CAFE, Gasoline Prices and the Law of Diminishing Returns

(A New Agenda for the Midterm Evaluation)

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March 2016

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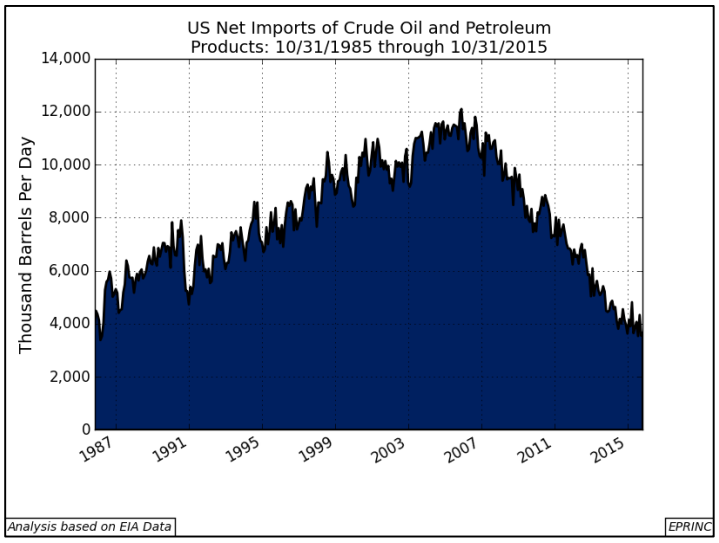
Introduction

The United States promulgates an extensive number of regulatory programs on the production and use of transportation fuels throughout the national economy. These programs include environmental and safety standards on both production and use of transportation fuels as well as mandatory annual performance improvements in automobile fuel economy for new models of automobiles and trucks. Regulations on transportation fuels have been developed to address a broad range of public policy concerns, including safe operation of manufacturing and storage facilities such as refineries and terminals, limits on automobile and truck tail pipe emissions to meet air quality standards, safe operation of motor vehicles, conservation of fuel to improve energy security, and reduce greenhouse gas (GHG) emissions.

Changing Outlook for U.S. Petroleum

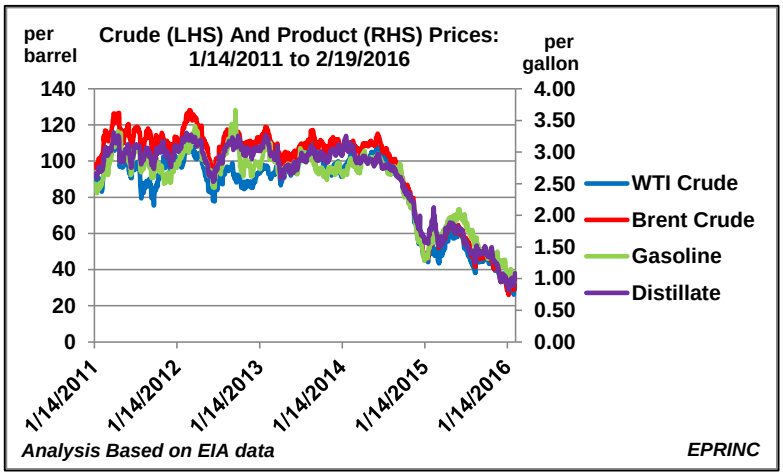
With regard to energy security, the North American petroleum renaissance has delivered growing supplies of oil and natural gas. The surge in crude oil production in the U.S., rising from 5 million barrels a day (MBD) in 2008 to over 9.5 MBD by mid-2015, has been a remarkable achievement of technological innovation and risk-taking. This liquids growth arrived on the heels of a large-scale development of natural gas supplies from unconventional plays, also known as tight or shale formations.

Figure 1



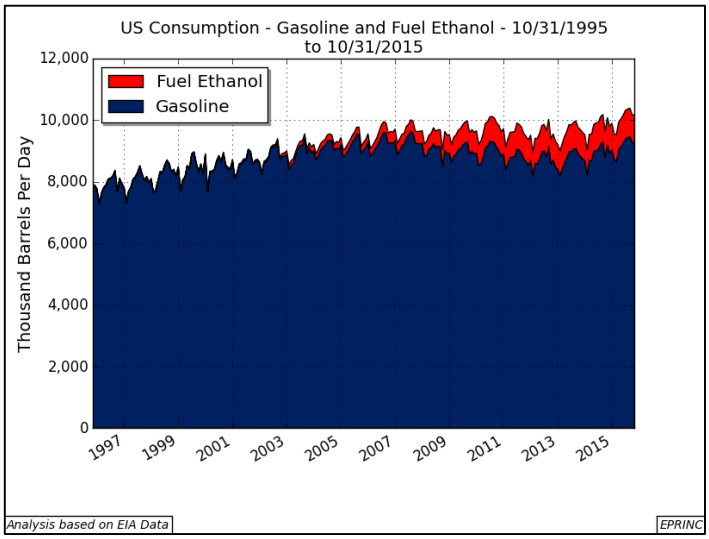
As shown in Figure 1, net imports of crude oil and petroleum products have declined from over 12 million barrels/day (MBD) in 2006 to approximately 4 MBD in early 2016, of which 75% is supplied by Canada.

Figure 2



In Figure 2, the American production surge also has contributed to the substantial decline in crude oil and product prices reaching levels not seen since 2003. The technological advances that have allowed oil production from unconventional or shale resources have fundamentally altered the long run outlook for the price of gasoline.

Figure 3



Furthermore, salutary effects from this expansion of domestic oil production is altering flows in world crude oil trade, shifting long-term price expectations, and challenging the long-held conventional wisdom on U.S. energy policy that was promulgated in an era of scarcity. After being written off as a petroleum province undergoing permanent decline, the U.S. now sits alongside Russia and Saudi Arabia as a leading oil and gas supplier. The lower oil prices will bring reductions in U.S. oil production, but EIA expects the declines to be relatively limited. EIA expects U.S. crude oil production to decline steadily from 9.2 MBD in December 2015, reaching about 8.5 MBD in November 2016. [1]

Another important feature of the U.S. fuels market is that demand for blended gasoline supplies (Figure 3) has remained relatively flat since 2006. Consumption of U.S. gasoline has in fact declined as growing volumes of ethanol have entered the gasoline pool, now at about 10% of the total.

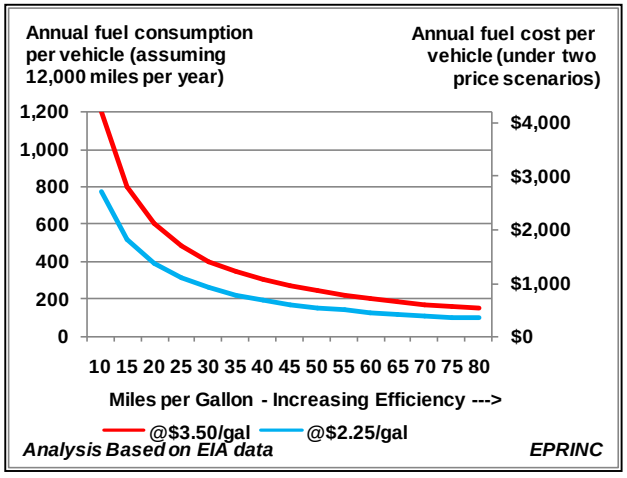
[1] For a full discussion of the resiliency of the US shale resource see Curtis, T. ***US Shale Dynamics in a Low Price Environment***, EPRINC, Wash DC. December 2014. https://www.dropbox.com/s/8j76zc0td6qqasb/Oil%20Shale%20in%20Low%20Price%20Environment%20Nov%202015.pdf?dl=0

CAFE

The Corporate Average Fuel Economy (CAFE) Standards program is one of the more important programs in the regulation of transportation fuels. This program was enacted by the Energy Protection and Conservation Act (EPCA) passed by the U.S. Congress in 1975. The purpose of the Standards has been to increase fuel efficiency in newly manufactured vehicles, thereby limiting fuel consumption. Congress was unwilling largely because of public opposition to reduce gasoline consumption through taxes in the midst of the already existing high fuel prices during the 1973 Arab Oil Embargo.

Instead Congress passed a mandate under EPCA requiring manufacturers and marketers to assemble vehicles with minimum fuel efficiency performance. The CAFE program has continued to raise performance requirements, and today the standards require complex assessments of both the performance of individual vehicles and the performance of a manufacturer's entire fleet in any given model year. Utilizing a challenging accounting method, the standard seeks to achieve improvements in both fuel economy and reductions in GHG emissions; however, the summary metric is expressed in miles per gallon (MPG). While implementation has been controversial and uneven over time, overall, there has been little challenge to the view that the CAFE standards have caused fuel economy to approximately double between the 1970s and the mid-1980s.

Figure 4

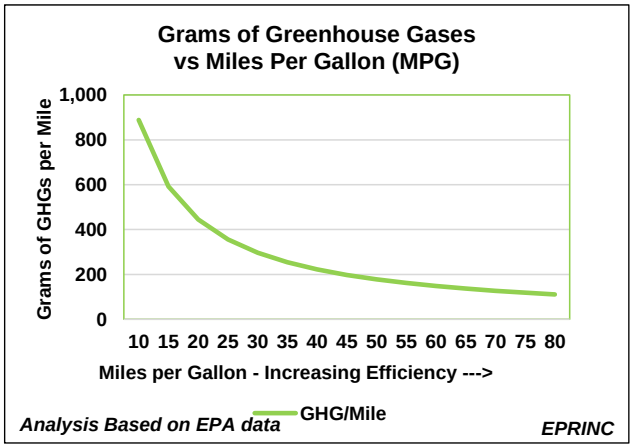


An emerging concern on implementing higher CAFE standards is diminishing returns from higher MPG requirements. EIA has shown that modest improvements in fuel economy in less efficient vehicles produce incrementally greater value than large improvements in more efficient vehicles. Note in Figure 4, the red line in the EIA chart[2] shows that even when gasoline is priced at $3.50 per gallon, consumers can expect the same annual savings of $700 in fuel costs from an improvement in fuel economy by lifting the vehicle performance from 12 mpg to 15 mpg as from 30 mpg to 60 mpg. When gasoline is priced at $2.25 per gallon, closer to current trends, as shown in the blue line in Figure 4, these savings are now only $450.

[2] Source: Energy Information Administration, June 11, 2014. See ***Today in Energy***, https://www.eia.gov/todayinenergy/detail.cfm?id=17071#

Similarly, the relationship in the improvements in the reduction of GHGs follows the same pattern of diminishing returns to that of fuel efficiency (please see Figure 5). One gallon of gasoline generates 8,887 grams of CO2 emissions. At 10 MPG there is 888.7 grams of CO2 that are generated. That is cut in half by a 10 MPG increase in fuel efficiency. To achieve the next halving of GHG-generation (reduction to 222.2 grams per gallon of gasoline consumption), fuel efficiency has to double to 40 MPG from 20 MPG.

Figure 5



Midterm Evaluation

In mid-2012, the U.S. Environmental Protection Agency (EPA) and the National Highway Traffic Safety Administration (NHTSA) issued the final rule for greenhouse gas emissions and fuel economy standards for model years (MYs) 2017-2025 for passenger cars, light-duty trucks, and medium-duty passenger vehicles. Each agency has unique responsibilities for establishing mileage performance standards.

As part of the rulemaking establishing the MYs 2017-2025 light-duty vehicle GHG standards, EPA made a regulatory commitment to conduct a Midterm Evaluation (MTE) of longer-term standards for MY 2022-2025. EPA will coordinate with the National Highway Traffic Safety Administration (NHTSA) and the California Air Resources Board (CARB) in conducting the MTE.

As required by law, NHTSA developed two phases of standards in the rulemaking. The first phase, from MYs 2017-2021, includes final standards that are projected to require, on an average industry fleet-wide basis, a range from 40.3—41.0 mpg in MY 2021. The second phase of the CAFE program, from MYs 2022-2025, includes standards that are not final, due to the statutory requirement that NHTSA set average fuel economy standards not more than 5 model years at a time.

Thus, the second phase standards represented NHTSA's current best estimate, based on the information available to the agency when the final rule of what levels of stringency might be maximum feasible in those model years. NHTSA projects that those standards could require, on an average industry fleet wide basis, a range from 48.7–49.7 mpg in model year 2025. At the same time, EPA is establishing standards that are projected to require, on an average industry fleet-wide basis in model year 2025 of 54.5 mpg to achieve reductions in GHG emissions.

Auto manufacturers are required to meet a specific and more stringent standard on average in each model year from 2017 through 2025. Because the standards are based on the vehicle's footprint, the burden of compliance is distributed across all vehicle footprints and across all manufacturers. Manufacturers are not compelled to build vehicles of any particular size or type (nor do the rules create an incentive to do so), and each manufacturer will have its own fleet-wide standard that reflects the light duty vehicles it chooses to produce.

The two agencies estimate the MYs 2017-2025 National Program will save approximately 4 billion barrels of oil and reduce GHG emissions by the equivalent of approximately 2 billion metric tons over the lifetimes of those light duty vehicles produced in MYs 2017-2025. The agencies project that fuel savings will far outweigh higher vehicle costs, and that the net benefits to society of the MYs 2017-2025 National Program will be in the range of $326 billion to $451 billion (7% and 3% discount rates, respectively) over the lifetimes of those light duty vehicles sold in MYs 2017-2025. [3]

The agencies estimate that technologies used to meet the standards will add, on average, about $1,800 to the cost of a new light duty vehicle in MY 2025, consumers who drive their MY 2025 vehicle for its entire lifetime will save, on average, $5,700 to $7,400 (7 and 3% discount rates, respectively) in fuel, for a net lifetime savings of $3,400 to $5,000. This estimate assumes gasoline prices of $3.87 per gallon in 2025 with small increases most years throughout the vehicle's lifetime.

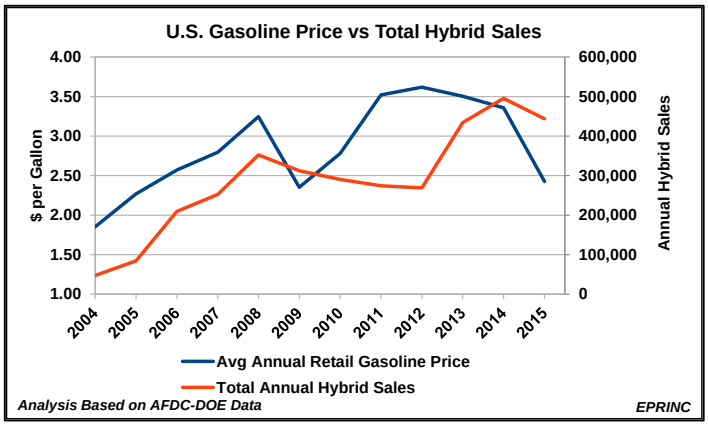
The National Resource Council's Board on Energy and Environmental Systems (NRC) undertook an independent assessment of the new MPG standards. [4] On balance, the NRC commended the agencies for offering a standard-setting approach that allowed manufacturers more flexibility, but that the rapid pace of required product development did raise concerns on the potential for stranded capital. While the report reviews the entire range of strategies to meet the new standards, it largely did not address the issue of a substantially lower long-term price for transportation fuels.

[3] EPA, **Regulatory Impact Analysis:***Final Rulemaking for 2017-2025 Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards.* See http://www3.epa.gov/otaq/climate/documents/420r12016.pdf

[4]***Cost, Effectiveness and Deployment of Fuel Economy Technologies for Light-Duty Vehicles,*** National Research Council, Board on Energy and Board on Environmental Systems · Division on Engineering & Physical Sciences · June 2015
http://sites.nationalacademies.org/cs/groups/depssite/documents/webpage/deps_166210.pdf

One technology that mitigates GHGs and raises fuel efficiency that has shown strong acceptance has been the hybrid-electric vehicle (HEV); examples of popular HEVs include the Toyota Prius and Ford Fusion. However as can be seen in Figure 6, HEV sales closely track that of the price of gasoline: rising fuel prices align with increasing HEV sales, and vice-versa.

Figure 6



Through the MTE, EPA will decide whether the standards for model years 2022-2025, established in 2012, are still appropriate given the latest available data and information. EPA's decision could go one of three ways: the standards remain appropriate, the standards should be less stringent, or the standards should be more stringent. EPA will examine a wide range of factors, such as developments in powertrain technology, vehicle electrification, light-weighting and vehicle safety impacts, the penetration of fuel efficient technologies in the marketplace, consumer acceptance of fuel efficient technologies, trends in fuel prices and the vehicle fleet, employment impacts, and many others.

As a result, the upcoming MTE should directly address challenges, among other concerns, from the new pricing environment. Among the more important challenges are the following:

1. How are consumer preferences for vehicles, size and performance likely to shift in an environment of low gasoline and diesel prices?

2. Given that justification for the new CAFE standards relies substantially on a calculation of economic benefits to consumers from fuel savings, what is a likely range of the reduction in economic benefits under a low price scenario?

3. Is this new price environment likely to raise the amount of stranded capital for auto manufacturers as they adjust to address the shift in consumer preferences in a lower fuel price environment?

4. What are the implications to the growth and stability of the auto industry in the new price environment?

5. How might a wider range of compliance strategies, including some modest adjustments to the MPG and footprint requirements substantially lower the compliance cost of the new standards?

6. What policies going forward provide the best balance of cost risk and environmental performance given the new fuel pricing environment.

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Appendix

The Regulatory Environment for Transportation Fuels 1975-2005

From 1950 through 1975, the U.S. refining industry was subject to considerable economic regulation. These sets of regulations sought to support the domestic price of crude oil, limit crude oil imports, and to expand the number of refineries in remote areas as a form of economic development.

Since 1975, many regulations of this type have been repealed.

Since the 1970s, the regulations that have been enacted that impact the production of transportation fuels by U.S. refineries and those fuels that are imported fall into three categories:
- environmental, public health, fuel efficiency;
- tax and accounting;
- and, more recently, blending mandates.

Environmental regulations are concerned with controlling the generation of toxic pollutants and green-house gases along with their impact on air quality and public health generated by the increasing numbers of motor vehicles. These regulations seek some combination of reduction, prevention, and substitution away from ecological hazards. The primary legislative conduits have been the 1970 Clean Air Act (CAA), and the 1990 Clean Air Act Amendments of 1990 (CAAA), which have created and authorized the EPA as the main agency to realize these goals.

Through 2005 the primary regulatory objective has been to control motor vehicle emissions of air pollutants. This has included the elimination of lead as an octane-rating enhancer, reduction of fuel-generated atmospheric ozone formation through the seasonal control of gasoline vaporization, diminution of carbon monoxide through increased blending of oxygenates and use of reformulated gasoline (RFG), sulfur reductions, exclusion of the use of carcinogens such as benzene as fuel components/additives. Beginning in 2005, the scope of objectives were expanded to include energy security and carbon dioxide reduction.

- Lead

Beginning in 1973, EPA set out to ban lead in transportation fuels. Full elimination of lead was completed in 1995. To compensate for the octane loss from the elimination of lead, MTBE was introduced as an octane enhancer in most parts of the United States; in the PADD 2 refining region (the Upper Midwest) ethanol was the octane enhancer of choice that was used to replace lead.

- RVP (Reid Vapor Pressure)

Uncontrolled fuel vaporization leads to increased formation of ozone in the atmosphere, which in turn is responsible for increased levels of smog and ozone-related health problems. RVP units are the metric used to evaluate a fuel's volatility and vaporization. The first phase of RVP

regulations ran from 1989 to 1991. Beginning in 1992, the second phase of RVP controls were put in place. Blending causes the RVP to be lower during the summer, hence less chance of evaporation, and higher during winter months, therefore assuring combustibility during cold weather.

- Oxygenates/RFG

Increased oxygenate blending targeted the reduction of carbon monoxide. Oxygenate blending began in 1989 with ARCO's introduction of EC-1, a gasoline that replaced lead with MTBE. This led to the development of RFGs (reformulated gasolines) and the adoption of national standards and programs. RFG Phase 1 ran from 1995 through 2000; RFG Phase 2 ran from 2000 to 2005. Combined, the RFG programs established fuel performance standards, and required the use of oxygenates at levels of between 2% to 2.7% of total weight of the fuel.

In addition, the RFG programs mandated the reduction in the use of benzenes and other carcinogens from fuels to miniscule amounts (0.7% from as high as 5.2%).

- Sulfur and other pollutants

The reduction of sulfur and other pollutants is being handled in several stages known as "Tiers." Targeting primarily sulfur, these rules seek to both change vehicle emission limits and fuel formulation rules. The Tier 1 program was enacted in the summer of 1991, and phased in progressively between 1994 and 1997. Tier 2 standards were adopted in December 1999, and phased in from 2004 to 2009.

- Tax and Accounting

Policy debates over taxes on domestic oil and natural gas operations recur often in regard to U.S. energy policy. The tax structure for the U.S. oil and gas infrastructure is complex. Among other things, it treats the operations of independents differently from those of integrated domestic and international companies.

There are numerous tax proposals in play at any one time. One contentious proposal that was proposed sometime ago, but continues to be considered is the repeal of LIFO (Last In, First Out) accounting for evaluating net revenue from inventory. The proposed legislation targets all U.S. manufacturing companies, not only those in the oil and gas industry. Overall, the estimate of the increased tax burden would be an extra $100 billion in the first ten years from the point of implementation, leveling off afterwards. There are no consensus estimates of what the impact would be on the oil and gas industry.

- Motor vehicles & CAFE 1

Enacted by the U.S. Congress through the Energy Protection and Conservation Act (EPCA) of 1975, Corporate Average Fuel Economy (CAFE) standards were implemented to increase fuel efficiency in U.S. transportation vehicles. Unwilling to impose higher gasoline taxes in addition to already existing high fuel prices due to the 1973 Arab Oil Embargo, EPCA chose instead to mandate manufacturers and marketers to assemble vehicles with minimum motor vehicle fuel efficiency levels. The computation is complicated, but the summary metric is expressed in miles

per gallon (MPG). The CAFE mandate seeks to raise the overall fuel efficiency for all vehicles produced for sale in the US: the higher the MPGs, the better. The CAFE standards have caused fuel economy to approximately double between the 1970s and the mid-1980s.

Post 2005: RFS, Tier 3, and CAFE 2 - Energy Security & carbon dioxide reduction
Beginning in 2005, the scope of legislative objectives impacting the refinery industry have become more aggressive. They have been expanded to include energy security and carbon dioxide reduction. They have also begun to have explicit blending mandates. The critical initiatives are the Renewable Fuel Standard (RFS), CAFE 2, and Tier 3 Regulations.

- RFS
RFS was first passed in 2005, and then further reinforced in by the 2007 Energy Independence and Security Act (EISA); it is also referenced as RFS2. It mandates the blending of (mostly) domestically produced biofuels into transportation fuels (ethanol into gasoline, biodiesel into petroleum diesel) at annually increasing volumes. In the original statutes, these volumes are to rise to levels where they would be 36 billion gallons per year (2.3 MBD) by 2022, or about 20% of currently forecast transportation fuel consumption. The RFS' rationale is to reduce dependence on petroleum imports along with promoting lower carbon fuels.

The targeted blending volumes in the original statutes were particularly aggressive, and have proven to not be achievable in the designated timeframe. EPA, through its statutory waiver authorities, has announced required blending volumes lower than the initial requirements. But the biofuel blending volume trajectory continues to move upward.

- CAFE 2
Since the passage of the original CAFE 1, this legislation has been modified and amended, notably by EISA; but directionally it continues to require ever increasing overall fuel economy. By 2020, a manufacturer's combined fleet of passenger and non-passenger vehicles must achieve an average 35 MPG from the current 24 MPG, a 45% increase. Congressional Research Service has cited estimates that point to a reduction of 2.3 MBD of transportation fuels consumption if these policies continue through 2030.

- Tier 3
Tier 3 standards were finalized in April 2014. The requirements will be phased in between 2017 and 2025. Their critical requirement is to further reduce transportation fuel sulfur from 30 parts per million (PPM) to 10 PPM. These standards also mandate that the useful life of vehicle emission control equipment be extended, and that the standards apply to a broader set of motor vehicles to include heavier duty gasoline-powered ones.