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Cost, Conflict and Climate: U.S. Challenges in the World Oil Market

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Cost, Conflict and Climate: U.S. Challenges in the World Oil Market

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Abstract: Dramatic increases in the price of crude oil during the last half of 2007 have ratcheted up attention on energy policy, but cost is only one of the three oil challenges that confront the U.S. This short essay discusses the recent increases in oil prices and attempts to clarify how the challenge from high oil costs interacts with, but is distinct from, the geopolitical and climate change challenges that oil use also creates. Central to addressing these challenges successfully is recognizing that policy responses need to be evaluated in the context of the worldwide oil market.

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Interest in energy policy surged in 2007 as evidence of disruptive anthropogenic climate change accelerated and concern over conflict in oil-producing areas grew. For the average American, however, the most attention-grabbing factor was the high cost of gasoline. The price spikes in fall 2007—at a time of the year when consumers have come to expect declines—were driven by oil prices that hit near-record levels in November, even after adjusting for inflation. High gasoline prices will almost certainly keep oil in the policy debate during 2008.

For that debate to be useful, however, it is critical to understand U.S. oil consumption and production in the context of the worldwide oil market and to recognize the distinctions and relationships among the three challenges that U.S. oil consumption presents: the economic impact of high oil prices, the geopolitical effects of large wealth transfers to some oil-producing countries, and the contribution to global climate change caused by burning oil and its refined products. These are often treated as a single issue in the policy debate and media coverage, but they are in fact quite distinct. Addressing any one of these challenges can help or hinder progress on the others.

Recent Oil Price Movements

As figure 1 shows, the price of oil started 2007 around $60 per barrel and stayed in that range into the middle of the year. By late summer, however, it was climbing and continued to do so until it peaked at nearly $100 in early November. It ended the year at just below $96.[2] Adjusted for inflation, this is very close to the previous historical peak in oil prices that occurred in 1981.[3]

The movements in 2007 continue an important trend that began in 2003. For the previous 20 years—since the beginning of oil futures trading on the New York Mercantile Exchange (NYMEX)—long-dated futures had traded very close to $20 per barrel, even as near-term contracts fluctuated as high as $40 and as low as $10 per barrel. Adjusted for inflation, long-dated futures declined gradually. Figure 2 shows the futures curve for

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[2] The "front month" crude contract on the New York Mercantile Exchange shown in figure 1 is the price for delivery of oil about five weeks later on average. It is the price most commonly referred to as the "spot price" of oil.

[3] The prices are not exactly comparable, because no futures market for oil existed in 1981. The price that is generally used for the 1981 calculation is from a survey of bilateral spot oil transactions and is for more immediate delivery than the front month crude contract on the NYMEX.

NYMEX light sweet crude contracts at annual intervals since 1990 (all in November 2007 dollars).[4]

Figure 2 demonstrates that while the high spot price in late 2007 is notable, even more remarkable is the change in the market's long-run pricing of oil. Short-term spot oil price fluctuations generally reflect transitory supply gluts or production constraints, but long-run pricing signals the overall market view of the longer-run resource scarcity. From 1983 to 2003, the market's long-run view of oil prices declined slightly in real terms, but that view has changed completely since 2003.

In recent years, oil price increases have frequently been discussed as a weak-dollar phenomenon, but that appears to be a relatively small part of the story. Figure 3 tracks the price of the NYMEX contract for 3-year-out delivery in terms of U.S. dollars, euros, British pounds and Japanese yen since the recent climb began in 2003. It shows that the long-term increase has been greatest in the dollar, but it has been quite substantial in all major hard currencies. In 2007, the dollar lost about 10% of its value against these other major currencies, while the dollar-denominated price of crude oil increased about 50%.

Most U.S. consumers feel the oil price increases most immediately at the gas pump. The price of gasoline has been rising in real terms since 1999, which was when inflation-adjusted gas prices hit their lowest level in history. Figure 4 shows real retail gasoline prices since 1990. The rising price of gasoline is attributable in part to oil prices—every $1 per barrel increase in crude prices translates to approximately an additional 2.5¢ per gallon at the pump.[5]

Beyond oil prices, the price of gasoline has also been driven up by rising refinery margins. The oil shocks of the 1970s drastically reduced the growth in gasoline demand relative to expectations at the time and left the oil industry with a great deal of excess refining capacity. No new refineries have been built in the U.S. since the 1970s, but demand has grown, so by the beginning of this decade the capacity overhang had mostly disappeared.

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[4] The futures curves shown in dashed lines in figure 2 present the price for delivery of oil at various dates in the future as of the date associated with the left endpoint of each curve.

[5] This relationship is widely understood in the industry, but is frequently confused in the media when reports compare percentage changes in the price of oil to percentage changes in the price of gasoline. As a share of the total gasoline cost, the cost of the oil that goes into making a gallon of gasoline varies widely with fluctuations in the price of oil and in refining margins, so there is not a consistent relationship between percentage changes in the price of oil and gasoline.

Mergers in the industry also created at least some pockets of market power, though it is difficult to say how much impact this has had on refining margins.[6] Around 2000, demand started straining domestic refining capacity at some times of the year. The result has been higher and more volatile refinery margins. Figure 5 shows the inflation-adjusted "crack spread", the difference between the (front month contract) price per gallon of crude oil and gasoline on the NYMEX—the most common measure of refining margins—since a gasoline contract began trading in 1985.[7] Refinery capacity constraints, which are particularly salient in the spring and summer, are reflected in larger refinery margins.

The Effects of Oil Price Changes on Consumers

The full effect of an oil price shock extends well beyond the pump, of course. Only 45% of refined oil product used in the U.S. is motor gasoline. Figure 6 shows the variety of oil uses in the U.S. and their shares. In all, the U.S. uses about 21 million barrels of oil (and imported refined oil products) per day or 7.6 billion barrels per year.[8] Over the medium to long run, virtually all of the cost of that oil must be paid directly or indirectly by consumers.[9] That means that oil at $80 per barrel costs U.S. consumers over $450 billion per year more than oil at $20 per barrel, or somewhat more than $1500 per person annually.

Oil is also produced in the U.S. In 2007, the quantity was equal to slightly less than one-third of the U.S. quantity consumed. This shortfall of production in the U.S. is frequently presented as the primary energy challenge the country faces, particularly by advocates of expanded exploration and drilling in the U.S. In reality, expanded production in the U.S. would have only a very modest effect on the price of petroleum products. Oil is bought and sold in a worldwide market, and prices are set based on the balance of worldwide supply

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[6] See Borenstein, Bushnell and Lewis (2004).

[7] In 2006, the NYMEX switched over from trading a contract for gasoline futures to a contract for "RBOB," the gasoline component that is blended with ethanol (on average about 95% RBOB, 5% ethanol) to make the gasoline product that is now most commonly sold in the U.S. Figure 5 reflects the changeover in contract type.

[8] U.S. consumption is almost one-quarter of the 86 million barrels per day worldwide total.

[9] That is, intermediate buyers of oil and refined oil products operate in industries that for the most part will earn normal rates of return in the medium to long run. Thus, increases or decreases in the price of oil are unlikely to be absorbed by those firms.

and worldwide demand. This means that additional production of oil in the United States has effectively no more benefit to U.S. consumers than production in any other part of the world that has sufficient geopolitical stability to deliver reliable supply. It also means that any increment to supply must be seen in comparison to the world oil market in order to evaluate its effect on prices. Drilling in the Arctic National Wildlife Refuge in Alaska, for instance, would most likely deliver about 1 million barrels per day to what would likely be about a 100 million barrel per day oil market by the time that oil came online. That 1% increase in oil supply would have a very modest effect on world oil prices. The fact that it would expand oil production in the U.S. by more than 15% is entirely irrelevant for evaluating its impact on prices to consumers.

To some extent, the wealth created by oil production in the U.S. offsets the impact on consumers from higher oil prices. This occurs through two different mechanisms: oil company profits and royalty or tax payments to federal and state government and private land owners. Nearly all of the incremental income from oil production in the U.S. falls into one of these categories. Payments to government are recirculated to consumers through either lower taxes or increased government services. The distributional effect will depend on the exact disposition of the revenues.

U.S. oil company profits are more complicated. The revenue returned to U.S. consumers could be greater or less than the incremental income from oil production inside the U.S. "U.S. oil companies" also operate outside of the United States; their incremental profits when oil prices rise come from both U.S. and non-U.S. production. On the other hand, non-U.S. oil companies are also engaged in production on U.S. land. BP is the second largest oil producer in Alaska. This discussion, of course, raises the question of what a "U.S." oil company actually is. Put differently, who owns each oil company? For the purpose of this analysis, one would like to know the share of marginal oil company profits that are distributed to U.S. citizens. Without that information, which is not publicly available, it is difficult to estimate the amount of oil company incremental profits that are distributed to U.S. consumers. Nonetheless, with more than two-thirds of oil for U.S. consumption coming from outside the country—and worldwide production of U.S.-headquartered companies well below half of U.S. consumption—the net negative wealth effect in the U.S. of an oil price increase is substantial. Perhaps equally important, the redistribution of oil company profits almost certainly has a highly regressive effect on income distribution.[10]

Beyond these direct effects of oil price increases, there are also macroeconomic concerns about the process of economic adjustment. Oil price shocks are associated with nearly all of the economic downturns that have occurred in the United States since 1970. Unfortunately, although there has been extensive study of this relationship, the impact of the most recent run-up is unlikely to be predictable from the experience of the previous 30 years. The major oil shocks of the 1970s occurred at a time when gasoline prices were regulated and oil made up a much larger share of the economy. At that time, the federal government responded to international oil market disruptions by imposing regulations that significantly worsened the macroeconomic impact. Likewise, the share of household expenditures on gasoline and other petroleum products has declined substantially over the last three decades. Perhaps most importantly, prior to the last few years, the experience with oil price shocks has been primarily from supply side disruptions, while the current increase is probably driven primarily by strong demand. A less-regulated gasoline market, a more flexible economy in which petroleum products play a smaller role, and an oil price shock occuring primarily due to strong demand seems likely to result in less pressure towards macroeconomic decline.

International Wealth Transfers and Geopolitics

The international wealth transfers from oil price changes also have geopolitical impact. While some confused observers cite figures about the geographic source of the oil that is consumed in the U.S., the worldwide integration of the oil industry means that all oil demand pushes up the price of all the world's oil and benefits all sellers of oil. It doesn't matter how much oil the U.S. buys from the Middle East or Venezuela, only how much oil it buys from the world market (including domestic production).

The increase in world oil prices strengthens the economic hands of oil exporters, including some that are vocally antagonistic to U.S. interests. Oil at $80 per barrel means that Iran is earning at least $40 billion more per year from its oil exports than it would be earning if the price were $20 per barrel. Financing Hamas and Hezbollah to the tune of hundreds of millions of dollars per year—or investing in the technology to build nuclear weapons—would be barely noticeable in the Iranian government accounts compared to the effect of

[10] Within the U.S., it is almost certainly the case that the income elasticity of oil consumption is well below one and the income elasticity of overall equity ownership is well above one.

these oil price movements.

One might think that such a significant transfer away from U.S. consumers and towards unfriendly and repressive governments (and only occasionally their populations)—combined with the high cost of the oil-related war in Iraq—would inspire policies aimed at reducing use of oil in the U.S., but there has been little movement in that direction. The view of many American consumers seems to be more aptly captured by the bumper sticker that asks "*What's our oil doing underneath their country?*".

More generally, high oil prices and large import quantities contribute to international trade deficits. The trade deficit weakens the U.S. currency and means the U.S. must either borrow back those funds or sell assets. Both have been occuring, leading to the somewhat inconsistent position that exporters of oil (as well as other goods and services) should continue to sell to the U.S., but should not use the revenues from those sales to purchase U.S. banks, ports, oil companies, or other valuable assets.

Oil Consumption and Greenhouse Gases

In 2007, environmental issues, particularly concerns about climate change, took on a much higher profile. Unfortunately, energy policy discussions often fail to distinguish between geopolitical and climate change concerns. The coal industry sometimes compounds such confusion by touting its product as a solution to the U.S. energy problem. Much greater use of coal could indeed reduce our use of oil through a coal-to-liquids technology that produces a gasoline-equivalent product. That technology is economic at current oil prices. It is, however, no solution at all to the climate change challenge, and would in fact exacerbate the problem. "Clean coal" technologies may someday allow a gasoline-equivalent product to be produced from coal without the process emitting greenhouse gases, but that carbon sequestration technology is not close to commercial at this point. Even if it were, the liquid fuel would still be burned in an internal combustion engine and would emit CO_2 from the tailpipe in the same quantities as occurs today from the use of gasoline. Coal-to-liquids is probably the most important example of conflict among policies that address the three different energy challenges.

Ultimately, addressing the effect of oil consumption on climate change will require much greater use of non-fossil fuels for transportation. Two broad technologies are most frequently considered for the medium run of 10-20 years: biofuels and electric vehicles.

The dominant biofuel in the U.S. is corn-based ethanol. Over 95% of transportation energy is supplied by oil in the United States, with nearly all of the remainder coming from corn-based ethanol. Unfortunately, due to the energy intensive production process, corn-based ethanol likely reduces greenhouse gases by no more than 20% compared to gasoline, and may actually increase GhGs when the full life-cycle impact is considered.[11] Corn ethanol does significantly reduce oil consumption, most likely by about 80%, but the coal and natural gas sourced energy that goes into ethanol production offset the GhG reduction. Ethanol can be produced from other plant feedstocks, some of which don't displace arable land use as corn and other food-based feedstocks do, but these all remain very expensive as of today. Ethanol also has the problem of being more corrosive and more prone to absorb water than refined oil products, so more costly to transport and use. Currently, domestically produced ethanol receives a tax credit of 52 cents per gallon in the U.S. and is protected from import competition by a large tariff on ethanol coming from most other countries. Hydrocarbons that are much more similar to conventional oil can also be produced through biologic processes. One of the most exciting is as a by-product of algae growth that consumes CO_2 in a process that can be slightly carbon negative. Unfortunately, cost again remains a significant barrier at present.

Electric vehicles are considered by most observers to be a less likely alternative transportation paradigm over the next two decades, but not out of the running. If electricity for these vehicles were produced from conventional fossil fuels, some GhG reduction would still occur, but it would be limited. With power from wind, solar, geothermal, nuclear or other zero-GhG generation, the gains would be much larger. With all costs considered, these sources are more expensive than coal and natural gas and would remain so for at least many years even with a moderately high GhG tax or tradeable permit cost of, for instance, $50/ton.[12] Figure 11 shows that the only non-fossil fuels with significant market share in electricity are nuclear and hydroelectric power. The other alternatives amount to only a tiny share of U.S. electricity generation. And federal support for research to

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[11] See Farrell et. al. (2006).

[12] The statement is disputed by many nuclear power advocates. Nuclear power, however, continues to face significant safety, security, and waste disposal issues. Without government protection from insurance liability, few people argue that it would be economically viable. The rosy scenarios for nuclear power costs that are frequently cited by nuclear power advocates ignore both this liability protection and the real cost of nuclear waste disposal, including the cost of compensating neighboring communities around such a disposal site.

improve these technologies has been stagnant since 2001, just as the need for technological improvements in these areas has become more apparent and pressing.

Still, these sources for producing electricity will not contribute to reducing greenhouse gases from transportation until an efficient, low cost, electric storage technology for mobile usage is created. Right now, researchers are working on this battery problem, but progress has been dishearteningly slow. Storage remains less space-efficient, more-expensive, and shorter-lived than it needs to be for electric vehicles to be cost competitive. With the most recent technology, lithium ion, safety concerns have emerged as a result of batteries that have caught fire.

Productive policy debate is frequently undermined by references to hydrogen as a new transportation energy source. Hydrogen is an energy storage technology, not a new source of energy. It has to be produced through some other energy consuming process; right now the most cost effective process involves burning coal or natural gas, hardly a solution to the greenhouse gas challenge. Scientific observers generally view hydrogen transportation fuel as 20+ years from viability, and even then the energy source for producing hydrogen will remain a question.

Addressing Oil Challenges in the Context of the World Market

Americans can and should respond to these challenges, but it is important to understand the potential impact of these responses in the context of the world oil market. The policies generally proposed to address oil issues—*e.g.,* increasing fuel economy of automobiles, opening more domestic land for oil exploration, or replacing 10% of gasoline in the U.S. with biofuels—if carried out only in the U.S. would have fairly modest effects on the world market and, in particular, on the world price of oil.

Increasing U.S. fuel economy by 40%, from 25 to 35 miles per gallon, if it caused no increase in total miles driven, would lower oil consumption by about 3.6 million barrels per day, about 17% of today's U.S. oil consumption. While that would create substantial direct savings, such a gradual reduction over more than two decades—the change that is implied by the provisions in the 2007 energy bill once one accounts for the fact that U.S. automobile fleet turnover is under 8% per year—would have a small, possibly unnoticable, effect on the world oil price.[13] The reduction would be less than the growth in world demand between 2003 and 2005. By 2020, this would likely be less than 3% of daily demand. Replacing 10% of U.S. gasoline with biofuels would have a still smaller impact on price, and would not offer the direct financial savings that would result from improved fuel economy. There are many pros and cons in the debate over these policies, but claims that they will significantly alter the world oil market are not well founded.

The same is true of domestic exploration for oil. Even the most optimistic forecasts of expanded U.S. oil drilling suggest production increases of about the same magnitude as the oil savings from improved auto mileage over a decade-plus time frame. Increased domestic production raises issues of the tradeoff of environmental damage at the production site versus the value of the oil, as well as the size of the wealth gains to Americans through increased corporate profits and government revenues. One can debate those questions, but it is extremely unlikely that the contribution of increased domestic oil production to the world supply would have an identifiable effect on the prices of refined petroleum products in the U.S.

This is not to suggest that the demand side of the world oil market or supply from non-OPEC countries has no effect on price. Rather, it emphasizes the need to analyze such changes in the context of the entire world market. The global recession in the early 1980s drove down oil demand by 7% worldwide between 1980 and 1983 and probably helped lead to the collapse of oil prices in late 1985. None of the policies currently under consideration in the U.S. today, however, would have even one-tenth as great an impact on world supply-demand balance over a similar three-year period. Such a comparison suggests that without multinational coordination in demand reduction (preferably not coordination through widespread macroeconomic decline) or much more significant unilateral changes by the United States, the impacts on the price of oil and the wealth transfers to producing nations will be quite modest.

In the context of the world oil market, it is also clear just how vacuous calls for "energy independence" really are. The U.S. consumes far more oil than it produces, and that will remain the case so long as petroleum products are the basic transportation fuel in the country. But even if demand were reduced dramatically or abundant new supplies

[13] For comparison, it is worth noting that U.S. oil consumption fell by 10% in just the two-year period 1980-1982, driven by a major economic downturn.

were found so that domestic supply and demand were more closely balanced, the U.S. oil market would never be "independent" of the rest of the world. Short of drastic government intervention that no politician or policymaker is likely to propose, oil in the U.S. will sell at the world price of oil and prices of gasoline and other refined products will reflect that oil cost.

A more appropriate and achievable goal is energy security: relying on a diverse set of energy sources and technologies from which supplies can be reliably procured without (a) subjecting the U.S. economy to extreme price volatility; (b) enriching nations that repress their own people and are antagonistic to the U.S.; and (c) producing greenhouse gases at a level that could fundamentally change the climate.

Conclusion

As 2008 begins, energy consumption, and particularly oil consumption, presents three distinct challenges—cost, geopolitics, and greenhouse gases. These issues are likely to remain at the forefront of politics and policy debate. Each threatens the U.S. economy and quality of life in a different way, but all three threats are significant. Understanding the similarities and distinctions between these challenges, and the need to analyze them in the context of the integrated world oil market, will be critical in moving towards a more effective energy policy.

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Data Sources for Figures

Figure 1: NYMEX crude futures

Figure 2: NYMEX crude futures; BLS all urban consumers & all goods price index

Figure 3: NYMEX crude futures; International Monetary Market currency futures

Figure 4: U.S. EIA conventional gasoline prices; BLS all urban consumers & all goods price index

Figure 5: NYMEX crude, unleaded gasoline, and reformulated blendstock (RBOB) futures; BLS all urban consumers & all goods price index

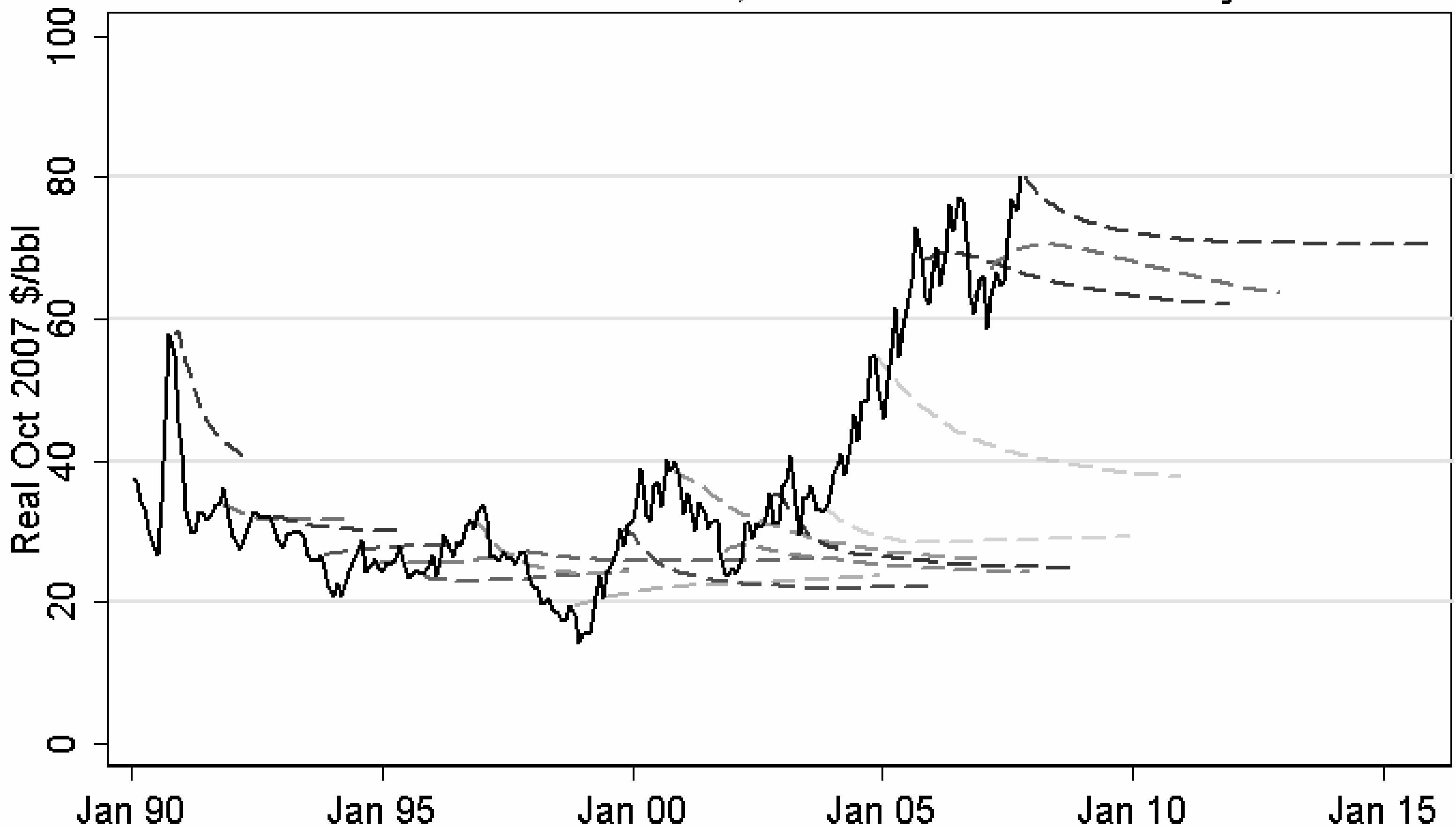
Figure 6: U.S. EIA, 2006 data

Figure 7: U.S. EIA Electric Power Annual Tables 1.1 and 1.1A

Figure 1: NYMEX Front Month Crude Contract

Figure 2: NYMEX Crude Front Month and Forward Curves

Solid line is front month contract; forward curves taken every October



Forward curves inflation-adjusted according to their trade date, not their contract date.

Figure 3: NYMEX Front Month Crude, Various Currencies

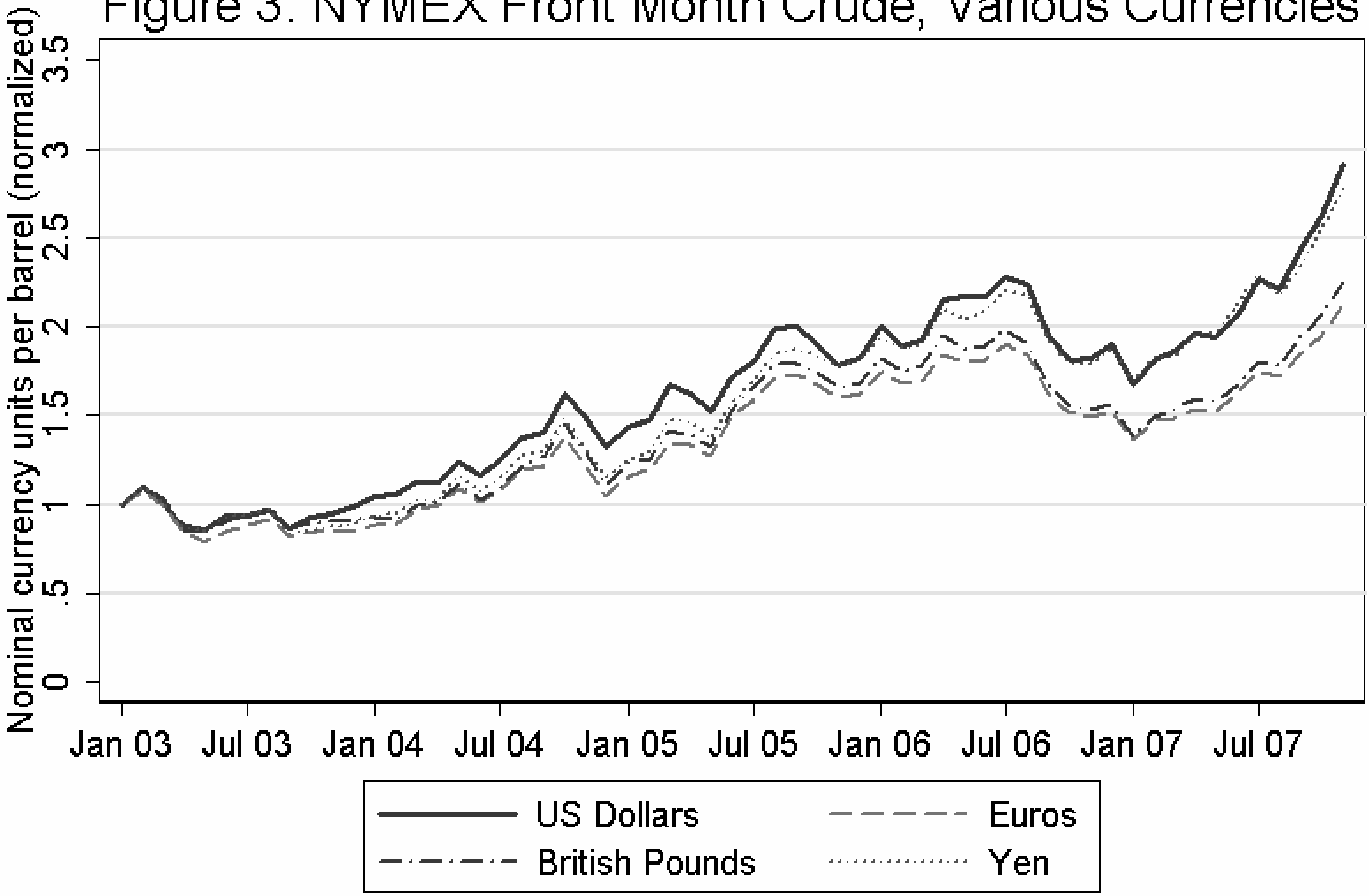


Figure 4: Retail Conventional Gasoline Price

Figure 5: NYMEX Front Month Crack Spreads

Spread is the difference between gasoline and crude oil contracts

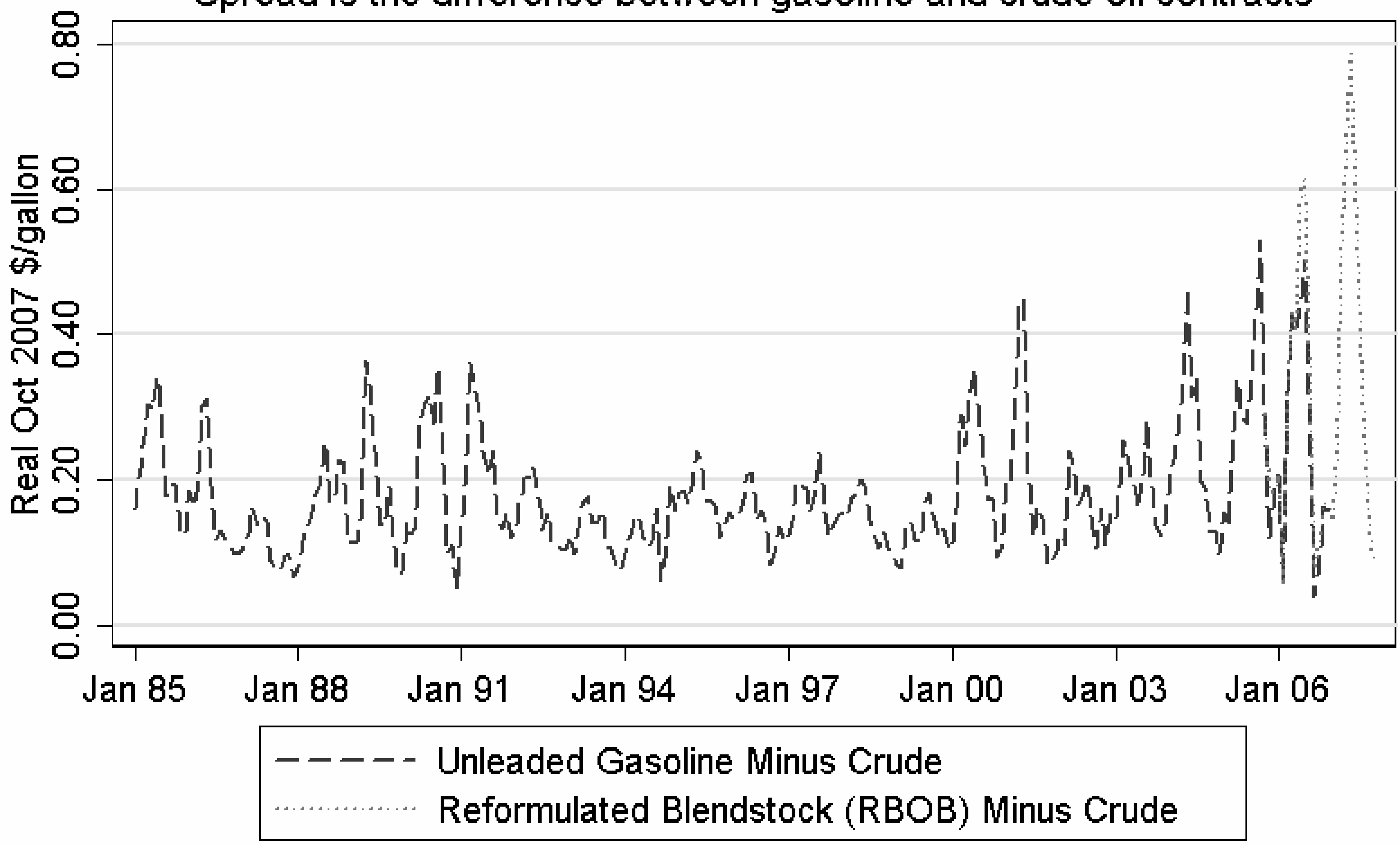


Figure 6: Uses of Crude Oil in the United States

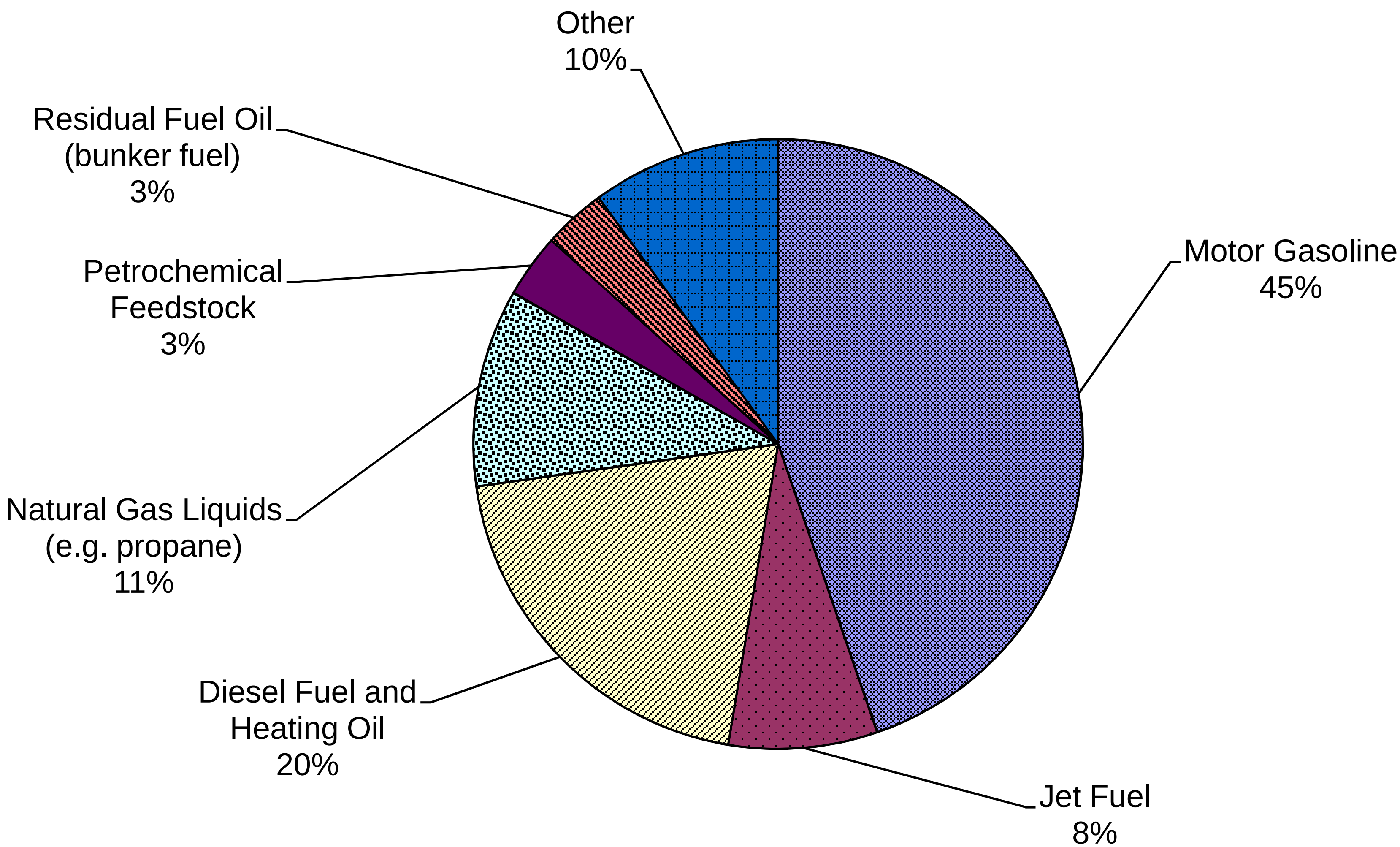


Figure 7: Sources of Electricity Generation in the U.S., 2006