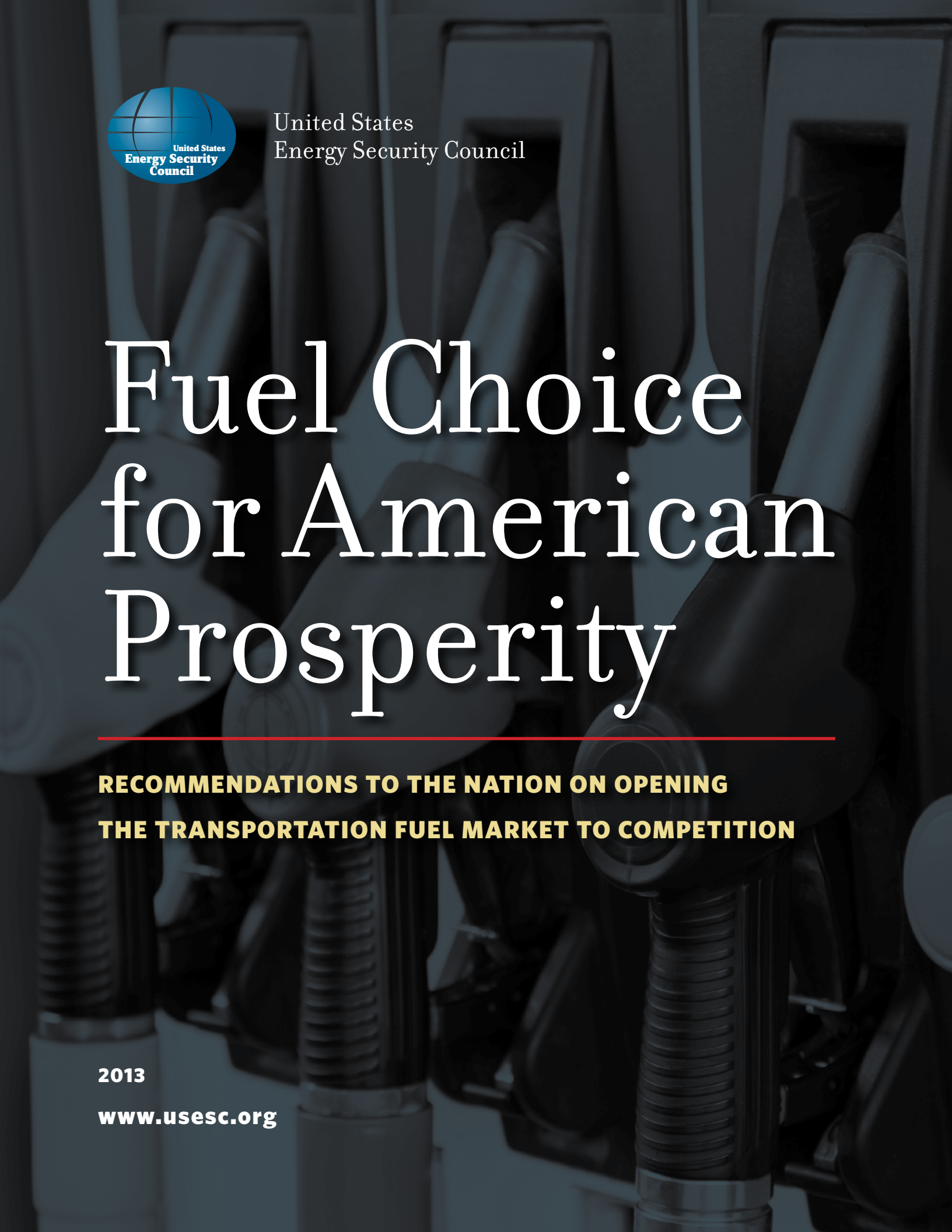


United States
Energy Security Council

Fuel Choice for American Prosperity

RECOMMENDATIONS TO THE NATION ON OPENING THE TRANSPORTATION FUEL MARKET TO COMPETITION

2013

www.usesc.org

List of Acronyms

BTX	Benzene, toluene, and xylene
BOV	Battery Operated Vehicle
CAFE	Corporate Average Fuel Efficiency
CNG	Compressed Natural Vehicle
DME	Dimethyl Ether
EPA	Environmental Protection Agency
EV	Electric Vehicle
FCV	Fuel Cell Vehicle
FFV	Flexible Fuel Vehicle
HEV	Hybrid Electric Vehicle
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
mpg	Miles per gallon
mpgg	Miles per gasoline equivalent gallon
MY	Model year
NAAQS	National ambient air quality standards
NBB	National Biodiesel Board
NGV	Natural Gas Vehicle
NHTSA	National Highway Traffic Safety Administration
NOx	Nitrogen oxide
NREL	National Renewable Energy Laboratory
NSPS	New Source Performance Standards
OFS	Open Fuel Standard
OPEC	Organization of Petroleum Exporting Countries
PHEV	Plug-In Hybrid Electric Vehicle
PM	Particulate matter
QER	Quadrennial Energy Review
RFS	Renewable Fuel Standard
SIP	State Implementation Plan
SOA	Secondary Organic Aerosol
VOC	Volatile organic compounds

Contents

Foreword

When a public policy problem is chronic, it is often a good idea to examine assumptions and seek alternative paradigms. This is the case with the oil challenge. The tendency of many of those thinking about energy security, including nearly every president going back to Dwight D. Eisenhower, has been to focus on the concrete and measurable – the number of imported barrels – rather than the difficult to assess abstract notion of oil's status as a strategic commodity. As a result, over the past forty years Americans have focused on a wrongly defined problem and debated how to reduce the nation's dependence on imported petroleum, specifically from the Middle East, rather than how to reduce the commodity's strategic importance. This has led to a public policy attachment to solutions intent on addressing that incorrectly defined problem (for example domestic drilling and vehicle efficiency) and to an assumption that the vulnerabilities associated with oil dependence will be alleviated should oil imports into the U.S. decrease. After forty years of experimentation it has become increasingly apparent that this paradigm is a failure. Import dependency has fallen – and today only nine percent of the oil we use originates from the Middle East – yet the price of fuel to the American family continues to rise. It is past time to recalibrate national thinking on oil to a more accurate problem definition and thus to solutions that have a chance of getting America – not to mention the rest of the world – out of the mire.

This report offers policy proposals aimed to do just that. Instead of focusing on import reduction, its purpose is regulatory reform aimed at removing obstacles to competition among different commodities in the transportation fuel market; it is after all oil's virtual monopoly over this market from which its status as a strategic commodity stems. The policies suggested here do not require subsidies, new tax-incentives or other handouts. They simply lay the foundation for a free and competitive fuel market from which all Americans – and indeed much of the world - could benefit. We hope they will get a decent hearing.

Anne Korin and Gal Luft
Co-Directors, Institute for the Analysis of Global Security (IAGS)

Introduction

Oil's strategic importance stems from its virtual monopoly as a transportation fuel. Today, 97 percent of transportation fuel is petroleum based. During the past four decades since the Arab Oil Embargo the policy consensus has been that if we only increased our domestic production of oil and/or learned how to use less of it we would be energy secure. We have done both: America's domestic crude production is at its highest since 1992 and our vehicles are more fuel efficient than ever. As a result America's oil import dependency has dropped from 60 percent in 2005 to 36 percent today, and it may drop further still. But none of this seems to have affected the global price of crude or the price of gasoline Americans pay at the pump. On the contrary, while our import dependency slumped our foreign oil expenditures nearly doubled, the share of oil imports in the overall trade deficit grew from one third to nearly a half and American motorists pay in real terms more for fuel than ever before. Clearly something is wrong with the paradigm.

What is needed is a competitive transportation fuel market in which a variety of energy commodities can vie with petroleum for market share. As long as the vehicles rolling onto our roads can essentially run on nothing but oil based fuels, and consumers are thus thwarted from making an on-the-fly choice among different fuels, America will remain susceptible to oil price hikes emanating from the Middle East to the detriment of our economy and national security – no matter how little oil we import from that region.

Competition is a bedrock of our American way of life. It's time to introduce it into our fuel market. As a first step, we must take a comprehensive view of the body of public policy that impacts vehicles and fuels, with an eye to smoothing regulatory hurdles that circumscribe market entry for both fuel competitive vehicles and competing fuels. Opening the door to greater numbers of vehicles open to a variety of fuels and speeding approval of those fuels as a package would allow for more competition. This model could then be exported to other countries that also seek to achieve a similar goal. This report recommends fiscally conservative proposals aimed at opening the transportation sector to competition. We urge policymakers to pursue this task as a necessity for the future security and prosperity of our nation.

Robert C. McFarlane and R. James Woolsey
Co-founders, US Energy Security Council

GAS LINES DURING THE ARAB OIL EMBARGO OF 1973

Executive Summary

Since the Arab Oil Embargo – forty years ago this October – president after president has pledged to reduce imports of "Middle Eastern" or foreign oil, whether by increasing domestic production, increasing the efficiency of our cars and trucks, or both. By next year, the Energy Information Agency forecasts that oil imports will fall to their lowest level since 1987 – half their level at the height of the Iraq War. But while imports of oil have fallen substantially, the amount of money the U.S. spends on oil imports has increased not just per barrel but in total. Energy security means reliable supply at an affordable price. The U.S. has been successful in improving the former, but its policies thus far have failed to reign in global oil prices and hence achieve true and lasting energy security.

The United States will remain exposed to oil price shocks as long as petroleum is essentially the sole player in the global transportation fuel market. The Organization of Petroleum Exporting Countries (OPEC), the oil cartel which holds some three quarters of conventional oil reserves, has not increased its contribution to the oil market perceptibly since 1973 and has constrained production capacity to the point that it accounts for but a third of global oil supply. What OPEC considers the "fair price of oil" – namely the price required to balance the national budgets of OPEC member regimes – has increased from $20 a barrel or so in the 1990s to $100 a barrel today, and is headed higher still, in no small part due to post-Arab Spring social spending increases by Persian Gulf regimes aimed at maintaining stability.

Oil is a fungible commodity with a global price, and thus even the theoretical elimination of foreign imports through increased U.S. production is not likely to bring long-term price relief to the consumer. Over the next decade, demand in China, India, and other emerging markets will continue to grow. Unmatched by substantial growth in supply from the regions where conventional oil is most prevalent and cheapest to discover and lift, this will drive the price of gasoline and diesel to higher and higher levels.

If we are to achieve true energy security and insulate ourselves from countries that whether by design or by inertia effectively use oil as an economic weapon against us and our allies, America must adopt a new paradigm – one that places oil in competition with other energy commodities in the sector from which its strategic importance stems: the transportation fuel market.

Although this may appear to be a daunting task, our country – and the globe – is abundant in energy resources that are cost-competitive with petroleum. Moreover, the technology to convert these resources into fuel is, in large part, is mature and economic. There is no need for subsidies, mandates, or special carve outs.

What we must do is relatively simple: level the playing field and end the decades-old regulatory advantage that petroleum fuels have enjoyed in the transportation fuel market. By pursuing a free market-oriented policy that has as its primary objective a competitive market in which fuels made from various energy commodities can be arbitraged against petroleum fuels, the United States can lead the world in placing the best price damper of them all - competition - on oil.

At the same time, Congress should ensure that the policies and rulemaking promulgated by the Environmental Protection Agency (EPA), which controls the types of fuels that power our cars through air quality regulation, are consistent with the objective of a competitive market in fuels.

Policy Recommendations

Our proposals focus on promoting the deployment of vehicles open to fuel competition and on easing regulatory and tax policy barriers to a competitive transportation fuel market. Once the share of fuel competitive cars and trucks in the total vehicle fleet passes a certain threshold – for light duty vehicles, that threshold is 15-20 percent – and only at that point, will there be a business case for fuel stations to install or retrofit infrastructure to serve competing fuels. At the same time, a proliferation of fuel competitive vehicles will create a demand opportunity and thus drive the private sector to expand capacity in those fuels that investors expect to be economic over the range of oil prices they anticipate.

The simplest policy pathway to opening vehicles to fuel competition is the Open Fuel Standard (OFS). This technology neutral policy requires that most light duty vehicles sold in the United States be capable of running on another fuel in addition to or instead of gasoline or diesel, whether liquid fuel, gaseous fuel, electricity, or some combination thereof, stipulating that flex fuel vehicles must be at the least gasoline-ethanol-methanol compatible to count as fuel competitive. However, a strong aversion to mandates among some constituencies presents a tough challenge for this policy's acceptance. The report thus presents an alternative pathway to achieving a similar outcome - one that avoids the need for a politically challenging mandate.

SPECIFICALLY, WE SUGGEST THE FOLLOWING:

Domestic Policy: Fuel Choice for America

- **NEW VEHICLES:** Congress should create a topline fuel competition CAFE credit for automakers that open at least half of the vehicles in their fleet to competing fuels, and ensure automaker compliance with CAFE counts as compliance with greenhouse gas regulations under the Clean Air Act. For flexible fuel vehicles to count as fuel competitive vehicles, they should be gasoline-ethanol-methanol flexible, not just gasoline-ethanol flexible. CAFE rulemaking should be re-focused on the original goal of energy security, prioritizing the reduction of oil's importance through a performance-based, technology-neutral approach. As part of this effort, the metric of miles-per-gallon (mpg) in CAFE should be abandoned as the principle measurement of success since energy density differs across fuels.

- **SECONDARY VEHICLE MARKET:** EPA should further deregulate the conversion kit market to enable safe, but low-cost, conversions to powering with substitute fuels.

- **FUELS CERTIFICATION:** The process EPA has recently opened to consider certifying a higher octane fuel in the Tier 3 rulemaking should be expanded to include all alcohol fuels and the broadest range of blends feasible.

- **FUEL TAX FAIRNESS:** Fuels should be allowed equal treatment under the federal tax code, and thus taxed on an energy content basis rather than a volume basis. State and local governments should also tax fuels equivalently using energy content instead of on a volume basis.

- **EMISSION CALCULATION FAIRNESS:** EPA should level the playing field and not include upstream emissions for non-petroleum fuels when determining the CAFE "compliance value" for light-duty vehicles, and for other purposes, since it does not do so for gasoline.

- **FLEXIBILITY FOR STATES:** EPA should remove bureaucratic hurdles that thwart states from utilizing transportation fuel strategies that improve air quality to meet their Clean Air Act obligations. Congress should consider more innovative solutions to expand this flexibility, including the creation of a market for particulate matter that would cover one pollutant from multiple sources and sectors.

International Policy: Building a Global Fuel Choice Agenda

- **FORM A U.S.-CHINA-BRAZIL ALCOHOL FUELS INITIATIVE.** The initiative can be expanded to include other countries with robust alcohol fuels programs.

- **EXPAND INTERNATIONAL COLLABORATION ON ELECTRIC VEHICLES** with specific focus on those research areas which could lead to significant cost reduction in automotive batteries.

- **DEVELOP INTERNATIONAL STANDARDS FOR AFTERMARKET RETROFITS** that make vehicles flexible fuel or CNG compatible.

- **DISTRIBUTE EDUCATIONAL MATERIALS TO FOREIGN GOVERNMENTS** on the health benefits of substitute fuels in displacing aromatics in gasoline as well as reducing particulate matter emissions.

- **EXPAND THE U.S.-CHINA SHALE GAS RESOURCE INITIATIVE:** Collaborate with China and other emerging shale gas producers on the development of new fracking techniques, new fracking fluids, safety standards and environmental best practices.

- **ENGAGE IN INTERNATIONAL EFFORTS TO REDUCE METHANE FLARING:** Collaborate with major methane flaring nations on identifying economic and environmentally sustainable strategies to turn unused methane into usable fuel.

IN SUMMARY

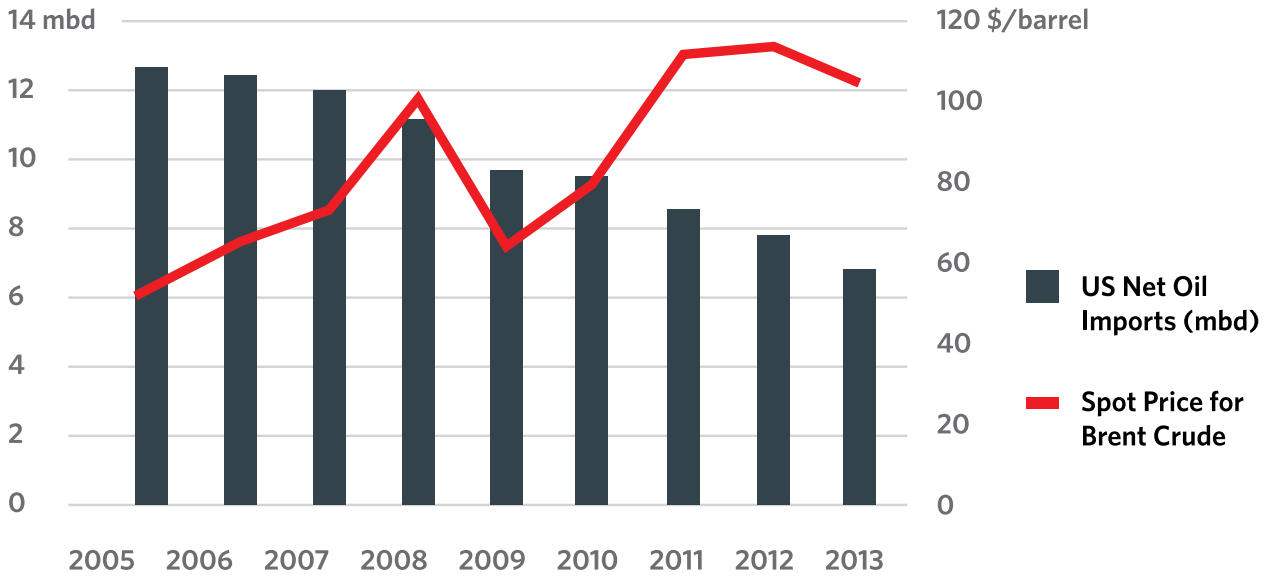
Washington must take a comprehensive, holistic view of energy policy as it relates to vehicles and fuels. Opening the door to fuel competitive vehicles and reducing the regulatory barriers to non-petroleum fuels would reduce the strategic importance of oil with its attendant national security implications, and reduce the Nation's vulnerability to oil price shocks. Forty years after the oil embargo, it is well past time to get started.

Needed: A New Oil Paradigm

NEARLY FORTY YEARS AGO, AMERICA CONFRONTED ITS FIRST OIL PRICE SHOCK. Since then, every President has pledged to achieve energy independence by reducing America's oil imports – focusing mostly on increasing domestic oil production and/or increasing vehicle fuel efficiency through regulation. It has been claimed that oil import reduction would yield lower crude prices and hence lower prices at the pump. As the last decade has made clear, this claim is unsupported by reality.

The Energy Security Paradox

THE PRICE OF OIL AND THE LEVEL OF IMPORTS ARE MOVING IN OPPOSITE DIRECTIONS

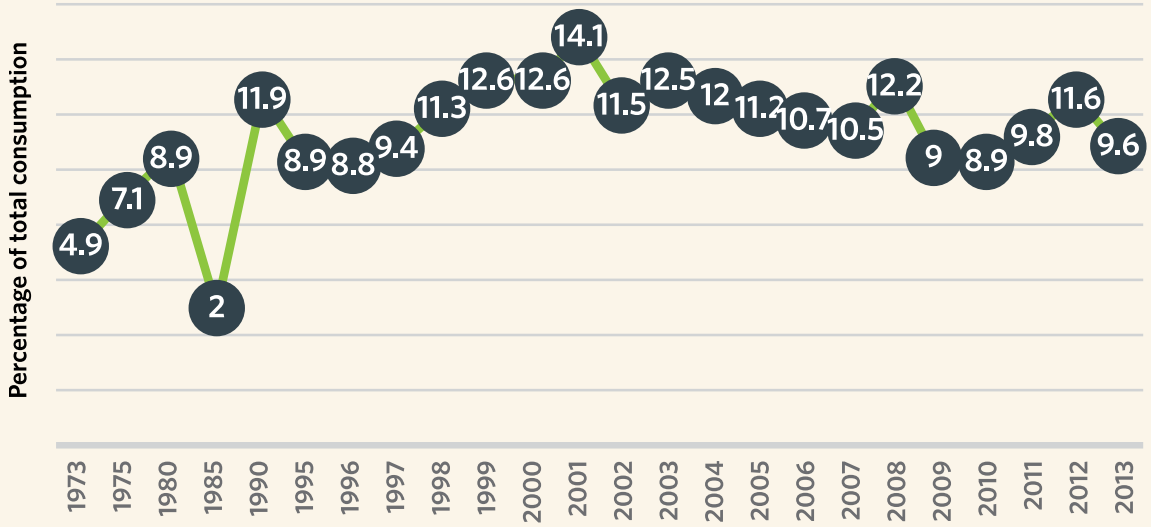


Since 2003 United States domestic oil production has risen sharply to the point the International Energy Agency projects that the United States is well on its way to surpass Saudi Arabia and Russia as the world's top oil producer by 2017. Additionally, fuel efficiency of cars and trucks is at all-time high. As a result of these efforts, U.S. imports of petroleum and its products declined to under 36 percent of America's consumption down from some 60 percent in 2005. But none of this has had any noticeable downward pressure on global oil prices. Over the past decade the price of crude quadrupled; the value of America's foreign oil expenditures doubled and the share of oil imports in the overall trade deficit grew from one third to about 50 percent. Most importantly, the price of a gallon of regular gasoline has doubled. Despite the slowdown in demand, in 2012 American motorists paid more for fuel than in any other year before.

Short of a collapse of the global economy, the age of cheap gasoline is likely over for America as long as oil is essentially the world's sole transport fuel. Expanded domestic oil production and improvements in the efficiency of our cars may have a positive impact on our trade balance and the environment but are now largely irrelevant to the price that consumers will face.

Oil is a fungible commodity in a global market place. When the global price of crude rises, it rises for everyone regardless of where countries obtain their oil. Between mid-February and April 2011, the war in Libya caused oil prices to American consumers to spike by 25 dollars per barrel despite the fact that America imported no oil from Libya. As long as the U.S. oil market is an integral part of the global oil market, even if American oil production could meet all of our needs, the country would remain vulnerable to external price shocks.

Oil imports from the Persian Gulf 1973-2013 as percentage of overall U.S. consumption

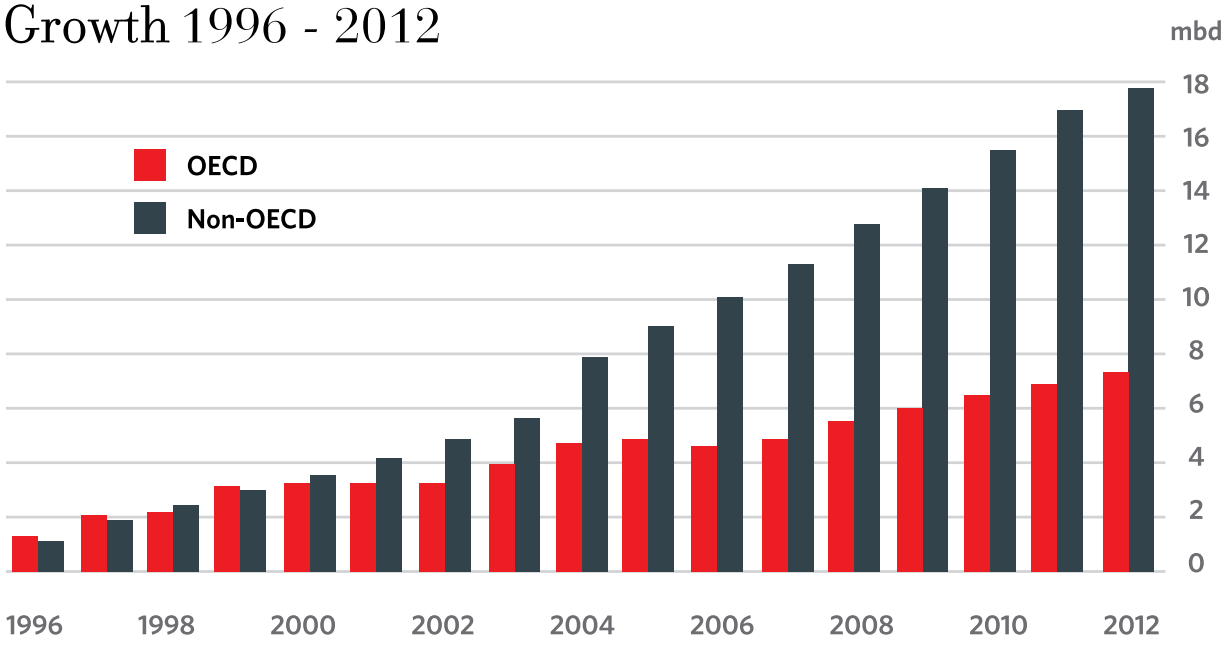


CONTRARY TO POPULAR BELIEF, THE U.S. IS NOT HEAVILY DEPENDENT ON THE PERSIAN GULF FOR OIL NOR HAS IT EVER BEEN. The region currently supplies under 10 percent of U.S. oil demand, and as the chart above shows never in history has the number surpassed 15 percent. Most U.S. oil imports originate in the Western Hemisphere.

What the U.S. imports from the Persian Gulf is the price of oil much more so than the black liquid itself. When the region destabilizes, price goes up for everybody regardless of their physical exposure to Middle Eastern crude. Even if the U.S. miraculously became self-sufficient in oil it would not be shielded from the world market, as were not other countries that used to be self-sufficient at one point or another like Canada, the UK, and Norway.

Many see powerful economic growth in emerging markets as the driver behind the upward movement in oil prices. The developing world's demand for crude is – just as in the developed world - transportation driven. In the first decade of the 21st century, China's oil demand more than doubled, and by 2014 it is projected to overtake the United States as the world's largest oil importer. In 2010, China surpassed the United States as the world's largest auto market. India, projected to surpass China by 2025 as the world's most populated country, is following a similar growth trajectory in terms of oil demand. Combined, China and India will soon surpass U.S. oil demand by a significant margin.

OECD vs. Non-OECD Cumulative Oil Demand Growth 1996 - 2012



But Asia's growing demand would not have been enough of a reason for oil prices to increase so sharply if it had been coupled with a parallel growth in global supply. While non-OPEC supply has been increasing and while the world economy is growing by leaps and bounds, OPEC, which holds some three quarters of the world's economically recoverable oil reserves and has the lowest per barrel discovery and lifting costs in the world, has failed to increase its production capacity on par with the rise in global demand. Over the past four decades, world GDP grew fourteen-fold; the number of cars quadrupled; global crude consumption doubled. Yet OPEC today produces about 30 million barrels of oil a day (mbd) – the same as it produced forty years ago. As a collective, OPEC acts as a monopolist in the global oil market and, consistent with that posture, despite its control of the bulk of the world's conventional oil reserves, it has constrained its production capacity to the point that it accounts for but a third of global oil supply. OPEC members' growing budgetary obligations mean that the price of oil required to balance the national budgets of its members - namely, what the cartel terms the "fair price of oil"- will remain high in order to ensure political stability. These obligations have increased sharply since the Arab Spring and are likely to continue to inflate as the population of the oil regimes grows.

Expanded non-OPEC production and reduced developed world demand do not reduce the price of oil in a sustained manner because these measures are straightforward for the cartel to counter: to the extent that the slack is not taken up by growth in demand in the developing world, the cartel can simply throttle down supply to drive oil prices back up as it has done numerous times when oil prices declined.

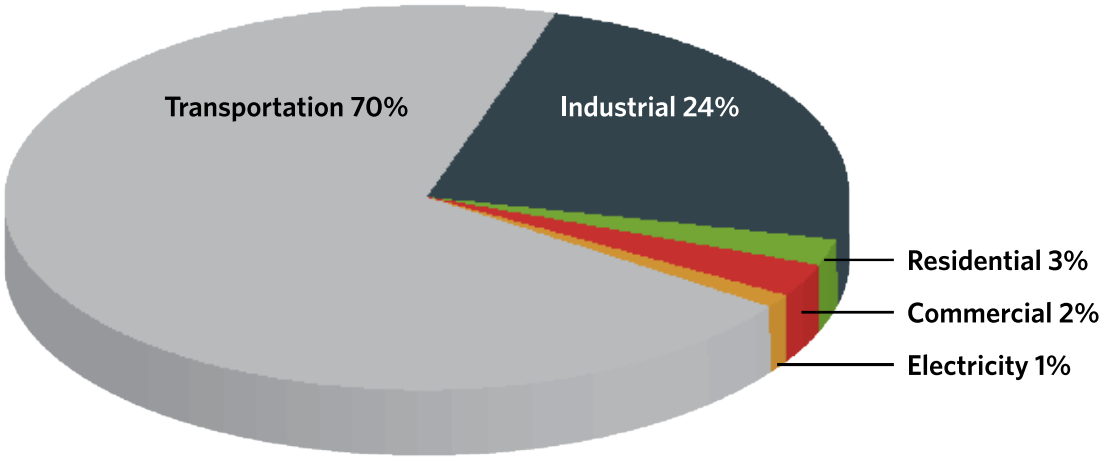
	1973	2013
World population	4 billion	7 billion
Number of automobiles	250 million	1 billion
World GDP	$5 trillion	$70 trillion
Global oil demand	55 mbd	88 mbd
OPEC production	30 mbd	30 mbd
Share of global supply	54%	33%
Price per barrel (2012 $)	$13	$100

Realistically, we cannot defeat the cartel in the courts or with diplomacy. What we can do is deploy what it fears most: competition with other energy commodities, for instance our cheap and abundant natural gas. To do so, we must address the source of OPEC's strategic significance: the petroleum-only vehicle. The petroleum-only vehicle ensures that as a collective OPEC holds the position of monopolist in the transportation fuel market. **Opening vehicles to fuel competition will enable arbitrage among the energy commodities from which fuel can be produced by allowing consumers to make an on-the-fly choice of which fuel to purchase depending on comparative price.** The proliferation of vehicles that allow fuel competition would send a signal to investors that there is a profit opportunity in expanding production capacity for fuels that can compete with gasoline (or diesel) within a broad range of oil prices. Over time, the increase in production capacity of competing fuels would lead to a situation where these fuels actually compete for market share with oil. This process would serve to drag down the price of oil even as it pushes up the price of some of its competitors.

DRIVING DOWN THE PRICE PAID AT THE PUMP IN A SUSTAINED WAY WILL REQUIRE OPENING THE TRANSPORTATION FUEL MARKET TO COMMODITY ARBITRAGE BY OPENING CARS TO FUEL COMPETITION.

Fuel competition would have geopolitical benefits as well. The petroleum-only vehicle is after all the source of oil's status as a strategic commodity. Oil's strategic importance stems from its virtual monopoly over transportation fuel (much as in a bygone era salt's strategic importance stemmed from its monopoly over food preservation). Contrary to decreasingly prevalent but still common popular perception, very little - a mere one percent - of U.S. oil demand is due to electricity generation, and also just one percent of U.S. electricity is generated from oil.

U.S. Oil Demand by Sector



Cutting into oil's transportation fuel dominance has only been a peripheral political objective over the past forty years with inconsistent support or anemic funding from one Administration to the next. Competing technologies and fuels to the internal combustion engine and to gasoline and diesel have often been viewed as political pet projects by the opposing party, resulting in a swift death when control of the Congress or White House shifted.

What is needed is an integrated, multi-pronged approach that cuts across Administrations and covers transportation fuels *and* vehicles. It is unlikely we will achieve true and lasting energy security without it.

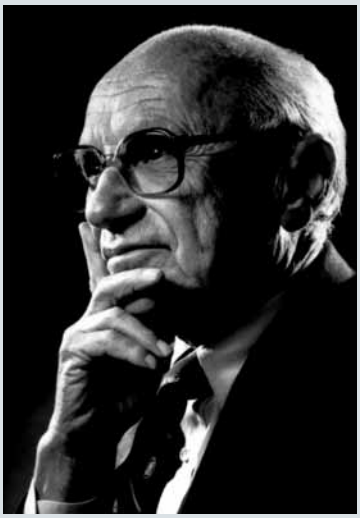
Some argue that consumers – or the markets – have already chosen gasoline because it is supposedly cheaper and more available and reliable than competing fuels. The reality is that there are fuels that are cheaper than gasoline. Electricity, natural gas, and methanol are less expensive than gasoline per energy unit– and in some cases, vastly cheaper. For some of these fuels, payback time when taking into account vehicle cost premiums is very short. This is particularly true for natural gas-based methanol, which enjoys a substantial price advantage over gasoline on a per-mile-basis and can be used in flexible fuel vehicles, whose marginal manufacturing cost as compared to gasoline-only cars is on the order of $100 a vehicle.

Furthermore, the price of gasoline at the pump does not reflect the true costs of oil. Oil price shocks and price manipulation by OPEC are estimated to have cost America nearly $2 trillion from 2004 to 2008, according to the Department of Energy.[1] And the RAND Corporation estimates that the Department of Defense spends between $68 billion to $83 billion per year

Why should government meddle at all?

Friedrich Hayek

Ludwig von Mises



Milton Friedman

Free market economists, including Friedrich Hayek, Ludwig von Mises, and Milton Friedman, argued that government has a role in eliminating monopolies and cartels. Hayek wrote, "Our freedom of choice in a competitive society rests on the fact that, if one person refuses to satisfy our wishes, we can turn to another. But if we face a monopolist, we are at his mercy." For his part, von Mises warned, "The forces aiming at a restriction of competition play a great role in our day. It is an important task of the history of our age to deal with them." And Friedman concluded that "the first and most urgent necessity in the area of government policy is the elimination of those measures which directly support monopoly."

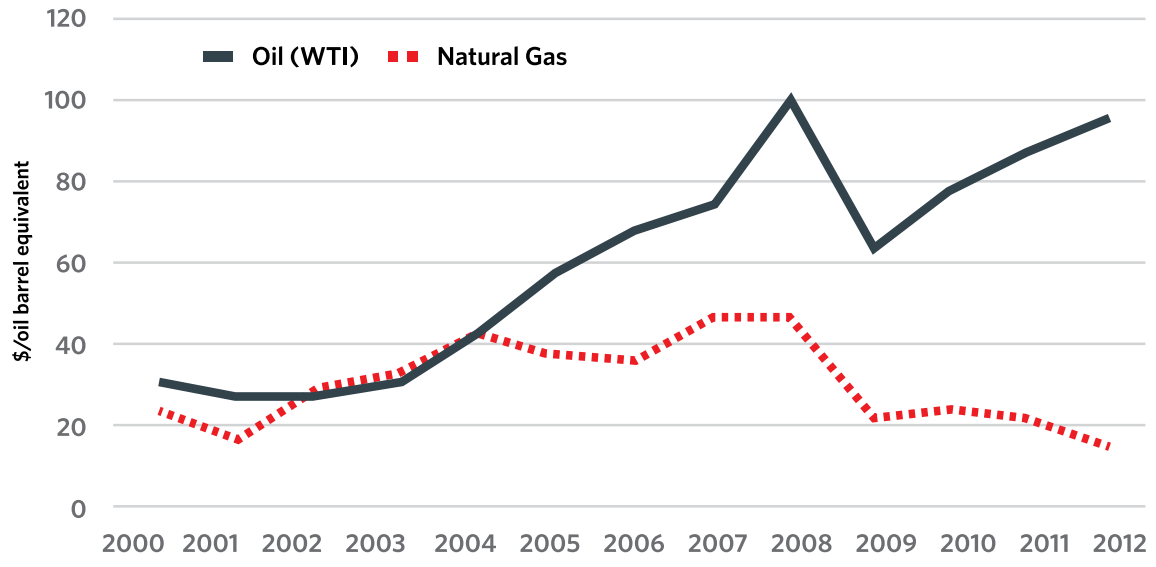
securing the passage of oil tankers around the world – a large sum given the country's fiscal challenges and shrinking defense budgets.[2]

The prevalence of petroleum-only vehicles has left little market incentive for filling stations and other fuel infrastructure to offer other fuel choices. The resulting lack of options at the pump in turn reduces the appeal for automobile manufacturers to open cars to fuels that are not commonly sold. This chicken and egg conundrum poses a multi-party coordination problem that is difficult to overcome. This report proposes steps that can be pursued by the Administration and the Congress to facilitate transportation fuel competition, in some cases by removing obstacles placed by the government itself that thwart this objective. The report examines how existing law and regulation can be improved in a fiscally conservative manner. In all cases, energy security is the priority while balancing economic considerations and environmental quality.

Fuel Options

There are a host of fuels that can compete with gasoline and diesel, and many of them can be made from natural gas. Historically, natural gas prices have always tracked oil prices, but as the graph below shows, the shale revolution has disconnected prices of the two commodities. Since 2008, oil prices, as well as the price of all other commodities, have rebounded more or less to their pre-2009 level, whereas natural gas prices have been on a decline. The price of natural gas dropped by about 80 percent between 2008 and 2013. The result: we are awash with cheap natural gas, but the commodity's traditional users, utilities and chemical producers, are not yet able to absorb much of it. At current oil and natural gas prices, oil is five times more expensive than natural gas on an energy equivalent basis. Therefore it makes sound economic sense to enable natural gas to compete against oil in the transportation sector. Natural gas has an important role in each category found below. It can be converted to liquid fuels - *including ethanol and methanol,* power natural gas vehicles, and be used as a feedstock to produce electricity which can power plug in hybrids and electric vehicles.

Oil vs. Natural Gas Prices on an Energy Equivalent Basis



ETHANOL

Ethanol is a fuel mostly made from the sugars of plant material, such as corn, sugar cane, and sugar beets, as well as cellulosic materials in cornstalks, grasses, and straw. It can also be produced from coal and natural gas by tearing apart and recombining hydrocarbons. Ethanol is blended with gasoline as a fuel additive because its high level of octane reduces engine knock and increases engine performance. E10, containing 10 percent ethanol and 90 percent gasoline, is the most common blend found at pumps. Other blends are available in limited locations, including E85, which contains a maximum of 85 percent ethanol for use in flex fuel vehicles (FFVs).

In the U.S., corn is the predominant crop used to produce ethanol – at least in part because of the limitations on feedstock imposed by the Renewable Fuel Standard (RFS). Production has more than doubled since 2007 to almost 14 billion gallons in 2012. Because it directly displaces oil in gasoline, if not for ethanol America would have imported an additional amount of oil equivalent to what we currently import from Saudi Arabia. Ethanol also reduces emissions. One study shows life cycle greenhouse gas emissions of corn ethanol are reduced by 19 to 52 percent, and significant reductions in tailpipe emissions, such as nitrogen oxide (NOx) and cancer-causing benzene, have also been reported.[3]

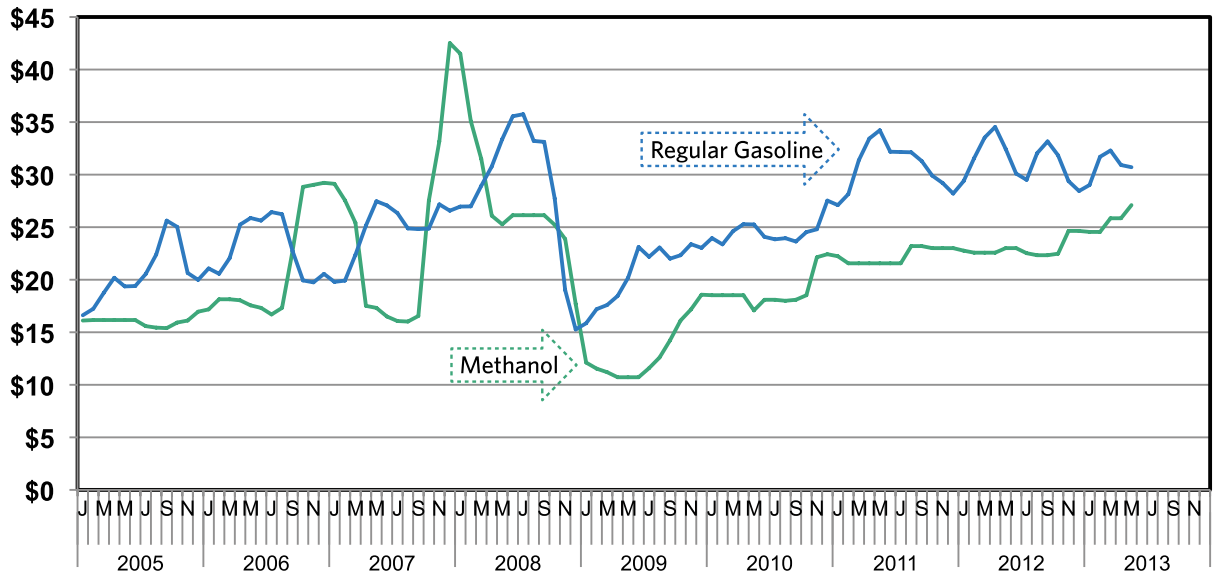
Despite its economic and environmental benefits, ethanol does have its shortfalls. The fuel packs less energy than gasoline, meaning fewer miles per gallon as the ethanol content rises. For E10, the mileage penalty is negligible, but for E85, there is a reduction of about 25 to 30 percent.[4] Transportation costs are also higher. Because it is corrosive to existing pipelines, the fuel is best shipped by truck, train, or barge to areas close to where ethanol is produced, primarily in the Midwest. As a result, E85 has limited distribution on the East and West Coasts.

METHANOL

Wood alcohol. A colorless, odorless, clean burning fuel that can be produced from natural gas, coal, biomass, and even recycled carbon dioxide. The market for methanol is already mature for non-fuel products as it is used in everyday items such as windshield wiper fluid, paints, and plastics. Methanol is cheaper than gasoline on a per mile basis because of low cost natural gas. Global methanol capacity is growing rapidly due to rapid uptake by China's transportation fuel market.

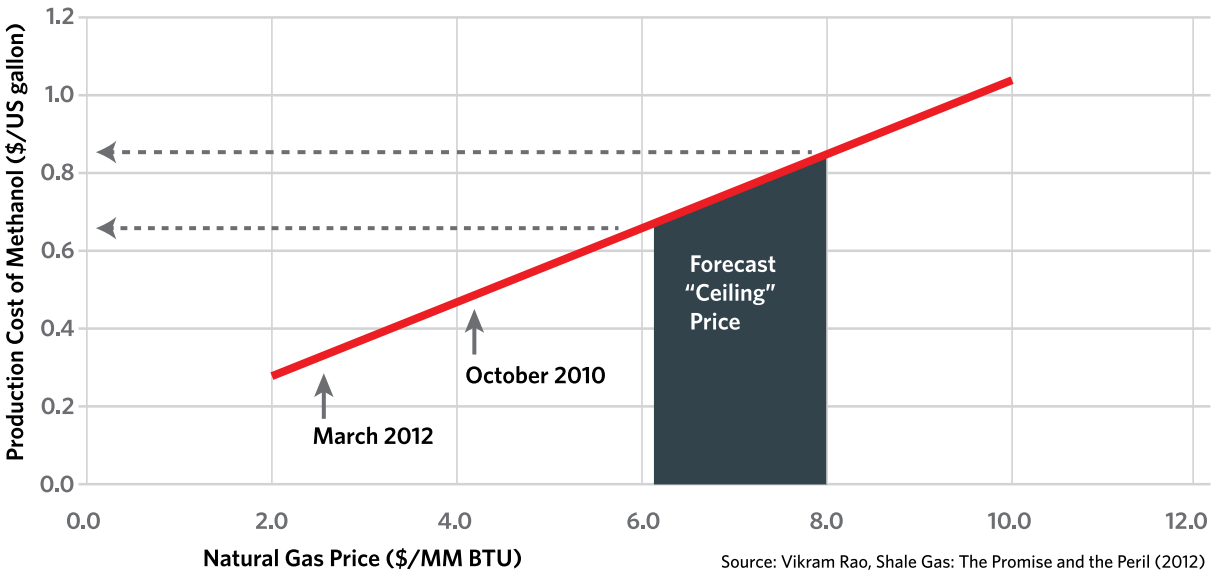
Methanol reduces hydrocarbon emissions (HC), nitrogen oxide (NOx), and particulate matter (PM). It is also safer, igniting at much higher temperatures and resulting in fewer car fires and explosions in impact accidents. Like gasoline, methanol is toxic when swallowed. And like ethanol, it is corrosive to vehicle parts, but requires relatively low-cost vehicle modifications to accommodate higher blends. Like ethanol, methanol has less energy than gasoline, which requires more trips to the pump. Therefore, the price per gallon must remain significantly lower than gasoline in order to attract consumers.

Methanol-Gasoline Comparison $/mmBTU



Source: Jim Jordan and Associates

Methanol Cost as Function of Natural Gas Price



Source: Vikram Rao, Shale Gas: The Promise and the Peril (2012)

BIODIESEL

Biodiesel is made from vegetable oil, such as soybean, animal fat, or recycled grease. Non-toxic and biodegradable, it can be used either as a blend or as a standalone fuel, with B20 the most common.

Production of biodiesel has ramped up quickly over the last decade as a result of federal and state tax incentives and the RFS, reaching 1 billion gallons in 2011. According to the National Biodiesel Board (NBB), biodiesel production supported more than 39,000 jobs and $3.8 billion in GDP.[5]

Biodiesel studies show that, even in low blends, it has positive environmental benefits. In 2002, the EPA concluded that harmful tailpipe emissions, such as particulate matter, carbon monoxide (CO), and hydrocarbons decrease steadily with its blend percentage. NOx emissions studies show either no impact or a slight increase, depending on the blend and type of vehicle used.[6]

Gaseous Fuels

A significant opportunity for petroleum displacement with natural gas lies with fleets – especially trucks, buses, and other heavier vehicles. Given their fuel use, compressed natural gas (CNG) and liquefied natural gas (LNG) are better suited for those vehicles than for passenger cars. The substantial cost savings at the pump allows for quicker recovery of the price differential between the natural gas vehicle and its diesel or gasoline counterpart. Because many fleet vehicles return to a centrally-located filling station at the end of a work day, the necessary investment in natural gas infrastructure is not prohibitive. Assuming a significant price spread between natural gas and diesel, the market share of LNG and CNG in the heavy duty fleet has an opportunity for substantial growth, particularly because of the regional nature of much of the freight industry.

COMPRESSED NATURAL GAS (CNG)

Compressed natural gas is made by compressing natural gas to less than one percent of its normal volume and storing and distributing it in hard containers. It can only be used in natural gas vehicles (NGVs), which come in the form of dedicated (natural gas only); bi-fuel, which run on natural gas or gasoline using two separate fueling systems; or dual-fuel, which use diesel for ignition and run on natural gas. CNG is most commonly used in light and heavy duty vehicles, and often used for public transportation and public works, such as city buses and garbage trucks. CNG is a cleaner burning fuel than gasoline or diesel, with smog-producing pollutants reduced by 60 to 90 percent and greenhouse gas emissions reduced by 30 to 40 percent.[7] The abundant supply of shale gas has made CNG a much cheaper fuel than gasoline by a national average of 45 percent.[8]

While the fuel might be cheaper, the up-front cost of a passenger vehicle is cost prohibitive for the average consumer. Today, the Honda Civic GX, the only original CNG vehicle available for purchase, sells for almost double its gasoline counterpart. Moreover, the cost to convert and certify existing vehicles to CNG is roughly $10,000. In addition, fueling sites are limited because of costs, ruling out long distance travel in a dedicated NGV. CNG also requires a much larger tank, which takes up valuable trunk or truck bed space.

LIQUEFIED NATURAL GAS (LNG)

Liquefied natural gas is produced by liquefying natural gas at extremely cold temperatures and storing it in cryogenic tanks. In its liquefied state, it requires about 1/600th the storage volume of natural gas, making it the ideal form in which to haul over long distances via pipelines, ships, or tankers, and then to re-gasify to natural gas when it reaches the end user.

As a transportation fuel, it is available in very limited locations at this time, mostly in California. Suited primarily for heavy-duty vehicles, it is typically used for garbage trucks and transit buses. Moreover, its storage in cryogenic tanks and high cost of production has made it impractical for widespread consumer use.

DIMETHYL ETHER (DME)

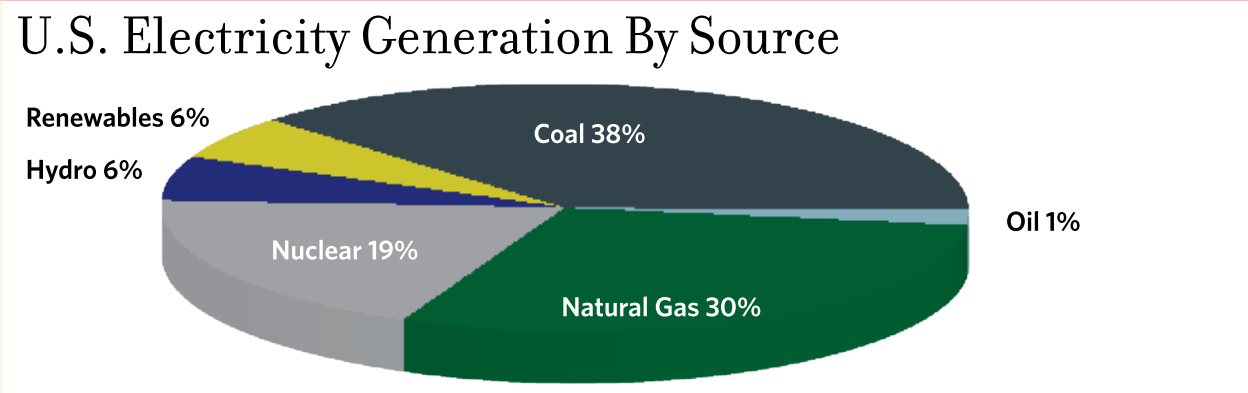
DME is a colorless gas which can be used as automotive fuel, enabling diesel substitution. It can be derived from many sources, including renewable materials (biomass, waste and agricultural products) and fossil fuels (natural gas and coal). Most of the world's DME is produced by means of methanol dehydration, but DME can also be manufactured directly from synthesis gas produced by the gasification of coal or biomass, or through natural gas reforming. DME is a clean burning fuel emitting less CO2 and 90 percent less NOx emissions than standard automotive fuels.

LIQUEFIED PETROLEUM GAS (LPG)

LPG, a byproduct of natural gas and petroleum, is a mixture of propane and butane which today powers more than 150,000 cars in the United States and 15 million worldwide. The cost for LPG refueling infrastructure is much more affordable than that of CNG, with pumps costing between $45,000 and $60,000. The price could go as high as $175,000 for a large public station. But as with CNG, the vehicle conversion cost is high $4,000-$12,000.[9] On an energy equivalent basis, the cost of LPG is twice that of CNG, which means consumers have to spend more on the vehicle side without any noticeable payback on the fuel side.

Though the concept of the electric vehicle has been around since the late 19th century, it was not until the 1990s that automakers began experimenting with consumer-grade vehicles in earnest. Interest and production waned until Toyota introduced the Prius, the first hybrid-electric car made for the public. More models have gradually been released in three major forms – the hybrid electric vehicle (HEV), the Plug-In Hybrid Electric Vehicle (PHEV) and the All-Electric Vehicle (EV).

The HEV runs on a traditional combustion engine, but is also powered by an electric motor that receives regenerative power from breaking as well as from the combustion engine. It is not plugged into a charge. One such vehicle, the Toyota Prius, claims 50 miles per gallon (mpg).[10]



The PHEV has a combustion engine, a liquid fuel tank, an electric motor, and a battery that can also be charged using a standard 120V household outlet. A PHEV with a battery that can power 20 or 30 miles of driving provides enough mileage to complete the average daily commute without kicking over to the combustion engine. The fuel tank acts as a range extender for longer drives.

The EV relies solely on electric power and must be plugged in to charge. Battery storage is greater than in the PHEV, so it has a longer electric-only driving range. Charging time, however, is also greater, and to reduce it, some owners have a 240V charging kit professionally installed in their homes before purchasing an EV.

With gasoline prices rising and technology improving, the electric vehicle is becoming a more attractive option to consumers. The Chevy Volt's 38-mile electric range costs an estimated $1.60 in electricity.[11] Consumers sensitive to environmental impacts are attracted to the fact that, when operating in electric-only mode, these vehicles have zero tailpipe emissions.

On the downside, the up-front cost of purchasing a PHEV or an EV can outweigh gasoline prices savings. A Plug-In Hybrid Prius lists for $7,800 more than a base price Prius; and a Toyota RAV 4 EV lists for $26,500 more than a traditional RAV 4.[12] Until a significant reduction in the cost of automotive batteries is achieved, even the tax credits offered on certain electric vehicle models cannot close the vehicle cost-to-fuel savings gap enough for the average consumer to justify the outlay.

Choice Enabling Vehicle Platforms

COMPRESSED NATURAL GAS VEHICLES (CNG) use natural gas compressed into a gas canister. They can be refueled from existing natural gas lines or by home refueling stations that tap into such lines.

BI-FUEL VEHICLES have two separate fueling systems, allowing them to run on either CNG or gasoline. Any existing gasoline vehicle can be converted to a bi-fuel vehicle. Authorized shops can do the retrofitting; this involves installing a CNG injection system and CNG cylinder in the trunk, and minor changes in the vehicle's plumbing and electronics.

DUAL-FUEL VEHICLES use diesel for ignition and run on natural gas.

PROPANE VEHICLES also known as liquefied petroleum gas (LPG) or autogas vehicles, come in two forms: dedicated and bi-fuel. Dedicated propane vehicles are designed to run only on propane, while bi-fuel propane vehicles have two separate fueling systems that enable the vehicle to use either propane or gasoline. There are also two types of fuel-injection systems available: vapor injection and liquid propane injection. In both types, propane is stored as a liquid in a relatively low-pressure tank.

FLEXIBLE FUEL VEHICLES (FFV) can run on any blend of gasoline, ethanol, and methanol – regardless of the ratio. Because of its low incremental cost of roughly $100, in the near and mid-term the FFV is the most cost effective platform for enabling fuel competition.

BATTERY OPERATED VEHICLES store electricity in an on board automotive battery and use the electricity to power an electric motor; they may also have a fuel tank and engine that serve as a range extender.

FUEL CELL VEHICLES run on hydrogen to power an on-board electric motor. The fuel cell converts the chemical energy from the hydrogen into electricity through a chemical reaction with oxygen or another oxidizing agent.

Table 1: Fuel Cost Comparisons				
Competing Fuel	Price at Pump (GGE) ($3.82 for gasoline and $3.70 for diesel as of October 2012)	Incremental Cost for Light Duty Vehicle	Incremental Cost for Heavy Duty Vehicle	Fuel Station/ Pump Cost
Corn Ethanol (E85)	$4.91	$50 to $100	-$15,000[14]	$20,000 for mid-grade conversion $60,000 for new pump
Methanol (M85)	$3.29	$90 to $300	-$15,000 to -$10,000	$20,000 for mid-grade conversion $60,000 for new pump
CNG	$2.12	$7,000 to $13,000	$40,000 to $70,000	$675,000 to $1,000,000
LNG	$2.00	N.A.	$40,000 to $90,000	$530,000
Biodiesel (B20)	$3.82	0	0	Up to $200,000
Biodiesel (B100)	$4.32	0	0	Up to $200,000
Electricity	$2.64 for full charge	$10,000 to $18,000 (PHEV)	$100,000	$1,000 to $3,000

Recommendations

Primary Objective: Open Vehicles to Fuel Competition

The simplest policy pathway to opening vehicles to fuel competition is the Open Fuel Standard (OFS). This technology neutral policy requires that most light duty vehicles sold in the U.S be capable of running on at least some other fuel - whether liquid fuel, gaseous fuel, electricity - in addition to or instead of gasoline or diesel. The OFS also stipulates that flex fuel vehicles must be at the least gasoline-ethanol-methanol compatible to count as fuel competitive. The OFS addresses the chicken and egg issue: who moves first, the automakers or the fuel stations? Although there are more than nine million FFVs on the road that can run on ethanol-gasoline blends up to E85, only a small percentage of the drivers of those vehicles actually use the fuel on a regular basis. In 2009, the Department of Energy estimated that only about 500,000 flex fuel vehicles were regularly fueled with E85 – most of which were operated by fleets.[15]

Retrofitting an existing 10,000 gallon gasoline pump and tank to serve alcohol would cost $20,000 including labor. To install a completely new system, rather than retrofit an existing one, would cost about $60,000. The total investments needed to deliver alcohol to every refueling station in the country would be $12 billion. These are not huge sums, but service station owners would need to see good enough potential demand in order to incur the expense and hassle of retrofitting their equipment. Today, the number of FFVs on America's roads is far too small -- FFVs currently only account for about 3-4 percent of America's passenger cars and trucks --for the private sector to see a business case in installing fueling infrastructure. Market analysts argue that 15 to 20 percent of the cars in a given area need to be capable of running on a given fuel to properly incentivize filling stations to retrofit pumps and tanks or install new infrastructure to serve that fuel. Further, the FFVs sold in the U.S. today have not been warrantied to run on methanol, only on gasoline and ethanol.

The proliferation of gasoline-ethanol-methanol FFVs would send a signal to investors that there is a profit opportunity in expanding production capacity for fuels that can compete with gasoline within a broad range of oil prices. This is particularly true for natural gas-based methanol, which due to low natural gas prices enjoys a substantial price advantage over gasoline on a per mile basis. Over time, this increase in production capacity would lead to a situation where these fuels compete for market share with oil products. This competition would serve to drag down the price of oil even as it pushes up the price of its competitors. Unfortunately, we are headed the opposite way – with the erosion of CAFE credits for FFVs, many industry analysts estimate automakers will sharply cut back the production of those vehicles, and investors would shy from investing in alcohol fuel production.

Over the past decade, several alterations of the OFS have been translated into legislation in both the House and the Senate and in all cases enjoyed bipartisan support. Yet, those bills faced opposition from the automotive industry mostly to do with industry reluctance to spend add flex fuel costs when competing fuels are not generally available at fuel stations.

Despite the fact that the OFS is the most effective, immediate and fiscally conservative tool available to break oil's virtual monopoly over transportation fuel, a strong aversion to mandates among some constituencies presents a tough challenge for this policy's acceptance. In the next section, we present an alternative pathway to achieving a similar outcome - one that avoids the need for a politically challenging mandate.

Domestic Policy Recommendations

A. NEW VEHICLES: FUEL COMPETITION CAFE CREDIT TO AUTOMAKERS THAT OPEN AT LEAST HALF OF THE VEHICLES IN THEIR FLEET TO COMPETING FUELS.

The Congress responded to the Arab Oil Embargo of 1973 by passing Corporate Average Fuel Economy (CAFE) – a law intended to reduce America's dependence on foreign petroleum by improving the fuel efficiency of cars and light trucks. Most recently, EPA and the National Highway Traffic Safety Administration (NHTSA) finalized CAFE standards for motor vehicles, raising the standard to 54.5 miles per gallon (mpg) by 2025. Many analysts are skeptical about the industry's ability to achieve such standards without significantly increasing the cost of new vehicles.

EPA has wide latitude to create incentives for automobile manufacturers to produce cars that are open to competing fuels. In its most recent rulemaking, the Agency developed "multipliers" to increase market penetration of EVs, PHEVs, fuel cell vehicles (FCV), and CNG vehicles sold in model years (MY) 2017 through 2021. The production of any of these vehicles will count as more than one vehicle in a manufacturer's compliance calculation, which helps counterbalance the increased cost of production of those cars and trucks.

Table 2: Energy Densities Compared to Gasoline

Fuel	Volume Ratio
Natural Gas	
CNG	4.8 – 5.9
LNG	1.57
Propane (LPG)	1.29
Hydrogen (LH2)	3.93
Reformulated Gasoline	1.01
Methanol	
M100	2.03
M85	1.76
Ethanol	1.53

However, CAFE's initial energy security centric vision has been blurred by the desire to use the law to promote greenhouse gas emission reduction goals, resulting in a regulatory diminution of the attractiveness to automakers of some fuels and the vehicle technologies that enable their use. While EPA, for example, awarded EV and FCV production the most with a multiplier value of 2.0 in model years (MY) 2017, phasing down to 1.5 in MY 2021, PHEVs and CNG vehicles were given multipliers of 1.6, phasing down to 1.3 in the same time frame. The Agency decided against giving FFVs any multiplier benefit whatsoever. With the lack of CAFE credits for FFVs, automakers may lose the incentive to produce the lowest cost fuel-competition enabling vehicle platforms available in the market today.

Further, CAFE's window sticker metric – miles per gallon (mpg) – causes gasoline to be favored in the public mind. Non-petroleum fuels are less energy dense per volume compared to gasoline (See Table 2) and so attain fewer miles per gallon. Consumers are accustomed to thinking in terms of mpg and how far their car typically travels on a tank of gasoline. **In terms of impact on the consumer's wallet, however, the key metric is cost-per-mile, not miles-per-gallon.**

Recommendations

Congress should provide a fuel competition CAFE credit to automakers that make at least half of their fleet fuel competitive vehicles. This credit should be added to the topline of an automaker fleet's average fuel economy calculation. For flexible fuel vehicles to count as fuel competitive vehicles, they should be gasoline-ethanol-methanol flexible, not just gasoline-ethanol flexible. Compliance with CAFE requirements should also count for automakers as compliance with greenhouse gas regulations under the Clean Air Act.

Congress should ensure that CAFE rulemaking take a performance-based, technology neutral approach, integrating into the CAFE system the goal of reducing the strategic importance of oil rather than viewing it primarily as an instrument to regulate greenhouse gas emissions.

The metric of miles per gallon (mpg) in CAFE should be abandoned as the principal measurement of success. We recommend an educational effort on the pocketbook importance of comparing cost per mile across fuels, rather than miles per gallon. For regulatory purposes, we recommend a shift to a metric that allows apples to apples comparisons among fuels and technologies: miles per gasoline equivalent gallon (mpgg).

B. SECONDARY VEHICLE MARKET: REDUCE RED TAPE FOR CONVERTING GASOLINE AND DIESEL VEHICLES TO COMPETING FUELS

Light-duty fleet turnover is highly contingent on the state of the economy and has wildly fluctuated over the past several years between 15 and 27 years, assuming a fleet size of 240 million vehicles. Consequently, policies that allow for the conversion of existing dedicated gasoline/diesel vehicles to run on competing fuels can help accelerate the penetration of fuel competitive vehicles in the overall fleet, thus increasing incentives for private sector investment in fueling infrastructure.

Allowing consumers greater opportunities to convert their gasoline cars and trucks empowers them to help make a difference – by reducing the importance of oil, improving local air quality, cutting emissions, or saving money at the pump. It also opens the door to mass vehicle conversions by owners of used car lots and to economic conversion offerings by vehicle service chains like Midas and Meineke. Consumers with easy access to filling stations that offer competing fuels can thus take full advantage of those fuels' price advantage over gasoline or diesel.

In general, there are three types of conversions – switching a gasoline or diesel car to run solely on another fuel (dedicated), changing a vehicle to run on higher alcohol blends (flex fuel), or installing an additional fuel tank so the vehicle can burn the competing fuel as well (bi-fuel). In America, however, onerous regulations and staggering cost of conversion has deterred consumers. EPA responded in 2012 by streamlining rules for conversion of gasoline and diesel engines and vehicles, expanding compliance options to include less burdensome demonstration requirements for older vehicles and greater flexibility concerning testing requirements. However, conversion costs remain prohibitively high.

CONVERTING TO NATURAL GAS

The cost of converting a light duty gasoline car to CNG, for example, is roughly $10,000 per vehicle – a substantial sum that is much more than the $3,800 average price tag faced in other parts of the world. For example, in Italy conversion price for cars range from $1,800 for vehicles with carburetors to $3,100 for vehicles with sequential injection systems. In Russia, consumers pay less than $2,000. In developing countries like Pakistan, Thailand and Bangladesh consumers pay even less, converting their vehicles to CNG for under $1,000.

Stricter environmental and safety standards for U.S. vehicles account for some of the cost difference. Over 1/3 of the $10,000 conversion cost here in America is a result of the cost of the approximate 10 gallon, Type IV, carbon-fiber CNG tank. According to industry cost estimates, installation labor and other parts for the conversion system account for another 20 percent plus of the price tag for conversion. The remaining cost of conversion is probably a combination of the price tag of EPA

Nine reasons why fuel competition is good for the environment

1. Oil is the largest contributor to U.S. CO_2 emissions. A variety of competitive fuels have lower lifecycle carbon content than oil based fuels.

2. Oil gets dirtier, other fuels get cleaner. Due to a shift from coal powered electricity to natural gas, nuclear and renewable power, the electricity that fuels EVs and PHEVs becomes cleaner as time goes by. The shift to next generation biofuels, as well as the production of fuel from recycled CO_2, will also deliver environmental benefits. On the other hand, as oil price rises more crude extracted from carbon intensive tar sands and oil shale will flow into the market.

3. Reduce methane flaring. Throughout the world, natural gas producing countries flare methane, a greenhouse gas 72 times more potent than CO_2, at the wellhead. According to the World Bank, 5 trillion cubic feet of methane are flared globally, equivalent to roughly one third of U.S. natural gas consumption. It takes 100 cubic feet of natural gas to produce one gallon of methanol. Opening the door to methanol will entice methane flaring countries to monetize this potent greenhouse gas by capturing it and turning it into usable fuel.

4. Enable CO_2-to-fuel pathways. The most economically sensible way to deal with CO_2 is not to bury it but to use it as feedstock in the production of usable and sellable products. Ethanol and biodiesel can be made from CO_2 soaking algae. Methanol can be made from hydrogenated flue gas emitted by power plants.

5. Absent prosperity, environmental concerns fall to the bottom of the public's priority list. Perpetuating petroleum's virtual monopoly over transportation fuels exposes our economy to painful oil shocks with crippling economic impact. Fuel competition serves to dampen oil prices as it allows consumers to shift on the fly to other fuels and hence would help protect the U.S. economy from recessions.

6. Enable the poor to grow their fuel. Poor, oil dependent countries suffer most from rising oil prices. If cars were open to fuel competition, developing economies would be able to develop their agricultural sector and grow their own fuel on the vast swaths of land currently used, at most, for subsistence farming. Turning degraded land into cultivated land would reduce CO_2 concentrations.

7. Natural gas fuels emit less greenhouse gas than gasoline. Compressed natural gas yields a 28 percent reduction vs. petroleum fuel displaced. Methanol from natural gas yields an 8 percent reduction. Fuel competition would enable natural gas based fuels to compete against oil, something the current fleet does not permit.

8. A growing portion of our oil is drilled offshore. As the BP Gulf of Mexico spill showed offshore drilling presents risks of environmentally devastating spills. Alcohol fuels like ethanol and methanol dissolve in water and are readily consumed by bacteria and therefore pose no risk to the environment or to groundwater in case of spillage or leak. Within a few days of an Exxon Valdez-like alcohol spill, the ocean would be back to normal.

9. Gasoline is detrimental to human health. Today, oil companies use aromatics as octane boosters. Aromatics like benzene, toluene and xylene are toxic, carcinogenic and increase pollution. Alcohol fuels are high octane yet non-carcinogenic and would obviate the need for aromatics.

compliance and certification and excess profit in the system - some industry specialists believe that the regulatory burden imposed by the EPA most likely constrains competition in conversion kit manufacturing, thus creating a market that results in abnormal profits.

Recommendation

The conversion kit market needs to be further deregulated to offer safe, but low-cost conversions for broader consumer adoption of substitute fuels – particularly for older vehicles. Specifically, EPA should allow vehicles that are five years or older to convert to using non-petroleum fuels with a non-EPA certified kit, with minimal tailpipe testing upon completion of installation by a certified installer. Such a program would help guarantee safe installation of tanks, fittings, and any cabin detection ability if needed, while ensuring that post-conversion tailpipe emissions remain as stringent or actually improve.

C. FUEL CERTIFICATION

The Clean Air Act prohibits the commercial introduction of fuels and additives that are not substantially similar to those "certification" fuels used to test vehicles and engines for meeting emission standards. Currently, EPA uses a zero-percent ethanol fuel for certification purposes, with manufacturers using E10 in their durability process for achieving evaporative emissions standards. In addition, all vehicles are designed to run on E10 and still work as if they were powered with gasoline not blended with ethanol. California, however, is moving toward an E10 certification fuel by 2015.

Blends higher than E10 do not meet the Clean Air Act requirement of being "substantially similar." Consequently, in considering higher blends, EPA would either need to certify a new higher-blend fuel or grant a waiver that would allow for its introduction.

The Agency can grant a waiver to the Clean Air Act requirement if it is shown that vehicles and engines would continue to meet their emissions standards over their "full useful life" (e.g., 100,000 or 120,000 miles for light-duty motor vehicles, depending on the vehicle type and model year), despite using the proposed fuel or additive.

In 2010 and 2011, EPA – hoping to create greater market opportunities for ethanol – granted waivers that allow, but do not require, the introduction of E15 (15 percent ethanol and 85 percent gasoline) for use in model year 2001 and newer light-duty motor vehicles. E15,

however, is currently restricted in more than 30 states and not permitted at all in 18 others. The administrative process in clearing those hurdles, including the updating of fuel-specification regulations at the state level, will almost certainly take at least a few years, even in the states friendliest toward ethanol.

More recently, ethanol interests have lobbied EPA to certify E30 (30 percent ethanol and 70 percent gasoline) as a compliance fuel to meet tougher air quality standards – specifically under Tier 3. Certification of a higher ethanol blend would provide a higher-octane fuel that would power a new generation of vehicle engines designed to meet the new CAFE standards.

In the interest of reducing obstacles to fuel competition, EPA's default position, absent clear harms, should be to allow as many fuel blends as possible to enter the market, where they can compete on their economic merits.

Recommendation

Expand the process EPA has recently opened to consider certifying a higher octane fuel in the Tier 3 rulemaking to include all alcohol fuels.

D. FUEL TAX FAIRNESS

The prevailing method of fuel taxation, particularly at the state level – on the gallon, instead of energy content – penalizes non-petroleum fuels due to their lower energy density and thus raises the barrier to consumer acceptance.

Many states continue to tax fuels on a volume basis instead of using energy content – a policy that presents a major obstacle to competing fuels and one that needs to be addressed.

The National Governors Association should review tax policy at the state level with the objective of leveling the fuel tax playing field in mind.

For its part, Congress has taken steps in the past to tax fuels based on their energy content, but the treatment of certain fuels remains a problem. LNG, for example, is penalized vis-à-vis diesel because the excise tax rate faced by both fuels is roughly the same on a volume basis at around $0.24 per gallon. However, since LNG is only roughly 60 percent as energy dense as diesel, it takes 1.7 gallons of LNG to equal the energy content in one gallon of diesel.

When energy content is used as the metric, for the amount of energy contained in one gallon of diesel, LNG faces an effective tax rate of $0.41 compared to the $0.24 that diesel itself faces. This difference results in taxes accounting for a greater share of the total retail cost of liquefied natural gas – 32 percent of LNG's total cost versus only 23 percent for diesel. CNG, in contrast, is taxed by the federal government on an energy basis at about $0.18 per energy equivalent of a gallon of gasoline.

During the 112th Congress, Rep. William Thornberry (R-TX) introduced HR 3832, the LNG Excise Tax Equalization Act, which sought to amend the Internal Revenue Code to provide for the fair treatment specifically of LNG, using energy content as the standard. We encourage a reinvigorated discussion in Congress on the negative impact of the current tax code on competing fuel deployment, not limited to LNG – particularly in the context of tax reform.

Recommendations

Congress should allow fuels equal treatment under the federal tax code by taxing fuels (including LNG) on an energy content basis rather than a volume basis.

Level the tax playing field in the states. State and local governments should tax fuels using energy content – instead of on a volume basis.

E. FLEXIBILITY FOR STATES

Under the Clean Air Act, EPA periodically establishes new national ambient air quality standards (NAAQS) or revises an existing standard to improve public health. In so doing, EPA determines which areas of the country meet or do not meet the standard. States are then required to develop a general plan – technically known as a State Implementation Plan (SIP) – that is submitted to the Agency for approval. SIPs explain how the state will meet and maintain air quality standards across its territory and include details on complying with the NAAQS for each of the state's areas that fail to meet those standards. Specifically, SIPs identify the emissions control requirements that the state will use for compliance and enforcement, including strategies for reducing emissions from stationary and mobile sources.

Current EPA policy, however, makes it relatively difficult for states to gain credit for emissions reductions in the transportation sector, which reduces the demand for competing fuels and related technologies. Consequently, states must rely on cutting emissions further from stationary sources for attainment purposes – a compliance measure that has become increasingly costly.

SIPs potentially affect both large and small businesses, but since EPA has already forced reductions from utilities and larger businesses, the burden to carry the weight forward in the stationary sector will fall on small businesses – most likely with severe job impacts.

Construction bans may also follow during certain hours in order to comply with the new standards. If a state fails to reach EPA's targets, the Clean Air Act allows the federal government to punish that state by cutting federal highway funds, resulting in delayed or suspended transportation projects in cities already experiencing increased traffic and job loss.

Flexibility in Attaining Particulate Matter Reductions

The Clean Air Act requires EPA to set NAAQS for particulate matter (PM) that poses risks to the public health, including aggravation of respiratory and cardiovascular disease. PM includes many types of tiny particles, which differ in terms of their formation, chemical properties, size, mass, and toxicity. PM10 includes particles that are smaller than 10 microns in diameter, while PM2.5 includes even finer particles that more easily damage the respiratory system and pose a greater danger to the public.

PM is made up of particles that are directly emitted by cars, trucks, buses, and stationary sources, as well as secondary particles that are formed in the atmosphere from reactions involving precursor pollutants, such as nitrogen oxides, sulfur oxides, volatile organic compounds (VOCs), and ammonia (NH3). Secondary PM particles, which tend to be the more dangerous PM2.5, are emitted when fossil fuel combustion produces gases that react with sunlight and water vapor.

Vehicles and many stationary sources, such as power plants, thus emit PM directly as well as precursor pollutants that form secondary PM. Cars and trucks, for example, emit toluene, xylene, and trimethyl benzene, which are VOCs and the most significant Secondary Organic Aerosol (SOA) precursors, according to EPA.

Emissions from those compounds have been estimated to be responsible for 50 to 70 percent of total SOA in some air sheds. In turn, pollution studies suggest that the contribution of SOA to particulate matter can vary from 20 to 80 percent during the same day.

EPA, however, admits that the link between SOA and PM2.5 is not well understood – mostly because of modeling uncertainties. Thus, the Agency has not required states to address VOCs in their PM2.5 attainment plans and evaluate control measures. If, however, the state or EPA later demonstrates that controlling VOCs would reduce PM2.5 concentrations in or outside the state, those pollutants would be included in the state's PM2.5 implementation plan, according to the Agency's rulemaking.

It is important to note that EPA does not explicitly prohibit states from including VOCs in their PM2.5

SIP, but the Agency places the burden on the states to "prove" a detailed link between VOC controls and PM attainment. Because complex VOC mobile emissions are incredibly difficult to model, the Agency has in effect taken those reductions off the table by creating a bureaucratic or administrative hurdle that the vast majority of states cannot clear. By doing so, it is also – *unintentionally* – reducing the appeal of fuels that have much cleaner PM profiles, including electricity, the alcohol fuels, and natural gas.

EPA's uncertainty regarding the contribution of VOCs to PM2.5 attainment should not pose a substantial barrier to a state gaining at least some credit for controlling those emissions in its PM2.5 SIP.

A review of PM regulation shows that at the time of the 1990 Clean Air Act amendments, VOCs from mobile sources made a slightly larger contribution to PM2.5 than sulfur dioxide (SO2) emissions from stationary sources (55 percent to 45 percent). Since 1990, stationary sources have been much more regulated by EPA, thus mobile sources have gained a much greater share of the contribution to PM2.5. In fact, EPA estimates that VOCs from mobile sources will contribute roughly 90 percent of PM2.5 by 2020.

Undoubtedly, we can expect little sulfate to be left from power plants after EPA pushes through its planned regulations on coal-fired power plants, including coal ash and New Source Performance Standards (NSPS) for greenhouse gas emissions. Accordingly, EPA will face great difficulty in achieving substantial PM reductions in the future unless it addresses VOC emissions from transport.

If left unchanged over the longer term, EPA's administrative policy towards the VOC-PM link will lead to a dramatic increase in the costs to the states of seeking PM attainment through much more expensive regulation of stationary sources, including small businesses.

Recommendations

EPA should follow an administrative policy of granting states as much flexibility as possible in targeting lower cost VOC mobile source emissions as part of their PM2.5 attainment strategy. At the same time, the Agency should continue to work with the states to develop a model that produces more certainty as to the link between VOCs and PM2.5.

The Congress should consider more innovative solutions, including the creation of a market for particulate matter that would cover one pollutant from multiple sources and sectors. Because compliance options for squeezing the last amount of particulate matter from stationary sources are becoming more and more expensive, a PM market – which would probably be regional-based because of the nature of PM direct and secondary emissions – could provide an avenue for stationary sources, including utilities, to purchase lower-cost offsets in the transportation sector.

F. LEVEL THE PLAYING FIELD ON EMISSION CALCULATION

EPA includes upstream emissions for non-petroleum fuels when determining the CAFE "compliance value" for light-duty vehicles but it does not do so for gasoline. This imposes an unfair burden on electrified vehicles as well as on a variety of substitute fuels. It is particularly important to ensure that progress toward vehicle electrification does not get become entangled in the regulatory shift from coal. Some environmental groups have expressed concerns about the shift to electric vehicles in those parts of the country where power is generated from coal. Taking into account the full cycle of energy production demonstrates that in such areas electric cars may emit more greenhouse gasses than comparable gasoline vehicles. We caution that any efforts to reduce the role of coal in generating electricity should not have negative spillover effects on electric cars.

Recommendation

EPA should not include upstream emissions when determining the CAFE "compliance value" for light-duty vehicles, nor for other purposes. The Agency has never attempted to regulate gasoline-fueled vehicles in such a way. Doing so for BOVs and for the various substitute fuels, while not doing so for gasoline, would serve to enshrine a regulatory driven competitive advantage for petroleum-based fuels.

G. TARGETED RESEARCH TO OPEN TECHNOLOGY BOTTLENECKS

The federal government has been expending resources in various directions of energy R&D. The private sector is and will continue to be the main engine of innovation. Public money allocated to energy research would be best utilized if invested in opening technology bottlenecks which prevent maximizing fuel and vehicle choices.

Recommendation

As part of the government-wide Quadrennial Energy Review (QER) that seeks to align the capacities of the public and private sectors, the administration should identify key technology bottlenecks which inhibit fuel competition in order to better orient federal programs and resources.

THE PROMISE OF VEHICLE ELECTRIFICATION

Electrified vehicles – both plug in hybrids and pure electrics - have the potential to play an important role in reducing the strategic importance of oil. Unquestionably, the country's energy security would improve with a substantial deployment of electrified vehicles, given the diverse fuel mix that generates electricity. Vehicle electrification increases the number of energy sources able to participate in the transportation sector adding nuclear, coal, natural gas, hydro-power, wind, and solar to the fuels market.

America already has a substantial network of electricity infrastructure, and if technology breakthroughs result in significant cost reductions in battery storage, the country could also benefit from the efficiency advantage provided by electricity. For example, if 1,000 cubic feet of natural gas were used to produce fuel for a pure EV, it would provide enough energy for that car to travel over 450 miles, compared to the roughly 225 miles that a natural gas vehicle could drive on the same amount of fuel, according to a 2010 report from MIT.

Congress and recent administrations have provided a policy framework in support of vehicle electrification. The Energy Independence and Security Act of 2007 provided important provisions for battery operated vehicles. The Emergency Economic Stabilization Act of 2008 provided tax credits of up to $7,500 per car to early adopters. The American Recovery and Reinvestment Act of 2009 allocated $2.4 billion in loans to three electric vehicle factories in Tennessee, Delaware, and California and an additional $2 billion in grants to support 30 factories that produce batteries, motors, and other EV components. Additional funds were committed to various transportation electrification demonstration and deployment projects. Sales of battery operated vehicles in the United States are growing steadily. Unfortunately, the technology has become embroiled in partisan politics and unwarranted stigmatization. As with any new technology there may be technical malfunctions, bankruptcies and teething problems as the technology makes its way to the mass market. These are normal artifacts of creative destruction , and should be understood as such.

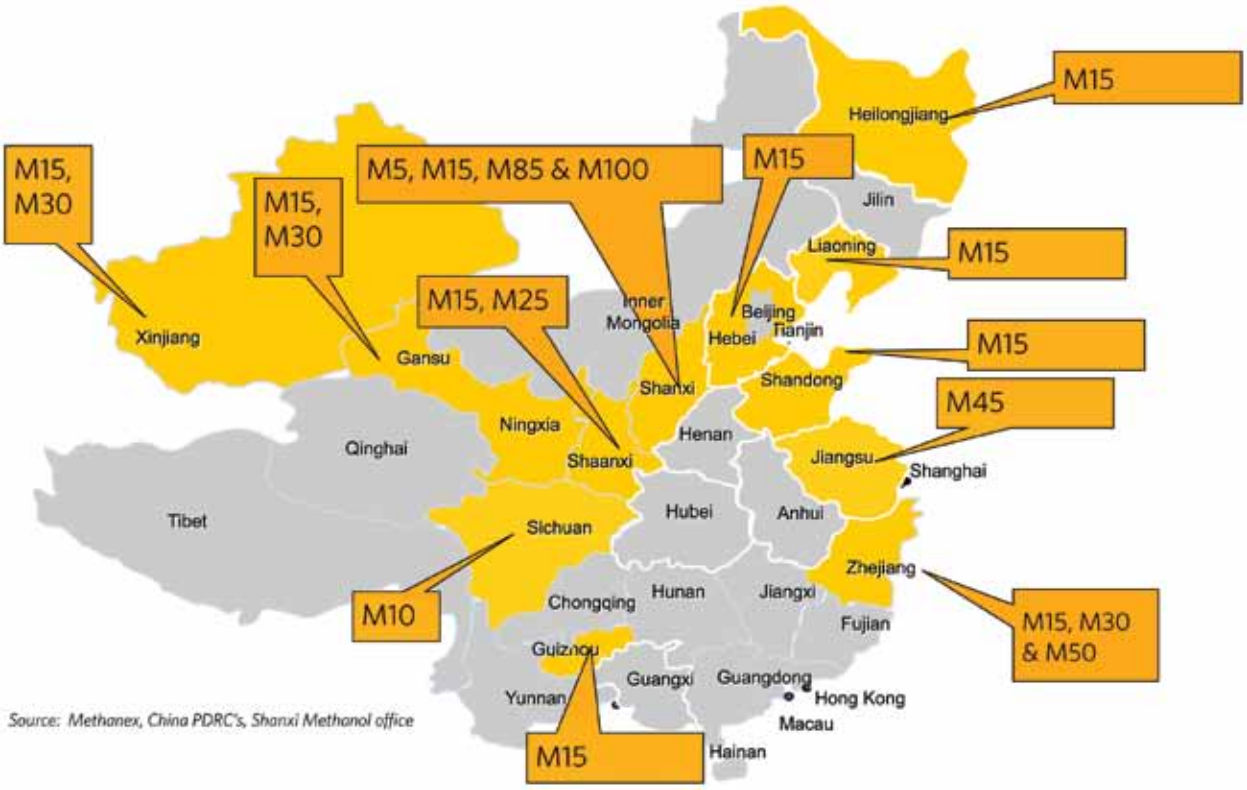
Building a Global Fuel Choice Agenda

Since eighty percent of the world's oil is consumed outside of the U.S. and more than three quarters of the world's automobiles are used overseas, breaking oil's virtual monopoly over transportation fuels requires the U.S. to encourage its allies and other major economies to pursue the same goal in their domestic markets. The U.S. should lead the charge in building a global agenda to achieve fuel competition in as many countries as possible with an emphasis on developing Asia - the world's fastest growing oil consuming region and the world's fastest growing automobile market. Developing Asia's crude oil demand is projected to almost double by 2035, yet, relative to its needs, Asia is poor in oil. However, it is well endowed in energy sources like coal, conventional and non-conventional natural gas and biomass, all of which can be converted to automotive fuel. Asian countries like Thailand, India and Malaysia exhibit large and growing fleets of CNG vehicles. Methanol is now being blended or tested in 26 out of China's 31 mainland provinces. Indonesia and Malaysia have set their sights on biofuels. Many Asian countries are developing and introducing EVs and recharging infrastructure, thus integrating into the transportation system energy sources that to date have been excluded from it such as solar, wind, hydro, geothermal and nuclear power. Asia is also important due to the fact that one half of the world's new vehicles are manufactured in China, Japan and South Korea. It is in America's interest to ensure that most of these vehicles will be fuel competitive and that a variety of fuels have access to the marketplace.

Growing demand for oil in the developing world is not only a growing economic burden but also the source of an all-encompassing health challenge. Motor vehicles have emerged as the chief culprit behind air pollution in major cities in China and the rest of the developing world. Given the expected growth in the global passenger fleet, America's effort to accelerate the proliferation of cleaner burning competitive fuels could play a major role in reducing toxic air pollution in developing countries and hence contribute to human health and prosperity.

A. FORM A U.S.-CHINA-BRAZIL ALCOHOL FUELS INITIATIVE

The U.S. and Brazil are the world's largest ethanol producers. China is the world's largest methanol producer. All three countries are pouring billions of gallons of alcohol into their fuel supply and have deployed millions of alcohol-fueled vehicles as well as refueling infrastructure. The growth and the expansion of the methanol fuel market in China could provide invaluable insight on opening the U.S. market to the era of cheap natural gas; China, for its part, could gain insights from America's and Brazil's long experience with ethanol blending. China and the U.S. are the world's largest auto markets and both nations have shared interest in accelerating the deployment of tri-fuel vehicles.



China's methanol blending program

Methanol is now blended or tested in 26 out of China's 31 provinces. China's methanol annual production capacity (unlike in the rest of the world in China methanol is produced from coal) has grown from 2 billion gallons in 2003 to 15 billion gallons today, about the size of America's ethanol industry. China has more than 200 methanol factories nationwide. Within less than a decade China's methanol use in the transportation sector grew from virtually zero to a point it replaced eight percent of the country's gasoline demand. M15, a blend of 15 percent methanol and 85 percent gasoline is offered widely in several provinces and light duty vehicles use it regularly without any impact on the engine.

Other provinces are testing and deploying M30, M45, M60, M85 and M100. Those blends are substantially cheaper than gasoline. In Shanxi province roughly 100,000 taxis were converted to run on M100 and M85. By 2015, 200,000 additional light duty vehicles will be converted to use methanol. Hundreds of buses and commercial vehicles already run on M100 and M85 and 50,000 methanol heavy duty trucks are planned to be introduced. Chinese automakers like Cherry, Geely, FAW, Shanghai Automotive, and Maple have rolled out cars that can run on M100 or M85. There have been hundreds of millions of refuelings with methanol and no health problems were observed among the thousands of workers who deal with methanol on a daily basis and the motorists fueling their cars. Methanol has also yielded an improvement in air quality. Shanxi officials report a 20 percent decrease in CO, NOx and Benzene emissions and a 70 percent reduction in particulate matter.

Recommendation

Form a U.S.-China-Brazil Alcohol Fuels Initiative to advance cooperation of the three major alcohol producing countries in all matters related to alcohol fuel blending and to engage with other countries who are planning to introduce alcohol fuels programs. Activities under the alcohol fuels initiative will include joint standards and development, joint pilots and demonstrations, joint technical roadmaps, fueling infrastructure development, environmental studies, public awareness and engagement.

The initiative can be expanded to include other countries with robust alcohol fuels programs. One such country is Israel. In light of the massive discoveries of natural gas off of Israel's coast, in January 2013, the Government of Israel passed a resolution to examine standardization processes which would allow for the use of gasoline-methanol blends, at a level of 15 percent methanol, as well as mixtures with an even higher concentration of methanol, at levels of 30 percent to 85 percent. Israel has recently completed a national M15 pilot, and it is now embarking on an additional pilot examining the adoption of mid-level blends.

B. EXPAND INTERNATIONAL COLLABORATION ON ELECTRIC VEHICLES

The electrification of transportation has been a common goal to the U.S., China and most OECD countries. Announced in 2009, the U.S.–China Electric Drive Initiative provided the foundation for U.S-China collaboration on this field, focusing on research on advanced battery technologies, demos and testing, safety, battery recycling and the development of codes and standards. Despite a number of collaborative international efforts, the electrification of transportation still faces significant barriers to mass market penetration.

Recommendation

Increase participation in these programs with specific focus on those research areas that could lead to significant cost reduction in automotive batteries.

C. FACILITATE FUEL CHOICE FOR SECONDARY MARKET VEHICLES

Nearly one billion petroleum-only vehicles are on the road worldwide. In many parts of the world, the economics of engine retrofits to allow vehicles to run on alcohols and/or natural gas are compelling. Yet in some regions, there is a large regulatory burden on retrofits and consumers are denied the option to purchase fuels that on a cost-per-mile basis are cheaper than petroleum fuels. This leads to phenomena like illegal blending and unsafe vehicle conversions which often result in accidents and loss of life. In collaboration with other interested countries and major industry players, the U.S. can play a role in proposing rules, standards and best practices to allow car owners around the world to safely retrofit their gasoline-only vehicles to run on other fuels in addition to gasoline.

Recommendation

Work with other countries and industry to develop international standards for aftermarket retrofits to flexible fuel vehicles and CNG vehicles and refueling infrastructure.

D. DRIVE THE REPLACEMENT OF AROMATICS IN GASOLINE

Aromatic compounds commonly known as BTX – for benzene, toluene, and xylene – are often added to boost the octane rating of gasoline. Those aromatics are known to cause upper respiratory problems, and benzene is a widely recognized carcinogen. The inherently high octane ratings of alcohol fuels eliminate the need for these additives.

Recommendation

Issue educational materials to foreign governments on the health benefits of substitute fuels in displacing aromatics in gasoline as well as reducing particulate matter emissions.

E. EXPAND THE U.S.-CHINA SHALE GAS RESOURCE INITIATIVE

China is by far the world's largest reserve holder of shale gas. Yet, due to a combination of political and technological reasons, thus far it has not followed U.S. footsteps in utilizing this resource. Developing the shale gas sector in China and other countries is in the U.S. interest as it will expand the world's resource base and reduce developing Asia's reliance on natural gas imports from countries like Russia and Iran. It could also augment China's coal-to-methanol program by adding natural gas-derived methanol.

Recommendation

Collaborate with China and other emerging shale gas producers on the development of new fracking techniques, new fracking fluids, safety standards and environmental best practices.

F. ENGAGE IN INTERNATIONAL EFFORTS TO REDUCE METHANE FLARING

With North Dakota becoming America's fourth largest oil and gas producing state, the U.S. recently joined the unflattering list of the world's top ten methane flaring nations. Methane emitted into the atmosphere traps 72 times more heat than carbon dioxide. Methanol enables the monetization of methane that would otherwise be flared. About ten percent of the world's flared natural gas would be sufficient to produce 50 billion gallons of methanol - enough to fuel fifty million cars.

Recommendation

As part of the World Bank Global Gas Flaring Reduction Partnership, the U.S. should collaborate with major methane flaring nations on identifying economic and environmentally sustainable strategies to turn unused methane into usable fuel.

Appendix: Solving the RFS Dilemma

America's renewable fuel program for transportation is defined largely by the mandates and targets established by the Renewable Fuel Standard (2005) and Renewable Fuel Standard 2 (2007) – hence referred to as the RFS, which was adopted with strong bi-partisan, environmentalist, and industry support. Yet a few years later, pressure is mounting to reform or repeal the RFS. Already, opposing camps are gearing up for a major struggle – with ethanol interests who wish to preserve the mandate facing off against the oil and refining sector, livestock and poultry groups, food interests, and some environmentalists.

BOTH MAINTAINING THE RFS STATUS QUO AND REPEALING THE MANDATE ARE POLITICALLY CHALLENGING PROPOSITIONS. THE RECOMMENDATIONS PRESENTED IN THIS REPORT HAVE OFFERED A THIRD WAY.

Repealing the RFS without a broader reform that negates the need for the mandate and brings us closer to a truly competitive market in fuels would perpetuate oil's virtual monopoly and expose America to further threats from OPEC. Equally distortive would be the perpetuation of the monopoly that the RFS gives ethanol for the additive market, preventing feedstock competition.

Because ethanol is blended with gasoline at the terminal level to boost octane – which improves the fuel's performance, the recent reduction in gasoline demand in the U.S. has resulted in a corresponding drop in the amount of ethanol demanded by refineries and blenders – and lower than what was anticipated when the RFS targets for ethanol blending were approved in 2007.

Currently, most ethanol is sold to the public in the form of E10, which has been allowed by EPA for use in conventional motor vehicles for the past 30 years. With present gasoline consumption levels (roughly 130 billion gallons) and E10 blending, we can assume a ceiling for demand – otherwise known as the "blend wall" – of about 13 billion gallons of ethanol blending into the gasoline pool.

The "blend wall" is raised or lowered by the demand for gasoline and/or the amount of ethanol that EPA allows to be blended into gasoline – a regulatory process that is separate from the RFS under Section 211 of the Clean Air Act. Accordingly, an additional drop in the demand for gasoline would further lower the "blend wall" or an approval of a higher blend than E10 by the Agency would increase it.

Although the RFS has no explicit regulatory link to the "blend wall," its implementation, in practice, (i.e., the compliance ease or difficulty with blending the required amount of ethanol into the gasoline pool) is determined by this ceiling – for both corn and advanced ethanol. Thus, over the next several years, the "blend wall" will probably determine the success or failure of the RFS mandate.

While demand for gasoline is dropping, the RFS requires an escalation in the amount of corn ethanol gallons mixed with gasoline – from 13.2 billion in 2012 to 13.8 billion in 2013, reaching a peak of 15 billion gallons in 2015, a target that remains consistent until 2022. Almost all gasoline in America is already blended with 10 percent ethanol, while the 15-billion gallon target in two years would represent about 13 percent by volume of all gasoline used – more than what the current "blend wall" allows. Hence, the targets under the RFS mandate have already reached the "blend wall" and are beginning to exceed the market demand for blending ethanol into gasoline.

Undeniably, the inability to absorb all of the mandated corn ethanol in the nation's gasoline pool certainly deters investment in other competing fuels, including methanol, which is cheaper than ethanol and can be made from America's cheap natural gas, as well as advanced biofuels.

Achieving the RFS blending requirements over the coming years will be next to impossible without tearing down the "blend wall." To accomplish this objective, we would need real market penetration of higher-percentage ethanol blends, which first requires a process for certifying new fuels and an increase in flex-fuel vehicles on the road – earlier recommendations in this report.

If our recommendations in this paper are followed, much of the problem represented by the RFS would be addressed – though we recognize that our suggestions and the time necessary to implement them would not grant relief to obligated parties and consumers in the near term.

The blending requirements for conventional ethanol under the RFS would become obsolete if a higher ethanol blend successfully penetrated the market – which could occur if Congress and the Administration followed our recommendation in opening up a certification process for competing fuels and appropriately incenting automakers to produce flex fuel vehicles.

Endnotes

1 "Reduce Oil Dependence Costs," U.S. Department of Energy, Energy Efficiency & Renewable Energy, http://www.fueleconomy.gov/feg/oildep.shtml

2 Crane, Keith et al. "Imported Oil and U.S. National Security," Rand Corporation, 2009, pp. 97. http://www.rand.org/content/dam/rand/pubs/monographs/2009/RAND_MG838.pdf

3 M. Wang, M. Wu and H. Huo, Life-Cycle Energy and Greenhouse Gas Emission Impacts of Different Corn Ethanol Plant Types (2007), Argonne National Laboratory, http://iopscience.iop.org/1748-9326/2/2/024001/pdf/erl7_2_024001.pdf

4 US Department of Energy, Energy Efficiency & Renewable Energy, http://www.fueleconomy.gov/feg/ethanol.shtml

5 National Biodiesel Board, http://www.biodiesel.org/policy/federal-affairs

6 US Department of Energy, Energy Efficiency & Renewable Energy, http://www.afdc.energy.gov/vehicles/diesels_emissions.html; EPA Report, A Comprehensive Analysis of Biodiesel Impacts on Exhaust Emissions (2002); National Renewable Energy Laboratory (NREL), Effects of Biodiesel Blends on Vehicle Emissions (2006)

7 US Department of Energy, Energy Efficiency & Renewable Energy, http://www.fueleconomy.gov/feg/bifueltech.shtml

8 US Department of Energy, Energy Efficiency & Renewable Energy, "Clean Cities Alternative Fuel Price Report", October 2012 http://www.afdc.energy.gov/uploads/publication/afpr_oct_12.pdf

9 American, Abundant… and Affordable?: A Cost Analysis of Natural Gas Vehicles (NGVS) and Fueling Infrastructure, Autogas for America, http://autogasforamerica.org/pdf/Alternative%20Fuel%20Fact%20Brief-%20Natural%20Gas.pdf

10 Toyota Prius Website, http://www.toyota.com/prius/#!/Welcome

11 Chevy Volt Website http://www.chevrolet.com/volt-electric-car/faq.html

12 Toyota Website http://www.toyota.com/

13 "Ford Predicts Fuel from Vegetation," New York Times, 20 September 1925, pp. 24.

14 "Alcohol Boosted Turbo Gasoline Engines," Working Document of the National Petroleum Council Future Transportation Fuels Study, Made Available August 1, 2012 http://www.npc.org/FTF_Topic_papers/4-Alcohol_Boosted_Turbo_Engines.pdf

15 Stacy C. Davis, Susan W. Diegel, and Robert G. Boundy (June 2011). Transportation Energy Data Book: Edition 30, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy, http://cta.ornl.gov/data/tedb30/Edition30_Full_Doc.pdf. Retrieved 2011-08-28. See Table 6.1 pp. 6–3.

16 "EPA Announces Final Rulemaking for Clean Alternative Fuel Vehicles and Engine Conversions," EPA, Office of Transportation and Air Quality, EPA-420-F-12-058, August 2012, http://www.epa.gov/otaq/consumer/fuels/altfuels/documents/420f12058.pdf

17 "California Certification Fuel," California Environmental Protection Agency, Air Resource Board, November 1, 2012, http://www.arb.ca.gov/fuels/gasoline/certfuel/certfuel.htm

18 Alternative Fuels Data Center, http://www.afdc.energy.gov/fuels/ethanol_e15.html

19 Simon Workman and Jaime Rall, "Taxation of Alternative Fuels," National Conference of State Legislators, http://www.ncsl.org/issues-research/transport/taxation-of-alternative-fuels.aspx

20 NGVAmerica. "Statement of NGVAmerica: United States Senate Energy and Natural Resources Committee," July 24, 2012.

21 "New PM-2-5 NAAQS prompts strong reactions," Enviro.BLR http://enviro.blr.com/environmental-news/air/CAA-air-regulations/New-PM-2-5-NAAQS-prompts-strong-reactions/

22 Environmental Protection Agency. "Clean Air Fine Particle Implementation Rule; Final Rule," 40 CFR Part 51, pp. 20593.

23 Ibid

24 Environmental Protection Agency. "The Benefits and Costs of the Clean Air Act from 1990 to 2020 – Final Report," Table 5.3, March 2011.

USESC Members

HON. NORMAN AUGUSTINE
FORMER CHAIRMAN, LOCKHEED-MARTIN; FORMER UNDER SECRETARY OF THE ARMY

HON. WILLIAM L. BALL
FORMER SECRETARY OF THE NAVY

GEOFFREY BIBLE
RETIRED CHAIRMAN & CEO ALTRIA GROUP, INC.; RETIRED CHAIRMAN, KRAFT FOODS INC.

HON. JOHN BLOCK
FORMER SECRETARY OF AGRICULTURE

HON. HAROLD BROWN
FORMER SECRETARY OF DEFENSE

GENERAL WESLEY CLARK
FORMER SUPREME ALLIED COMMANDER EUROPE

HON. WILLIAM P. CLARK
FORMER SECRETARY OF THE INTERIOR; FORMER NATIONAL SECURITY ADVISOR

GENERAL CARLTON W. FULFORD, JR.
FORMER DEPUTY COMMANDER IN CHIEF, UNITED STATES EUROPEAN COMMAND

HON. C. BOYDEN GRAY
FORMER WHITE HOUSE COUNSEL; FORMER AMBASSADOR TO THE EU

HON. ALAN GREENSPAN
FORMER CHAIRMAN OF THE FEDERAL RESERVE

HON. STEPHEN HADLEY
FORMER NATIONAL SECURITY ADVISOR

HON. JEFFREY K. HARRIS
FORMER DIRECTOR OF THE NATIONAL RECONNAISSANCE OFFICE

HON. GARY HART
FORMER SENATOR FROM COLORADO

JOHN HOFMEISTER
FORMER PRESIDENT, SHELL OIL COMPANY

HON. J. BENNETT JOHNSTON
FORMER SENATOR FROM LOUISIANA AND CHAIRMAN OF THE SENATE ENERGY COMMITTEE

HON. JOHN LEHMAN
FORMER SECRETARY OF THE NAVY

MIKE LEVEN
PRESIDENT, LAS VEGAS SANDS

GOVERNOR LINDA LINGLE
FORMER GOVERNOR OF HAWAII

GENERAL BARRY MCCAFFREY
FORMER DIRECTOR OF THE WHITE HOUSE OFFICE OF NATIONAL DRUG CONTROL POLICY

HON. ROBERT C. MCFARLANE
FORMER NATIONAL SECURITY ADVISOR

WILLIAM J. O'BRIEN III
CHAIRMAN & CHIEF EXECUTIVE OFFICER, O'BRIEN ENERGY COMPANY

PROFESSOR GEORGE OLAH
NOBEL LAUREATE IN CHEMISTRY

HON. WILLIAM PERRY
FORMER SECRETARY OF DEFENSE

HON. MARY PETERS
FORMER SECRETARY OF TRANSPORTATION

T. BOONE PICKENS
CHAIRMAN, BP CAPITAL

GOVERNOR TOM RIDGE
FORMER SECRETARY OF HOMELAND SECURITY

HON. JAMES G. ROCHE
FORMER SECRETARY OF THE US AIR FORCE

HON. GEORGE P. SHULTZ
FORMER SECRETARY OF STATE; FORMER SECRETARY OF TREASURY

MARTIN E. TOOMAJIAN
PRESIDENT, ENERGY, HEALTH, AND ENVIRONMENT, BATTELLE

HON. JOHN C. WHITEHEAD
FORMER DEPUTY SECRETARY OF STATE; FORMER CO-CHAIRMAN OF GOLDMAN SACHS

HON. R. JAMES WOOLSEY
FORMER DIRECTOR OF CENTRAL INTELLIGENCE; CHAIRMAN OF THE FOUNDATION FOR DEFENSE OF DEMOCRACIES

The United State Energy Security Council (USESC) is a project of the Institute for the Analysis of Global Security (IAGS)

The Institute for the Analysis of Global Security (IAGS) is a non-profit public educational organization dedicated to research and public debate on issues related to energy security. IAGS seeks to promote public awareness to the strong impact energy has on the world economy and security and to the myriad of technological and policy solutions that could help nations strengthen their energy security. Visit us online at www.iags.org

The United States Energy Security Council (USESC) is a high-level extra-governmental group of former cabinet secretaries, retired senators and governors, military and business leaders working to strengthen US energy security. Visit us online at www.usesc.org

We thank George David Banks for his contribution to drafting this report and the Fuel Freedom Foundation for its generous support.

The Institute for the
Analysis of Global Security

www.iags.org