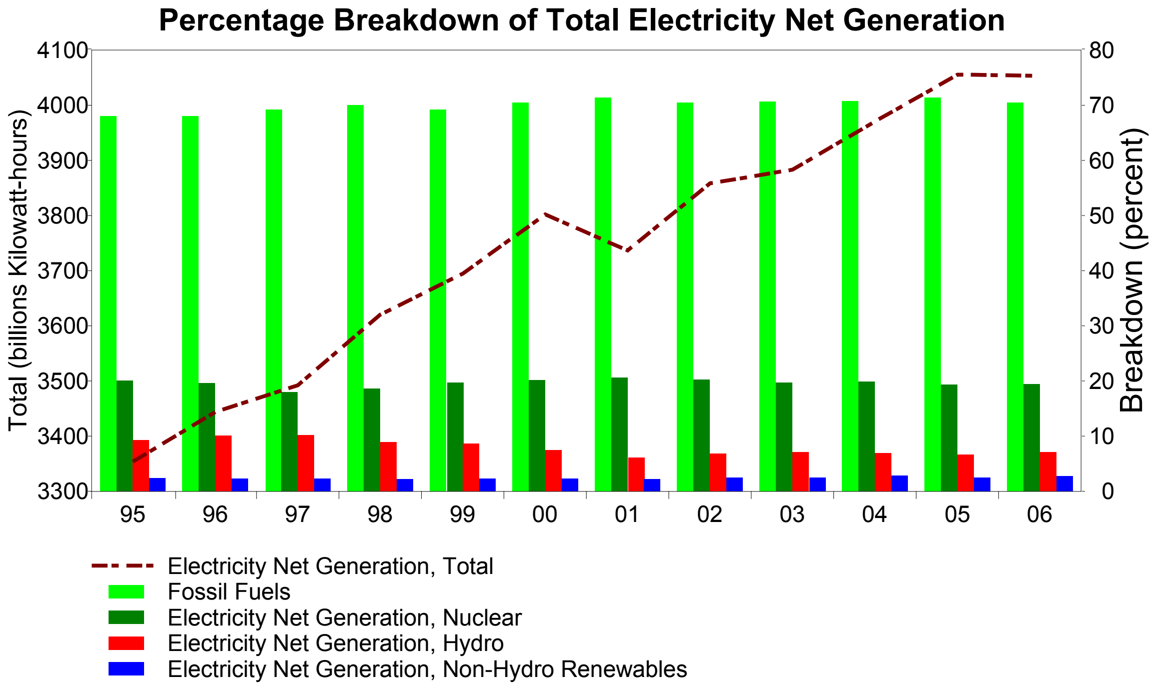
The U.S. Nuclear Regulatory Commission (NRC) has confirmed that applications for early site permits for the construction of two new nuclear reactors were received from Dominion Power and Exelon. Exelon plans to build a new reactor at its Clinton power plant in Illinois, and Dominion Power is considering adding a third reactor at its North Anna plant in Virginia. (EIA, Site Permits)

Renewables

Renewable sources of energy, including biomass (e.g., wood, grasses and waste), wind, solar and geothermal, are expected to contribute to electricity generation, spurred by better and cheaper technology, the inducement of higher fossil fuel prices and extensive federal tax credits. However, some renewables seem to be more economic than others. Biomass and wind lead projected renewable growth, for example. Wind, however, is more tenuous, for it depends for success heavily on the cost of fossil fuels. Still, renewables are expected to become more competitive over time. The EIA says, for instance, that geothermal and biomass plants need to be stacked up against new nuclear and coal facilities and not against low-cost baseload operations when weighing new generation investment. (EIA, Feb. 2007b)

If precedent is any guide, federal incentives to use renewables in the generation of electricity will likely redound positively over the long haul. Take as an example what has already happened with biofuels. Government support has fueled the rapid growth of the biofuel industry and may have reduced long-term risk for biofuel investments. As noted earlier, total renewable generation is projected to grow by 1.5

percent per year, from 357 billion kWhs in 2005 to 519 billion kWhs in 2030. (EIA, Feb. 2007b)

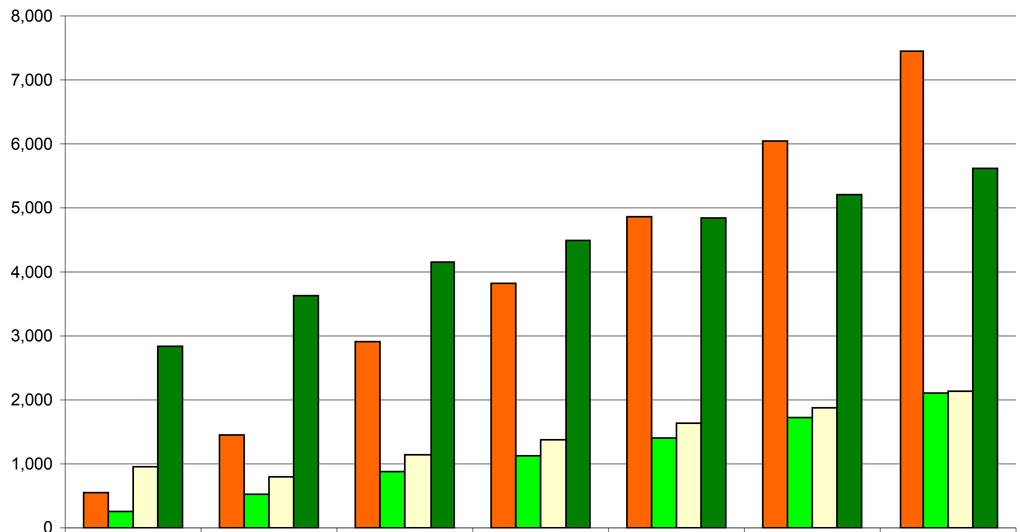


International Electricity

World electricity consumption doubles in the EIA's *International Energy Outlook 2006* (*IEO2006*), with projections from 2003 to 2030. The world's major economies – members of the Organization for Economic Cooperation and Development, or OECD – account for 29 percent of projected electricity growth. Developing nations (or non-OECD countries) represent the remaining 71 percent. (EIA, June 2006)

Net electricity consumption in OECD countries increases by 50 percent from 2003 to 2030 mostly as a result of increasing penetration and use of consumer electronics, office equipment and telecommunications technologies. In the United States, electricity demand increases from 3,669 billion kWhs in 2003 to 5,619 billion kWhs in 2030. Demand growth in the commercial sector is particularly strong, averaging 2.2 percent per year. Additions to commercial floorspace, the continuing penetration of new telecommunications technologies, and increased use of office equipment offset efficiency gains for electric equipment in the sector.

World Electricity Consumption by Country 1990-2030



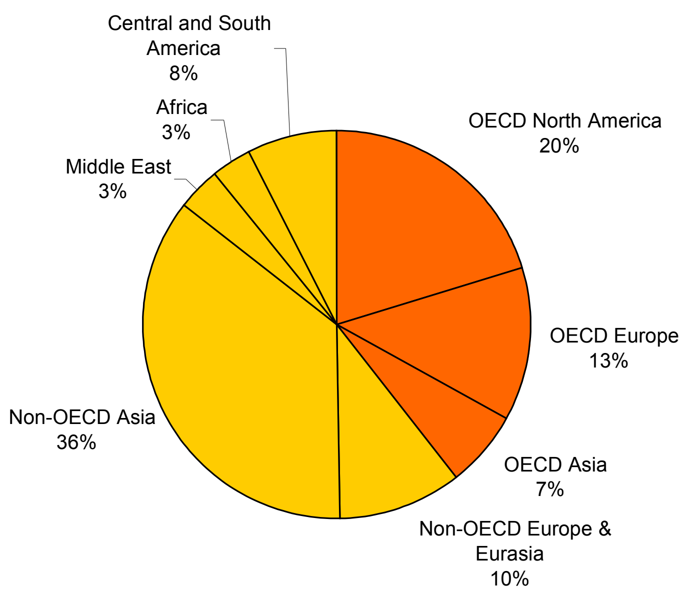
	1990	2002	2010	2015	2020	2025	2030
China	551	1,452	2,910	3,822	4,863	6,044	7,449
India	257	525	879	1,127	1,406	1,724	2,108
Russia	955	796	1,141	1,375	1,635	1,876	2,135
United States/a	2,837	3,629	4,155	4,491	4,844	5,208	5,619

Moderate increases are projected for electricity consumption in the industrial and residential sectors, averaging 0.8 percent per year and 1.5 percent per year, respectively. A similar pattern is projected for Canada, where net electricity consumption grows from 521 billion kWhs in 2003 to 660 billion kWhs in 2015 and 776 billion kWhs in 2030. The most rapid growth in net electricity use among the OECD countries is projected for Mexico, averaging 4.1 percent per year overall and 5.8 percent per year in both the residential and commercial sectors. (EIA, June 2006)

Driven by economic and population demands, electricity consumption in what have heretofore been developing nations is expected to grow at an average annual rate of 3.9 percent from 2003 to 2030, according to EIA estimates. Non-OECD Asia will have the highest growth rate at 4.7 percent per year, followed by Central and South America at 3.7 percent, the Middle East at 3.0 percent, Africa at 2.9 percent, and non-OECD Europe and Eurasia at 2.8 percent. The average annual growth rates translate to a near tripling of net electricity consumption in the non-OECD nations over the projection period. In 2003, non-OECD economies consumed 40 percent of the world's electricity; in 2030 their share is projected to be 56 percent.

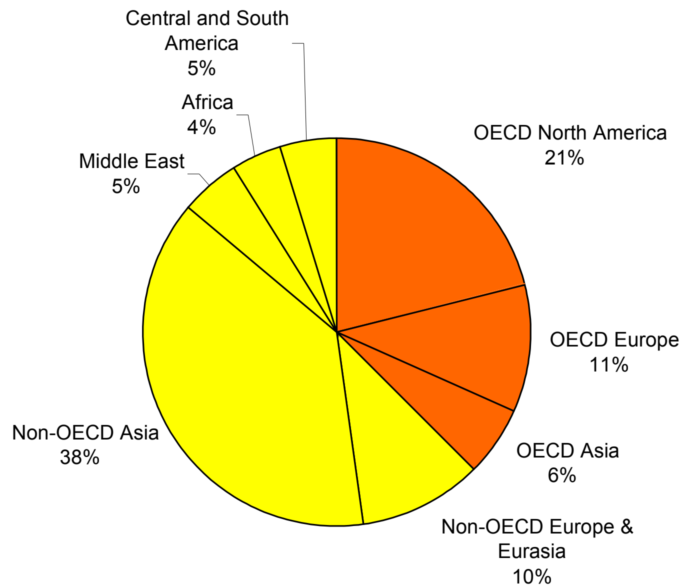
From 2003 to 2030, residential electricity consumption for the non-OECD economies as a whole grows from 23 percent to 30 percent of total net electricity consumption. In absolute terms, nearly four times as much electricity is consumed in the residential sector in 2030 than was consumed in 2003, supporting a major transformation in living standards as electric lighting, appliances, and new technologies become available to an increasing share of the world's population. (EIA, June 2006)

World Electricity Consumption by Region, 2030



Based on high economic growth assumptions, China overtakes the U.S. as the world's largest consumer of electricity sometime around 2020. EIA defines its "high economic growth" model as 0.5 percentage point above trend among OECD members and 1.0 point above trend for non-OECD countries. With countries like China growing at 10-percent-per-annum rates, the high growth scenario certainly seems achievable. What is more, the expansion of electricity doesn't stop with the big names like India and China. Taken as a whole, all non-OECD developing nations currently consume in the order of 40 percent of the world's electricity and OECD economies use the other 60 percent. By 2030, the EIA sees the tables reversed, with mature economies consuming 40 percent of the world's electricity and developing-turned-developed nations using 60 percent. (EIA, Feb. 2007b)

World Carbon Dioxide Emissions by Region, 2030

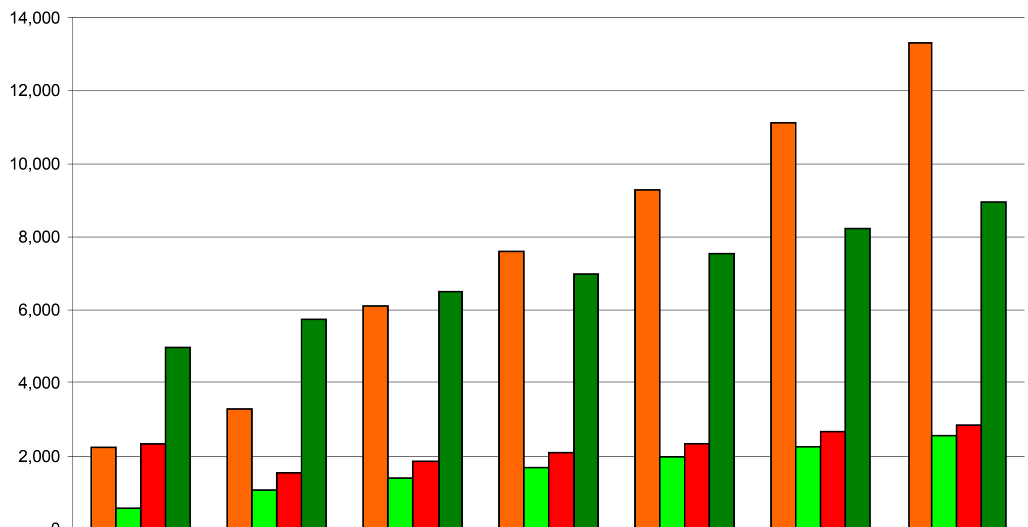


Global Warming

Those numbers can simply be flipped when it comes to carbon dioxide emissions. In 2003, the developed world was responsible for 52 percent of world CO_2 emissions, whereas developing nations cast off the remaining 48 percent. By 2030, according to EIA's high-growth forecasts, the developing-turned-developed world will be emitting 62 percent of all CO_2 gases, and the mature economies will be responsible for the other 38 percent. (EIA, Feb. 2007b)

The science of global warming aside, the advocates of severe restrictions on so-called greenhouse gases are on a collision course with the vast numbers of the world's poor, whose aspirations for a higher standard of living will require considerably more electricity. More electricity will almost surely mean more greenhouse gas emissions. Are the world's poor to remain in perpetual poverty because of fears about humanity's contribution to warming temperatures? It is hard to imagine how they will be barred from access to electric lighting, refrigeration, air-conditioning and electronic home entertainment – staples that the developed world takes for granted. Yet some global warming opponents might blow their stacks if economic progress and rising standards of living in the Third World mean more greenhouse gases.

World Carbon Dioxide Emissions by Country, 1990-2030



	1990	2002	2010	2015	2020	2025	2030
China	2,241	3,273	6,110	7,608	9,287	11,128	13,312
India	578	1,011	1,403	1,691	1,981	2,257	2,561
Russia	2,334	1,546	1,860	2,096	2,343	2,618	2,850
United States/a	4,978	5,748	6,502	6,987	7,543	8,232	8,957

The beauty of government regulations is in the eye of the beholder. What cannot be denied is the fact that regulations are, in effect, a tax. And, as economist Arthur Laffer frequently points out, if you want less of something, tax it more. Regulations raise the cost of doing business above and beyond what it would be in an unfettered system; they divert resources – financial and intellectual – away from profit-making aspects of business, and they often disadvantage regulated companies that must compete in the marketplace against lesser or non-regulated companies. Further, regulations invariably have unintended consequences that are often worse than the original complaint.

There are some issues, however, that seem to loom larger than life and global warming is one of them. The scientific theory notwithstanding, if global warming legislation is enacted, mandating substantial emission reduction in so-called greenhouse gases (e.g., carbon dioxide and nitrogen oxide), it is very hard to see 1) how American industry will be able to meet those targets without major production cutbacks and 2) how the electric power industry could continue to guarantee reliable service throughout the country.

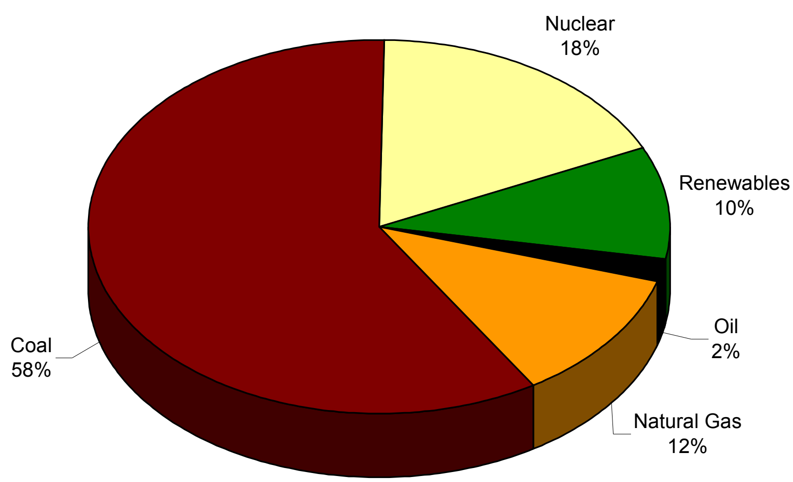
California's Public Utilities Commission (CPUC) already has voted (4-0) to prohibit electric utilities and other energy providers from entering into long-term contracts with power suppliers that emit more carbon dioxide than a typical modern natural gas-fired generating plant. The measure effectively bars power companies from buying electricity from most out-of-state coal-burning sources. The aim of the ban is to combat global warming and is an outgrowth of a anti-warming bill that Gov. Arnold Schwarzenegger signed into law last year, requiring the CPUC to adopt stricter emission standards for the state's electric utilities. Out-of-state coal-fired plants currently supply about 20 percent of California's electric needs. (Chea) The cost of implementation will therefore likely be expensive as utilities compete for alternative, low-emission sources of electricity.

'Californization'

California, the state with the worst, self-imposed electricity supply-demand imbalance, epitomizes the regulatory, political and environmental forces that too often prefer to demagogue problems associated with electric power rather than solve them. Take the above restrictions on out-of-state power purchases. Exactly what purpose does the law serve? California utilities will bid up the price of electricity produced by out-of-state plants that meet the new emissions standards, leaving others to buy their power from the remaining power plants. Will this reduce the total emission of greenhouse gases? No. All of the existing plants will continue to produce power, whether emitting a lot of CO_2 or not. Californians, however, will have to pay more for the privilege of using low-emitting power, having had their utilities bid against each other in the scramble to buy power that meets code.

This is the kind of surreal illogic that often afflicts utility regulation in California and elsewhere. Such ill-conceived, misguided and counterproductive regulatory fervor deserves to be called Californization. As economist Lawrence A. Kudlow once said about the state's financially foundering electric utilities, "California is the perfect example of statism run amok – statism and over-regulation leading to bankruptcy." (Kucewicz, 2001)

Electricity Sector Energy Consumption by Source, 2030



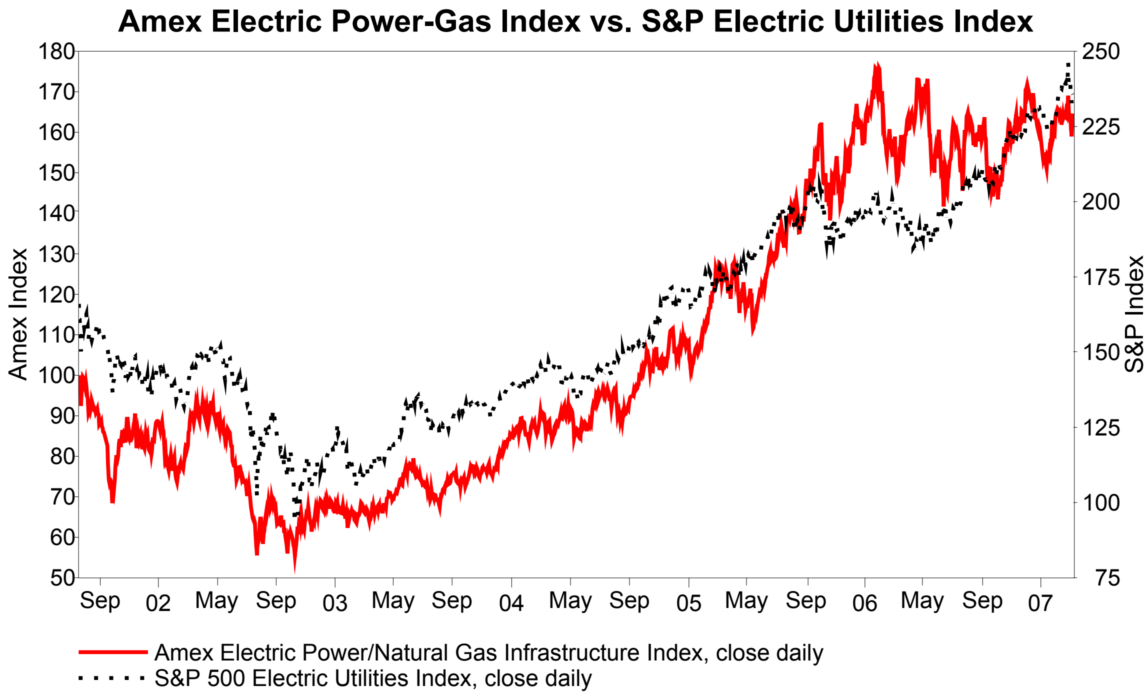
The Golden State, ironically, pioneered electricity deregulation. A 1996 decontrol bill, unanimously approved by the state legislature and signed by then-Governor Pete Wilson, was fatally flawed, however. It sought to protect Californians against potential price hikes by trying to maintain electricity price controls within a deregulated framework. The bill called for retail price controls – at least, temporarily – while it freed much of the rest of the electric power sector from state restrictions. The result was a regulatory jumble that was later exploited by a few nefarious electricity traders, who ultimately brought down several corporate managements (e.g., Enron and Reliant) and gave electricity deregulation a bad name. (Kucewicz, 2000)

Such wrongdoing naturally encouraged politically minded regulators, even though there is ample evidence that electric utilities neither possess nor exercise the powers long associated with what are called “natural monopolies” (i.e., businesses that by their nature have little or no competition within their service area). (Posner) It serves no one’s interest to turn electric power companies into political punching bags. Such a practice is folly, as California, with its “rolling blackouts,” power shortages and financial crises, knows too well. So much rides on the future of electric power, it is imperative that sanity, not sophistry, reign. There is no reason regulators can’t act responsibly. They should appreciate that by their actions they are helping to lay the foundation for a stronger, more productive economy, with more jobs at better wages and higher quality goods and services at lower prices.

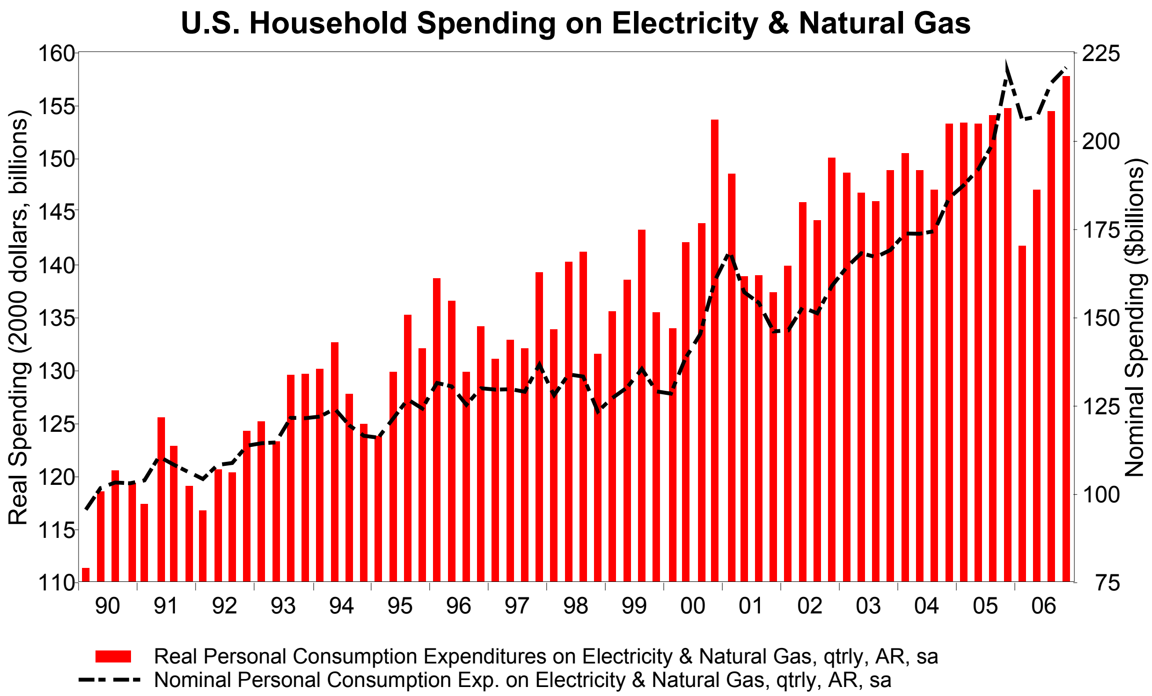
Capital Investment

High prices are a signal to investors that a particular sector of the economy requires more capital investment. In the case of energy, when the prices of oil and/or natural gas rise, investors flood the market with funds, hoping to make a killing by bringing new product to market before others do and while prices are still high. These investment monies go into new exploration and production, enhanced production of existing wells, etc. The rub is that as more energy supplies come to market, energy prices decline. And that is precisely what has happened in the past few years. As oil and gasoline set new highs, money entered the industry to produce additional supplies that eventually reversed the price trend and brought prices down. By way of example, note EIA’s latest projection that $25-to-$50-a-barrel oil is sufficient to trigger development of new energy sources, including oil sands, ultra-heavy oils, gas-to-liquids and coal-to-liquids. (EIA, Feb. 2007b) The new sources will compete directly with OPEC for market share.

Consider that U.S. oil production in 2006 is estimated to have averaged 5.1 million bbl/d, down slightly from 2005 levels. In 2007 and 2008, crude oil production is expected to increase to 5.2 and 5.4 million bbl/d, respectively, reflecting not only recovery from the impact of the 2005 hurricanes that depressed Gulf of Mexico production but also the startup of new deepwater production, especially the Atlantis platform in late 2007 and the Thunderhorse platform in late 2008. Meanwhile, domestic natural gas production is expected to increase by 2.4 percent in 2007, as drilling for natural gas continues at historic highs. Net imports of natural gas in 2007 are projected to drop for the second consecutive year. (EIA, March 2007b)



The U.S. Department of Energy also is projecting the Henry Hub natural gas price will average $7.58 per thousand cubic feet (mcf) in 2007 and $7.86 in 2008 compared with averages of in 2005 $9.01 and $6.98 in 2006. It further estimated WTI crude will average $62 a barrel in 2007 and $63.75 in 2008 versus $56.54 a barrel in 2005 and $66.01 in 2006. The price projections for 2007-2008, while not harmfully high, are sufficient to induce continued investment in new natural gas exploration and development. The level of investment, as measured by, say, the number of exploratory rigs in operation, is very sensitive to price. Rig counts tend to move in tandem with oil and natural gas prices, suggesting a positive correlation between prices and exploration. Matter of fact, the DOE itself says that domestic dry natural gas production is expected to increase by 2.4 percent in 2007, a slight increase from production growth in 2006, as drilling for natural gas continues at historically high levels. (EIA, March 2007b) The ratio of natural gas wells drilled to oil wells drilled is currently 2.8 to 1. Seismic crew counts have reached a high of 54 in the onshore continental United States, up from 43 last year and 41 the year before, while lower 48 states offshore seismic crews are down to 8 from 11 last year and 9 a year before that. Alaska currently occupies just one crew. (EIA, Feb. 2007c)



For the first time in 15 years, the number of oil wells drilled in the U.S. has surpassed the 1,000 mark. Natural gas drilling was 23 percent higher than June of 2005. Total footage of all exploration and development wells in June was 30 percent higher than last year. The rotary rig count, a key barometer of oil and natural gas investment, was up 23 percent in June from a year earlier. The count would be even higher, in fact, if more rigs were available, but many fell into disuse and disrepair when oil and gas prices slumped in the late 1990s (largely due to monetary factors affecting the dollar and causing widespread commodity price deflation).

Solutions

There is no magic-wand solution to the problem of high electricity costs and prices. The sources of the problem are many and varied and therefore the solutions to the problem are also many and varied. What they all have in common is this: Electricity prices will go down once more financial capital and greater intellectual knowledge and ingenuity are applied to solving the problem. More capital and better problem-solving will, *inter alia*, generate greater efficiencies, increase the supply of energy, expand the sources of energy, improve power transmission and distribution, and enhance conservation. And, given the regulated nature of much of the electric-power sector, the problem solvers must include not only industry but also government. Regulators and elected officials at the federal, state, and local levels have key roles to play in finding solutions to the high price of electricity.

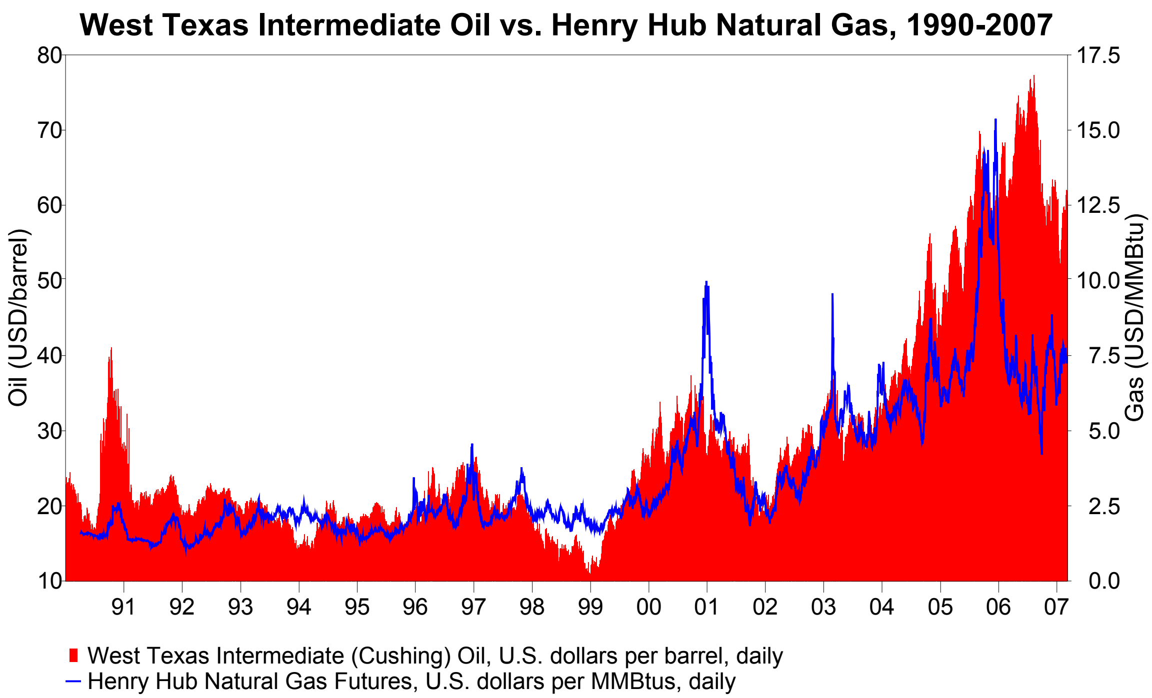
Regulators with foresight are also needed to help provide electric utilities with the financial wherewithal to fund the projects necessary to maintain a reliable source of electricity to the nation's homes, businesses and institutions. As the Brattle Group so well put it in a recent report on electricity prices, "The extent to which increasing utility costs are recovered in rates will determine the financial condition of the industry and affect its ability to make future generation, transmission, distribution, and environmental investments in a timely manner. With appropriate rate treatment, the industry will continue to provide reliable services at reasonable costs." (Brattle, 2006) Rates determined by government regulators almost always lowball the numbers in the name of helping consumers. But what good are low electric rates if services become unreliable and supplies insufficient to meet the country's electricity needs? The electric power industry shouldn't be denied the revenues to finance needed projects, the profitability to borrow at low rates of interest or the rates of return to attract capital investment, because that would be shortsighted, ill-advised and risky.

Markets do work. And as the late Robert L. Bartley, the editor of *The Wall Street Journal*, used to say: "There's no such thing as a shortage; there's only a price." At some point, the market clears: Supply equals demand. But those exquisite market forces can't work their wonders if government regulators won't let them. The best thing lawmakers, policymakers and regulators can do for the nation's electricity customers is to let electric companies do their job. The electric power industry has already proved it can build a reliable system, so let it continue to expand the network into the future to meet the country's growing needs for electricity.

Thus, in conclusion, after looking at the myriad economic, technological and financial factors impinging on the price of electricity, the future of the electric power sector ironically comes down to this: politics.

Appendix A: The Oil-Natural Gas Price Correlation

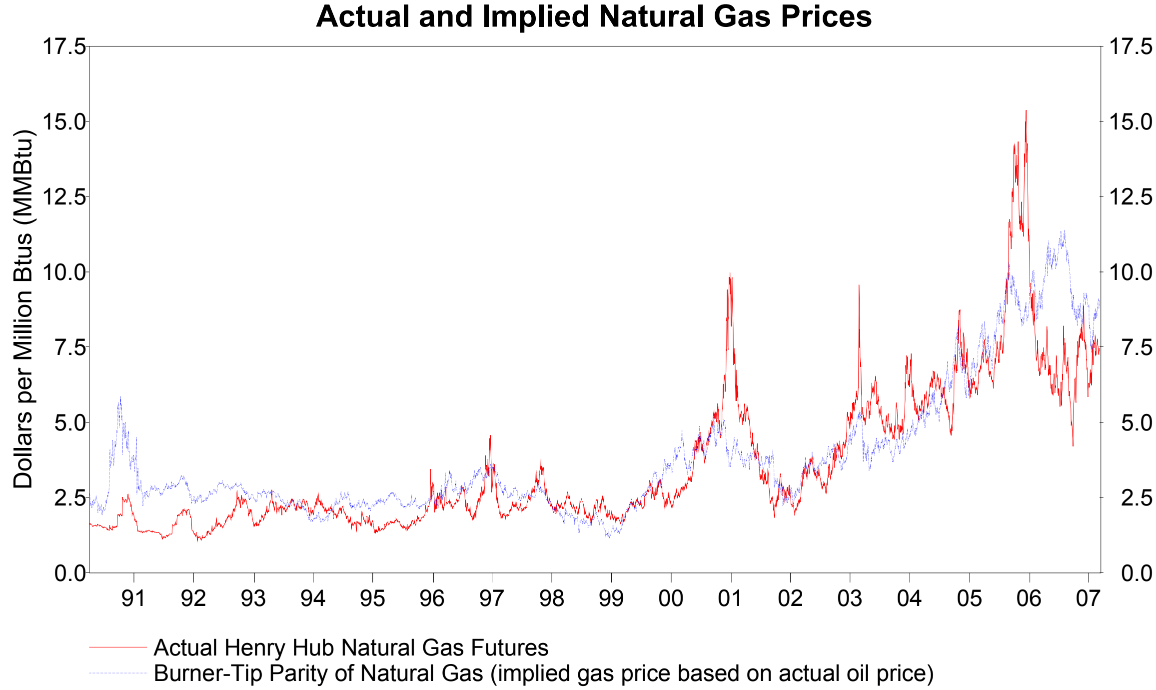
Linear regression analysis, which is a way of statistically confirming a connection between two or more sets of data, reveals that natural gas prices in the U.S. often are often determined by the price of petroleum. The data since 1990 show a positive correlation (R2) of 0.708 between the price of West Texas crude oil and Henry Hub natural gas. In other words, 70.8 percent of the time, the price of natural gas in the U.S. went up or down because the price of oil went up or down. The two prices aren't always so closely linked, however; 29.3 percent of the time, the prices diverge.



"[M]any may wonder whether oil price movements still shape those of natural gas and whether the old rules of thumb for relating natural gas prices to those of crude oil are still useful," posits Stephen P. A. Brown, director of energy economics and microeconomic policy analysis in the Research Department of the Federal Reserve Bank of Dallas. Over the past decade, for instance, the number of electric generating plants able to switch between natural gas and fuel oil has declined, and natural gas prices have seemingly become more independent of oil prices.

Refining the raw data, Brown finds that the connection between oil and natural gas prices become especially close when based "burner-tip parity" in which transportation costs are included. Natural gas costs more to transport than does fuel oil. Seasonality also plays a role in that the amount of natural gas in underground storage varies with weather conditions. After adjusting for these and other factors, Brown concludes that U.S. natural gas prices track those of WTI [West Texas Intermediate oil at

Cushing, Oklahoma] quite well and U.S. natural gas prices continue to be related to those for crude oil. (Brown, 2005)

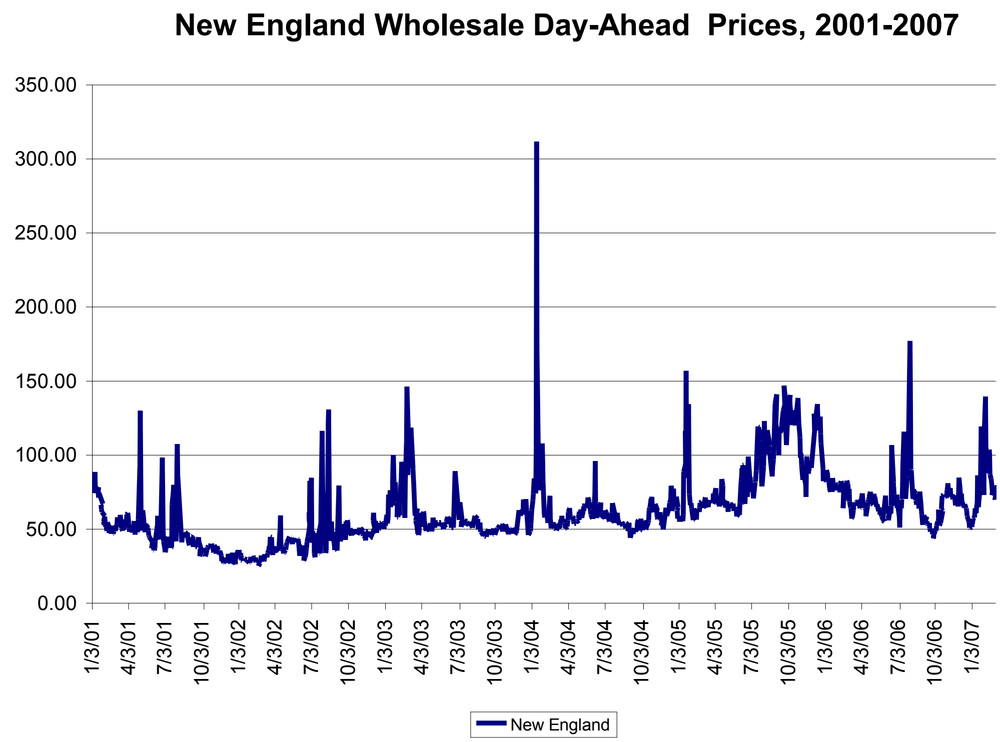


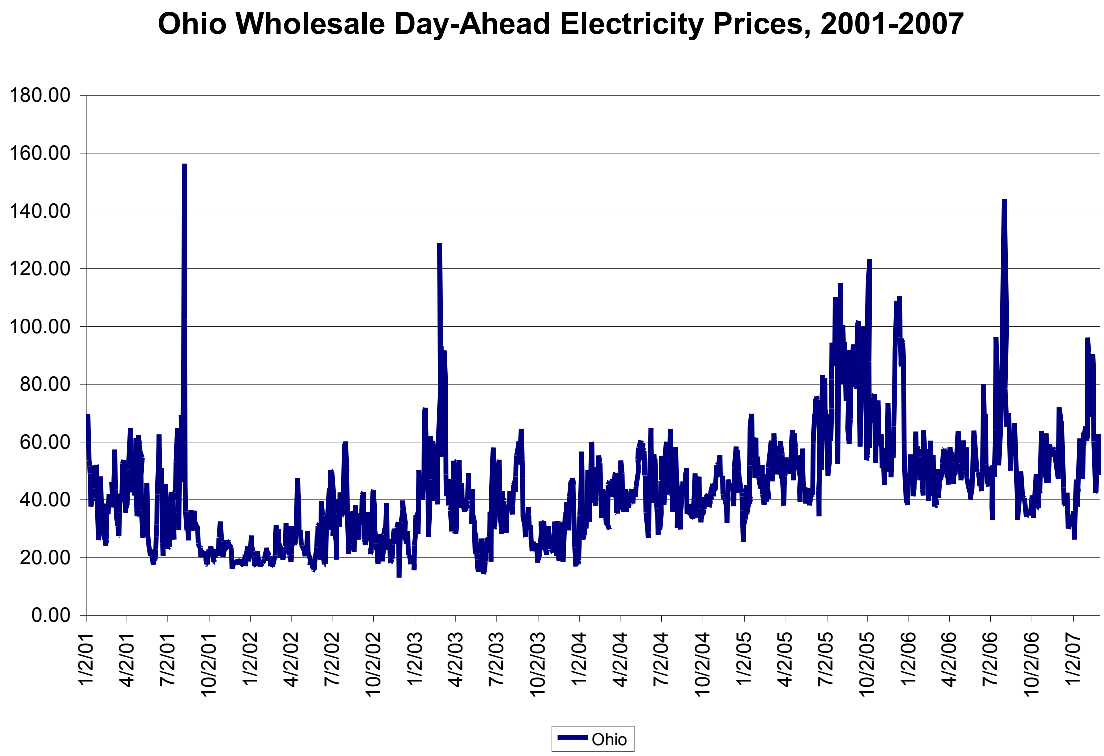
Another examination of the econometric relationship between the Henry Hub natural gas price and the West Texas Intermediate (WTI) crude oil price aims to capture the relative demand and supply effects over the period 1989-2005. The dynamics of the relationship suggest a 1-month temporary shock to the WTI of 20 percent has a 5-percent contemporaneous impact on natural gas prices, but is dissipated to 2 percent in 2 months. A permanent shock of 20 percent in the WTI leads to a 16 percent increase in the Henry Hub price 1 year out all else equal. (Villar, 2006) Once again, the data indicate a positive correlation between the price of oil and the price of natural gas in the U.S.

What's more, the development of a "world market" for natural gas likely would reinforce the linkages between natural gas and crude oil prices (Villar, 2006). Consider that natural gas and crude oil markets are already linked via liquefied natural gas (LNG), which permits the transoceanic delivery of natural gas from remote gas-producing countries to large gas-consuming areas such as the lower 48 states. LNG imports to the lower 48 states may affect the relative economics of crude oil and natural gas to the extent that natural gas consumption occurs at the margin. Most LNG contracts are indexed on oil prices, directly linking natural gas and crude oil prices (Foss, 2005). While most of these indexed contracts occur primarily in the Pacific Basin, short-term markets for LNG are developing on either side of the Atlantic Basin in the United States and Spain, facilitating interregional gas price competition between the United States and Europe (Jensen, 2003). The EIA expects total LNG imports to increase from their 2006 level of 580 bcf to 770 bcf in 2007. LNG import projections remain strong for 2008 as well, expanding by 39 percent and eclipsing the 1 trillion-cubic-foot mark. (EIA, March 2007b)

Appendix B: Wholesale Day-Ahead Prices at Selected Hubs

The following charts provide a historic overview of the costs of meeting peak load demand in assorted parts of the country – specifically, California, Texas, Ohio, and New England. As the charts illustrate, peak power is a highly volatile market, and if electric companies are caught short or unawares, the pricetag can be enormous.




Ohio Wholesale Day-Ahead Electricity Prices, 2001-2007
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
1/2/01
4/2/01
7/2/01
10/2/01
1/2/02
4/2/02
7/2/02
10/2/02
1/2/03
4/2/03
7/2/03
10/2/03
1/2/04
4/2/04
7/2/04
10/2/04
1/2/05
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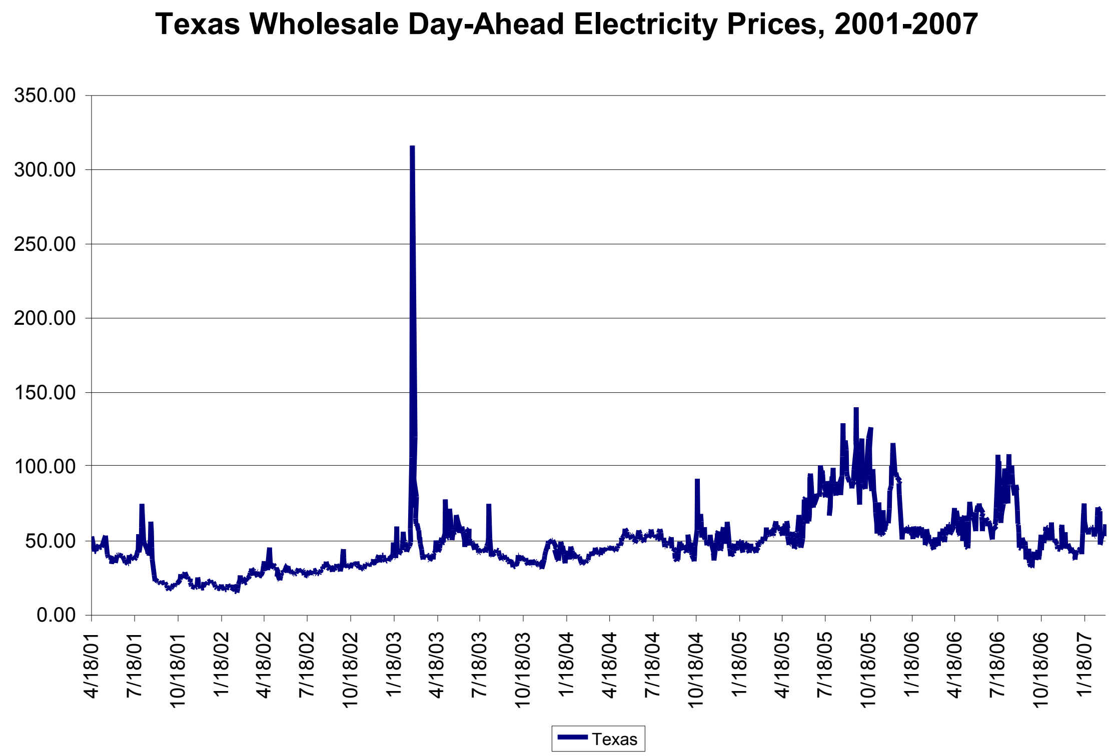
10/2/06
1/2/07
Ohio


Texas Wholesale Day-Ahead Electricity Prices, 2001-2007
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
4/18/01
7/18/01
10/18/01
1/18/02
4/18/02
7/18/02
10/18/02
1/18/03
4/18/03
7/18/03
10/18/03
1/18/04
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1/18/05
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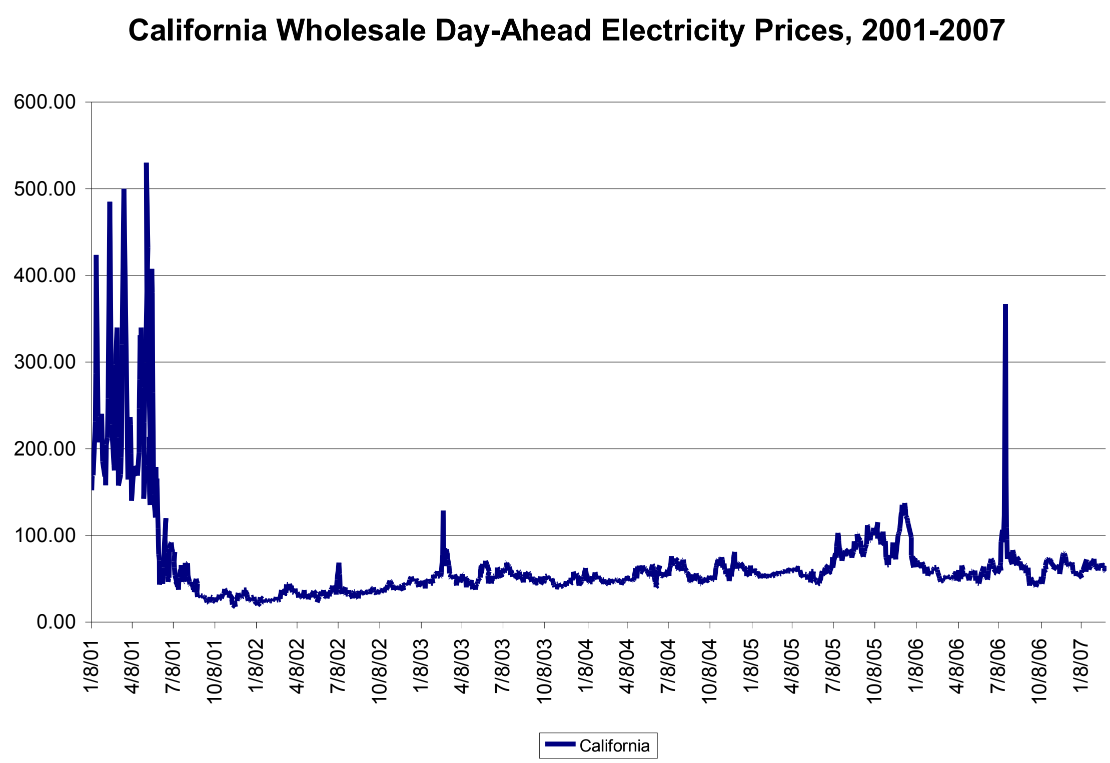
10/18/06
1/18/07
Texas


California Wholesale Day-Ahead Electricity Prices, 2001-2007
600.00
500.00
400.00
300.00
200.00
100.00
0.00
1/8/01
4/8/01
7/8/01
10/8/01
1/8/02
4/8/02
7/8/02
10/8/02
1/8/03
4/8/03
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