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GAS FAQ: U.S. GASOLINE MARKETS AND U.S. OIL IMPORT DEPENDENCE

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Frequently Asked Questions

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The U.S. Automobile Transportation Market

Q: Is the United States still the largest market in the world for road vehicle use?

Yes, there are about 250 million vehicles on the road in the United States, close to a vehicle for every person in the country. Coupled with the fact that we also drive our cars more than most, this translates into the largest motor fuel use of any country in the world.

Q: Is the number of cars in the United States continuing to rise?

Yes, there were 138 million registered privately owned automobiles and trucks in 1975. By 2005, that number had risen to 247 million. Studies indicate that the growth rate of vehicles *per person* will tend to level off as consumers reach a saturation point, but population growth in the United States continues to hold steady at about 1 percent per year. Thus, the number of motor vehicles in use will continue to grow at a steady rate based on a rising number of potential drivers.

Q: What does the large number of cars in the United States mean in terms of fuel use?

The United States' road petroleum use represents 33 percent of all road petroleum use globally, twice as high in percentage terms as all of Europe, where use represents 17 percent.

Q: Why are we so much more dependent on personal motor vehicles in the United States than the rest of the world?

There are multiple factors that have contributed to this. One factor is that taxes on motor fuels have been significantly lower in the United States than in many other developed countries. This has encouraged the use of personal automobiles versus various modes of public transportation. Low fuel prices have also encouraged the phenomenon of urban sprawl, which, in turn, tends to raise the average number of miles driven and the amount of time we spend in our vehicles relative to other countries, such as Japan and those in Europe. For example, an individual working in a major city may spend up to two hours per day in his/her own vehicle in stop-and-go

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traffic to travel 30 miles to and from work, especially in cities where public transportation options are lacking. The relatively low cost of motor fuel that has persisted in the United States for the past few decades has rendered the cost of private transportation a rather insignificant portion of the average individual's budget.

Q: Why do gasoline prices always seem to rise in the late spring and summer?

This movement in gasoline prices is related to the seasonal nature of gasoline demand. In general, demand in the summer is higher than in other times of the year. In particular, demand for gasoline tends to rise around the summer holidays such as the Memorial Day and Labor Day holidays, and to a lesser extent the Fourth of July, due to increased travel demands of American consumers going on vacation. Existing refinery capacity in the United States is not capable of producing enough gasoline to meet this higher demand. Thus, we must use gasoline that has been stored during times of lower demand and rely on imports to meet the seasonal increase. If demand rises, and inventory is not sufficient or there is difficulty in importing gasoline, then prices can rise especially high, particularly because demand in the short run is fairly unresponsive to changes in price. This has been happening with increasing frequency in the United States over the past few years. Last year, demand peaked in the summer (August) at about 9.7 million barrels per day, and refinery output of gasoline that same month was about 9.2 million barrels per day.

Q: Why have gasoline prices in the United States been steadily rising for the last few years?

The primary reason for the rise in gasoline prices has been the increase in oil prices. Research indicates there is stable long-run price relationship between crude oil and gasoline.¹ In the short term, however, demand and supply factors can cause gasoline prices to rise substantially. Given the shortage of refinery capacity in the United States, these short-run price departures have been growing larger and more frequent. Demand has grown steadily, but there has been little

¹ To learn more about the research on the long-term relationship between crude oil and gasoline prices, please visit the following URL:
http://www.rice.edu/energy/publications/WorkingPapers/Technical_Note_on_Long_Run_Gas_P_rice.pdf

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expansion of domestic production capacity. Thus, we have been increasingly importing gasoline to meet seasonal (summertime) increases in demand. At the same time, growing demand elsewhere in the world means increased competition for gasoline, which in turn drives up the price during high demand periods.

Domestic Production and Refining

Q: Why can't the United States just increase oil production at home?

The United States is the third largest producer of oil in the world behind Saudi Arabia and Russia, having produced 8.3 million barrels per day in 2006, of which 5.3 is crude oil and the remainder natural gas liquids (NGLs), other liquids, ethanol and oxygenates. Expanding U.S. production is difficult due to a combination of geology, economics and policy. Existing conventional oil that is produced in the United States comes from mature regions that have been fairly well-explored and are now experiencing geologically driven production declines. Recently, technology and higher prices have made it profitable to explore in deeper waters in the Gulf of Mexico and new oil reserves are being proved, but the process of exploration and development can take years before oil is actually produced. There are an estimated 800 billion barrels of crude oil locked away in shale deposits in the United States, but extraction is very expensive so companies have only recently started to invest in shale development as prices have risen. Environmentally related policy currently prevents exploration and development in oil-rich areas of the Eastern Gulf of Mexico, the Atlantic and Pacific Outer Continental Shelves, and areas in Alaska – preventing a considerable quantity of oil from being produced (some estimates place it in excess of 85 billion barrels of recoverable oil).

Q: How much could we reduce oil imports by opening the Alaska National Wildlife Reserve (ANWR) for drilling?

The exact amount of oil in the ANWR is uncertain, but geologists at the United States Geologic Survey have estimated that the area contains up to 10.4 billion barrels of economically

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recoverable oil. At a constant rate of potential production of 1 million barrels per day, this equates to roughly 28 years of supply once drilling began.

Q: How much gasoline is produced by oil refineries in the United States? What percentage is that of our domestic gasoline use?

Total refinery production capacity in the United States in 2006 was 17.4 million barrels per day, up from 15.6 million barrels per day in 1990. Thus, although no new refineries have been constructed, expansions at existing facilities have occurred resulting in an increase in capacity of more than 10 percent. These refineries produce not only gasoline (about 46 percent of annual refinery output), but also other petroleum products such as heating oil and other distillates (~25 percent), residual fuel oil (~4 percent), jet fuel (~10 percent) and other products (~15 percent). Production of each fuel is somewhat seasonal, with gasoline production ramping up to prepare for the summer driving season and heating oil output rising as the winter approaches. Currently, refineries in the United States produce an annual average of 8.8 million barrels per day of gasoline with capabilities to increase output somewhat during peak demand periods. In sum, domestic gasoline production is about 95 percent of demand annually.

Q: Shouldn't we be building more oil refineries in the United States? Some oil companies are saying that the U.S. government commitment to ethanol is discouraging them from building new refineries. If this is true, do we need to abandon the ethanol program to make sure we have enough oil refineries?

First, we do not necessarily need to build new refineries in the United States as long as gasoline can be imported without a high probability of interruption. As long as operational global refinery capacity is ample, gasoline prices should not substantially depart from their long-run equilibrium relationship with crude oil prices. However, if security of supply becomes an overriding concern, then expanded domestic production capabilities may be warranted. However, even higher U.S. refinery capability will not prevent the types of disruptions in gasoline supply and resulting price increases that occurred following Hurricanes Katrina and Rita in 2005.

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Regarding the claim by some oil companies that ethanol programs discourage refinery investment, the fact is that ethanol has very little to do with the decision to build a new refinery. The claim is likely part of a lobbying effort and nothing else. Refining is not historically a very profitable business. In fact, through much of the 1990s, refining profit margins were not sufficiently large to generate much interest in the construction of new facilities. However, the less expensive route of expanding capacity at existing facilities did occur, as the phenomenon known as “capacity creep” resulted in more than 1.5 million barrels per day of additional capacity in the last 15 years. If too many new refineries are built, the fear among industry investors is that refining margins would very quickly return to their historical norm, and render the capacity investment unprofitable, especially in light of today’s very high construction costs in the energy industry. Since ethanol is simply replacing the gasoline additive MTBE in the United States as a component in gasoline to produce a cleaner fuel, it is not at this point really competing with gasoline as a commodity product.

Given the rapid growth globally for transportation fuels, refinery capacity has become very highly valued, with existing capacity just barely keeping pace with demand. If demand growth has consistently outpaced projected construction of refinery capacity around the globe for many years, then it is hard to see how investors would likely lose money on the construction of a new domestic refinery. That is why some companies, notably Marathon and ConocoPhillips, are making such investments. While the government has offered locations and hinted at various incentives to encourage refinery construction in the United States, continued capacity creep may still be the preferred avenue for many energy companies simply because it places less capital at risk.

The China Question

Q: China’s road fuel use is growing rapidly. Will the United States have increasingly to compete for fuel with China?

Even though the population of China is four times as large as that of the United States, there are only roughly 13 million vehicles on the road in China today. Accordingly, China’s road

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petroleum use represents only 5 percent of the world total. However, continued strong economic growth will lead to significant increases in the number of motor vehicles and hence motor fuel use in China. China realizes the energy security implications of its growing road fuel use and has recently mandated fuel efficiency standards for various vehicle weight classifications.

Q: Is competition from China the reason why gasoline prices have increased so much in the United States?

No, gasoline prices have risen for a variety of reasons, most notably due to higher oil prices and limited peak U.S. manufacturing capability relative to total demand. China's rapid economic growth and increased oil demand is just one of many factors pushing up the price of oil.

Fuel Efficiency

Q: Have the CAFE standards introduced in the Energy Policy and Conservation Act of 1975 in the United States been effective?

CAFE standards have been phased in since 1978 with the passage of the Energy Policy and Conservation Act of 1975. They called for a standard of 18 miles per gallon (mpg) for passenger cars model year 1978, which was to rise to 27.5 mpg by the mid-1980s. Improvements in fuel efficiency that were realized from the late 1970s through 1990s, catalyzed by mandates and consumer demands for lighter vehicles, have resulted in considerable fuel savings. U.S. gasoline consumption would have been about 33 percent higher than it is now absent those improvements, meaning efficiency has acted as a virtual source of supply.

Q: What are the current CAFE standards?

Current U.S. CAFE standards are aimed to have all new passenger cars get an average of 27.5 mpg and new light trucks (including sport utility vehicles, or SUVs) get an average of 22.2 mpg for model year 2007. The standard for new light trucks has only recently been increased from 20.7 mpg, while the standard for passenger cars has been constant since 1990. Compliance by

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manufacturers is based on a sales-weighted average of all fuel economies in a given manufacturer's fleet of vehicles.

Q: What is the actual fuel efficiency of vehicles on the road, and why does it differ from CAFE standards?

According to the Federal Highway Administration, U.S. on-road efficiency for all motor vehicles is only 17.3 mpg, with passenger cars averaging 22.6 mpg and SUVs, pickups and vans averaging 16.8 mpg. The disparities between the CAFE mandates and the actual on-road efficiencies arise for several reasons. One, CAFE standards apply to new vehicles only, with older vehicles produced under a different set of mandates. It takes, on average, about eight to 10 years before a motor vehicle is retired from use, meaning many older, less fuel-efficient vehicles are still on the road. Secondly, consumer driving habits can create differences between actual fuel efficiency and the EPA reported ("window sticker") fuel efficiency. For example, stop-and-go driving, such as in rush hour traffic, will typically result in much lower fuel efficiency than the "window sticker" indicates. Third, alternative vehicle credits contribute to lower actual on-road fuel efficiency. Car makers receive CAFE credit for manufacturing flexible fuel vehicles, even if that vehicle, once sold, runs primarily on gasoline. Thus, a vehicle's fuel efficiency may be rated well *above* the current CAFE regulation even though its actual on-road efficiency is well *below* the mandated minimum. This means that even though the automaker is technically in compliance with the CAFE mandate, overall realized on-road fuel efficiency will actually be decreased as more flex-fuel vehicles are sold under the current regulation.

Another important fact also concerns SUVs. Lower CAFE standards for SUVs coupled with relatively low gasoline prices through the 1990s resulted in an explosion of SUVs in the on-road vehicle fleet, rising from only 15 percent of all passenger vehicles on the road in 1975 to roughly 40 percent today. This has actually contributed to a slight decline in the overall on-road fuel efficiency for passenger vehicles in the United States.

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Q: How much oil could we save by tightening the existing U.S. CAFE standards?

CAFE standards establish a floor, or minimum, for vehicle fuel efficiency. Raising the floor only affects overall fuel efficiency if auto manufacturers are forced to significantly improve the fuel efficiency of the vehicles they are currently producing. Thus, raising the minimum will only result in an improvement in actual on-road fuel efficiency (which was about 17.3 mpg in 2005) if automakers' fleets are currently near the minimum standard. Moreover, actual on-road fuel efficiency may actually be compromised by an increase in the number of ethanol-fueled vehicles because ethanol yields considerably lower fuel efficiency than gasoline. Ethanol vehicles receive an alternative vehicles credit in the CAFE accounting rules. For example, a flex-fuel suburban that actually gets 12 mpg on ethanol will get counted for the automaker as getting close to 30 mpg, even if the vehicle will be operated using regular gasoline the majority of the time (as is usually the case). So, the automaker will easily meet the CAFE standard, but actual on-road efficiency will decline. Thus, it is unclear how much of an increase in CAFE standards would be required to affect an appreciable increase in on-road efficiency if the ethanol credit program continues unadjusted.

Nevertheless, if we could improve on-road fuel efficiency by 1 additional mpg per vehicle we would save close to 600,000 barrels a day in American oil imports. Additional efficiency gains would save even more oil, but the savings diminish as better mileage performance tends to promote increases in driving distance.

Q: Given the fact that people don't buy a new car every year, how long would it take before higher CAFE standards translate into a higher average U.S. on-road efficiency?

Fuel savings from improved mileage standards is a slow process because vehicle turnover is slow. In fact, one Department of Energy study indicated that 75 percent of all cars remain in circulation at least 10 years. Thus, it would take more than a decade before higher standards fully affected the total U.S. car fleet.

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Q: Can we achieve U.S. energy independence through tighter CAFE standards?

No. U.S. crude oil imports were more than 12 million barrels per day in 2005. Given that we consumed just under this amount in 2005 for road transportation, it would be impossible to raise efficiency enough to eliminate oil imports through car mileage standards alone.

Energy Security

Q: Is achieving U.S. energy independence plausible?

Eliminating 12 million barrels a day of oil imports from our daily lives is not plausible. In fact, talk of energy independence is ridiculous and may not even be a worthwhile goal. For example, if achieving energy independence means relying on very high-cost forms of energy when suitable low-cost sources of supply are available internationally, then economic well-being and consumer welfare could be compromised by favoring self-sufficiency over free trade.

Q: It is often reported that Brazil owes its energy independence to its ethanol program. Is it possible to achieve energy independence in the United States through an aggressive ethanol program?

This is highly unlikely. The amount of motor fuel that would have to be produced to eliminate imports in the United States is considerably higher than what is currently produced. U.S. ethanol production was 316,000 barrels a day in 2006, up from 255,000 barrels a day in 2005. To achieve “overnight” oil independence by replacing gasoline with ethanol, we would need to produce approximately 10 times the amount of biofuels being produced *worldwide* today.

It is important to point out that Brazil did not achieve energy independence through its ethanol program alone. Brazil engaged in an aggressive offshore oil exploration campaign that raised Brazil’s domestic oil production from 650,000 barrels a day in 1990 to 2 million barrels a day currently. Brazil’s ethanol production has only increased from 232,500 in 1990 to 313,000 barrels a day currently.

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Q: What about the president's more modest goal of lessening oil demand by 20 percent by 2017? Is it feasible to produce enough ethanol to meet this target?

Reducing oil demand by 20 percent in 2017 is a daunting task, especially considering both population growth and economic growth will influence an increase in demand between now and then, and considering the fact that oil is consumed for reasons other than to produce transportation fuel. To simplify matters let's consider measures to keep demand in the transportation sector in 2017 equal to demand in 2005. This reduces the projected demand for oil in transportation in 2017 by about 17 percent. This is less aggressive, but may still prove difficult. For example, to utilize ethanol as a means to keep gasoline consumption from rising any further between now and 2017, we would need an additional 1.9 million barrels a day of ethanol, more than seven times higher than current U.S. production and an increase of 16 percent per year for the next 10 years. While the increase in ethanol production exceeded this amount last year, continuing to grow at this pace is likely to be a challenge. In fact, current levels of production of ethanol have already led to increases in corn-based food prices and analysts worry that in drought conditions, the unintended consequences of ethanol production on food costs could be even more severe. Moreover, the environmental impact of increased fertilization and irrigation are under study, with many groups claiming that the consequences for ecosystems along the Mississippi River and in the Gulf of Mexico could be drastic. Interestingly, the strongest lobby for the move to ethanol has been backed by food industry giant Archer Daniels Midland (ADM) which currently controls 24 percent of the current ethanol sales in the United States.

Q: What about reaching a 20 percent reduction via CAFE?

Even to hold U.S. gasoline use at 2005 levels by 2017 through car mileage standards, *on-road* vehicle efficiency must reach 22 mpg, or about 25 percent higher than what is currently the case. For this to occur over the next 12 years, given the efficiency of the cars on the road today and the time it takes for older cars to be retired from service, *new* cars will have to average considerably higher fuel efficiency than what is currently observed. How high depends upon the rate of diffusion of new vehicles (or, alternatively, the rate at which older vehicles are removed from the total vehicle stock). For example, if we could replace 20 percent of the cars on the road in the

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next 10 years, all *new* vehicles sold between now and then would have to average an efficiency of 42 mpg. However, if consumers were to accelerate the replacement of vehicles so that we could replace 50 percent of all cars on the road by 2017 (approaching rates seen in the late 1970s to early 1980s), the average on-road efficiency of all new cars sold would have to be 26.5 mpg. The latter case may seem more achievable in terms of the efficiency of cars currently available, but such an improvement requires considerable capital commitment from consumers (because large number of Americans would have to replace their older cars with new ones). In addition, such an efficiency gain represents an improvement of about 50 percent over current on-road efficiency.

Q: What about reaching a 20 percent reduction through conservation?

Again, let's consider the case of simply holding U.S. gasoline use at 2005 levels by 2017. To do this through conservation, each of us would have to drive about 45 miles less per vehicle per week by 2017. For many Americans, that could be one day a week commuting in carpool or by public transportation.

Carbon Emissions

Q: Some U.S. states are passing legislation to limit carbon emissions, including from the transportation sector. How much carbon emissions can we save by improving the efficiency of the U.S. automotive fleet?

It is hard to reduce national carbon emissions to the scales indicated necessary by the United Nations Intergovernmental Panel on Climate Change (IPCC) via car efficiency alone. For example, if we doubled on-road vehicle efficiency to just over 35 mpg by 2030, that would reduce U.S. transportation oil use by 1.6 million barrels per day and reduce carbon emissions from 542 million metric tons to 442 million metric tons in 2030. But globally, it has been estimated that we would need to eliminate the equivalent of 200 million barrels of oil per day to stabilize CO₂ in the atmosphere at 550 parts per million by 2050. Achieving this IPCC mark will take a coordinated effort by all countries in all energy-consuming sectors.

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Q: How about increasing the use of ethanol? Would that help limit carbon emissions more than gasoline?

There is disagreement as to the CO₂ savings implied by moving to ethanol. For example, the process of harvesting and processing crops into ethanol is fuel intensive, and must be considered when calculating the carbon intensity of the fuel source. However, one offsetting factor is that the crops themselves can act as a sink since plants use CO₂. To complicate the matter even more, if we wish to make an accurate comparison between ethanol and gasoline, the carbon intensity of gasoline production must also consider the carbon emissions all the way through the supply chain back to the wellhead. This can be fairly substantial because mining is a very energy-intensive industry.

Alternative Energy Sources

Q: Nuclear power and wind power are carbon-emission-free sources of energy. Are they the solution to our oil import dependence?

Reducing oil import dependence is not likely to happen through the electric power sector because very little of our nation's electricity comes from oil-fired generation. Nuclear and wind power could, however, be part of a broader solution to our oil import dependence if the transportation sector moved to using more battery electricity than liquid fuel. One such avenue that has been proposed is through the adoption of the "plug-in" hybrid motor vehicle.

Q: Are plug-in hybrid electric vehicles a viable option, and could they help reduce our oil dependence?

The plug-in hybrid seems to be a very attractive option when the cost of utilization is considered. These vehicles would allow most short distance driving to be achieved through the use of only a battery. The cost to charge a battery up to 35 kilowatt hours at an average retail price of 9.45 cents per kWh (which was the average price to residential consumers in the United States in 2005) is \$3.31. Such a charge would give a range of up to 150 miles, rendering a cost of 2.2

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cents per mile. This is far better than the cost per mile for the average gasoline-fueled internal combustion engine of 17 cents per mile (a \$3 per gallon equivalent at 17.3 miles per gallon). In fact, in order to get the cost per mile up to a \$3 per gallon gasoline equivalent, the retail price of electricity must be more than 50 cents per kWh, which is considerably higher than current prices of 9.5 cents per kWh.

Of course, moving to a transportation sector that is more dependent on electricity would drive up electricity demand, which could increase our dependence on imported natural gas while reducing our oil import dependence. But, if clean coal, nuclear, solar and wind energy were a part of this approach, the oil savings could be achieved without the offsetting increase in dependence on imported natural gas.

Q: China has been building facilities that can make transportation fuel out of coal. The United States has the largest coal reserves of any country in the world. Why aren't we doing that?

Coal-to-liquids (CTL) technology is not new, but it has evolved. CTL was used heavily by the Germans in World War II and by South Africa during apartheid. The United States has 27 percent of the world's proven coal reserves, which dwarfs the largest holder of oil reserves (Saudi Arabia at 12 percent) relative to world oil. Thus, the United States is well-suited to utilize CTL as a means of achieving energy independence. However, both environmental and economic factors inhibit wide-scale adoption.

On the environmental side, coal mining and processing raise many concerns, in particular CO₂ sequestration. If environmental factors are to be considered, then either coal will be off-limits because of its carbon intensity, or sequestration technologies must be used, which can raise the cost of CTL. Economically, oil prices must remain, by some accounts, above \$45 per barrel in the long run for CTL to be economically competitive. This is a sticking point. For example, if the United States adopted CTL, or some combination of CTL and other alternatives in a wide-scale fashion, the global crude oil supply-demand balance could significantly shift. In particular, if the United States reduced its oil use by enough, world oil prices would fall. Finding the right balance

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of CTL, alternatives, and imports is important to maintaining the competitiveness of those in the energy supply industries.

On Capitol Hill, there is currently debate about the scale to which CTL may expand in the coming years. Lawmakers in favor of CTL are seeking tax credits and loan guarantees for the development of CTL facilities.

Reality

Q: Given these facts, what is the best of the proposed policy options?

Unfortunately, the reality is that no single solution will lead to a *decrease* in U.S. gasoline consumption or achieve U.S. energy independence. The problem of U.S. oil import dependence is a complicated one to solve. It is going to take a portfolio of policies aimed at improving efficiency, encouraging alternative fuels, promoting public transportation, etc., to curb gasoline use in the United States. It may also require changes in lifestyle and perhaps, depending on circumstances in the future, personal sacrifices. That is the reality of our situation and the barometer through which proposed energy policies should be judged. The bottom line is that in order for us to decrease oil consumption, many of the proposed policies would have to be implemented all at the same time. Any single policy, implemented without the others, is unlikely to do anything more than eliminate only a small part of our projected future increase in oil import requirements.