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Fueling the Future: Policy-Based Comparison of Alternative Automotive Fuel Sources

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Fueling the Future:

A Policy-Based Comparison of Alternative Automotive Fuel Sources

*by Chris Stefan**

Introduction

The issues of energy supply and climate change are inseparable. With the world's demand for energy expanding, and concerns about climate change growing, policy decisions need to acknowledge the nuances of both problems. Fuel supply for the automotive sector represents the most obvious area where these issues overlap.

While efficiency increases in traditional hydrocarbon-based fuel sources are sure to continue, world economic growth will necessitate alternative energy resource development. Options available for change in the automotive sector include: (1) switching to technology that uses an alternative fuel source; or (2) increasing fuel efficiency using fossil fuels. A brief analysis of these two policy considerations is presented in this article.

World economic growth will necessitate alternative energy resource development.

The first section of this article will discuss viable fuel source options that may be the answer to our increasing energy needs; the common problems within each fuel source genre will also be discussed. The second section explores options that policymakers—on the local, state, and national level—can make to increase acceptance and prevalence of such alternatives.

Viable Fuel Source Options

There are presently seven viable fuel sources for automotive use.[1] These options include six alternative sources: ethanol, methanol, compressed natural gas, bio-diesel, hydrogen, electricity, and, of course, petroleum. These fuel resources can be separated by the nature of their production into three categories: (1) fuel sources that must be manufactured (requiring "energy to make energy"); (2) agricultural sources; and (3) fossil fuels. Regardless of the option chosen, legal strategies will play a pivotal role in both the final decision and the speed at which the transition is implemented.

It is important to remember that every viable option available today has considerable problems, some of which may be alleviated by future technology, and others that will need to be mitigated through regulation. When considering the environmental impacts of alternative fuel sources, the discussion must not be limited to only the impact on greenhouse gas ("GHG") levels, other environmental and economic impacts from these decisions must be analyzed.

For example, fuel sources that require "energy to make energy" may increase society's reliance upon traditional sources of energy, i.e. coal, natural gas, hydroelectric, or nuclear. Expanding the use of traditional energy sources will lead to an increase of the environmental and economic problems currently attributed to them (such as GHG emissions) and may result in economic repercussions by complicating the pricing for these existing energy services. In the case of agricultural sources, increasing pesticide use to result in higher yields will impact the environment and human health. As a result, reliance on agricultural sources may complicate the food and water markets that are currently in place. Additionally, the drilling and transportation of fossil fuels can lead to environmental contamination upon the occurrence of accidents. Geopolitics can influence supplies of fossil fuels; as a result, increasing utilization of fossil fuels will maintain the current system of economic vulnerability in producing nations.

Fuel Sources That Must Be Manufactured

Methanol

Methanol is an alcoholic compound capable of use as a fuel source; virtually all domestic methanol uses methane derived from natural gas associated with increased carbon emissions.[2] Research and development shows the weakness of methanol as a potential fuel because utilization results in low fuel economy and high costs.[3] Additionally, methanol requires additives to run an engine negating many of its advantages (i.e. high octane ratings).[4] Methanol can also have serious negative effects on human health and the environment[5] in addition to other environmental concerns associated with the leakage of methanol.

Regardless of the negatives, independent technological research in methanol continues, specifically focusing on the use of methanol as a potential hydrogen carrier for fuel-cells.[6] While use of these fuel-cells would still result in emissions of carbon dioxide at the point of use,[7] the greatest amount of GHG emissions in an economy that uses methanol as a fuel-cell carrier will be in the production of methanol itself.[8]

Hydrogen

Hydrogen is a source for automotive power that is associated with the use of fuel-cell technology. Hydrogen is a secondary

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source of energy, and increased levels of energy are necessary to safely transport it,[9] resulting in a high price of fuel for these vehicles. Additionally, the fact that hydrogen is highly combustible creates a safety concern.[10] This technology poses the risk of increased explosions resulting from traffic accidents, leading to high insurance-costs for these kinds of vehicles. The combustible nature of hydrogen also adds to the cost of transporting it. The use of "carriers," such as methanol and ethanol, might mitigate the risk of explosion in transporting hydrogen.[11] Unfortunately, this technology is not yet developed.

Electricity

Electric cars are able to tap into the preexisting complex electric infrastructure. The attractiveness of this car is unfortunately limited by a shortfall in battery technology.

The electric batteries used to power the vehicles are far more expensive than other batteries.[12] The most recently developed electric vehicles utilize lithium ion batteries.[13] These batteries have several problems, including a tendency to catch fire,[14] and such fires may have liability and litigation consequences. The life-cycle approach results in problems regarding recycling the batteries at the end of the car's life, a cost that will eventually be passed onto the consumers of the vehicles themselves. In addition, the limited range of the batteries and the need for battery re-charging may reduce the likelihood of widespread consumer acceptance.[15] The problem of re-charging would also complicate the utility market for electricity, as increases in demand could potentially overwhelm current systems.

Common Problems With Manufactured Fuels

All three of these fuel-options are most efficiently produced by non-renewable fossil fuels.[16] The resulting need for "energy to make energy" does not contribute to a reduction of GHG emissions. A solution is to investigate alternative energy resources that can efficiently produce methanol, electricity, and hydrogen. Nuclear energy is an option, but this source poses significant environmental and safety concerns. Hydro-electric power is also a consideration, but it is limited in availability and unlike nuclear power, it is not climate neutral.[17] Other primary sources of renewable power, such as wind, solar, geothermal, and wave, are not adequately developed to satisfy the market at this time.[18]

As a result, the environmental impact of all three of these options is largely dependent upon the method of production. Without adequate advances in the renewable sources listed above, a reliance upon any fuel source that must be manufactured will increase the demand for coal, natural gas, nuclear, and/or hydroelectric production. Consequently, policymakers need to realize that a reliance on manufactured fuel source must be coupled with an increase in the development of other alternative energy sources.

Agriculturally-Based Energy Products

Ethanol

Experts have shown that ethanol produced from corn, the most prevalent method of production in the United States, is inefficient.[19] Sugarcane-based ethanol, which is prevalent in Brazil, is a more efficient source of fermentable carbohydrates than corn. Cellulosic ethanol (ethanol fuel produced from cellulose) uses agricultural waste and shows promise in terms of efficiency; however, the technology has not yet reached maturation.[20] Furthermore, whether agricultural waste can produce enough cellulosic ethanol to provide for the entire automotive fuel market is an unanswered question.

Other problems with ethanol, regardless of its source, include the difficulty of transporting it to market, land use change for the cultivation of the input products, increased water consumption, and increased levels of nitrogen emissions. Ethanol also requires refinement, thus its overall efficiency would have to improve dramatically to justify it as an option.

Biodiesel

Biodiesel is considered a clean burning alternative fuel, produced from domestic, renewable resources (such as new and used vegetable oils and animal fats), that results in reduced carbon emissions. Additionally, biodiesel proponents argue that the process of growing plants to manufacture the fuel will act as carbon sinks, offsetting the emissions. However widespread use of bio-diesel will likely lead to land use change, another major contributing factor to climate change.[21] Concerns over water consumption also exist, as hydro-politics in many areas are currently complex. In addition, research suggests that biodiesel use may lead to increased human health impacts.[22]

Common Problems With Agriculturally-Derived Fuels

Both bio-diesel and ethanol share common problems. By relying on society's ability to grow a necessary food source, we would be placing our fuel supply at the mercy of the climate that is currently changing and may impact agriculture. Heat waves, forest fires, droughts, and other potential impacts from climate change could place the food and energy supply in jeopardy. The regulatory measures that need to address this problem include requiring a reserve capacity of whatever fuel utilized. This would require the producers of these fuel sources to be able to supply *more fuel* than the market demands, thus, the efficiency of either source would have to increase dramatically to be a reliable source.

The environmental impacts of a large-scale transition to agriculturally-based energy products are not entirely known. However, increases in land-use change, increased use of fertilizer and pesticides, increased water consumption, and perhaps increases in air or water pollution depending upon the method of production are all possible negative effects. Further, in areas of food scarcity using agriculture to produce fuel may result in dire conflicts.

Fossil Fuels

Compressed Natural Gas

Compressed natural gas is a fossil fuel, and because it is a finite resource, it is subject to price fluctuations and eventual depletion. If used as automobile fuel, it will likely increase natural gas utility prices and further complicate the larger energy and climate picture. In addition, increasing the value of natural gas would lead to an increase in expeditions to find potential sources of natural gas, which is often found in areas rich in crude oil.

Discoveries of sources of crude oil usually leads to lower prices for products derived from it, such as gasoline, diesel, and jet fuel. These discoveries and the subsequent price decrease of gasoline would slow the transition and stagger investment in alternative fuels. Given these drawbacks, the costs of creating a compressed natural gas infrastructure appear unjustified. Additionally, while fossil fuels represent the cheapest source of automotive fuel at the current time, policy-makers must remember that fossil fuels are exhaustible resources, and that eventual depletion is possible.

Encouraging The Changes

The next question to be tackled is how to encourage people to trust and purchase alternative fuel-powered vehicles. While concerns about the environment and energy supply are present amongst the populace, *economics determine consumer actions*. In order to make the economics of alternative fuel vehicles more attractive to consumers the tax code must be adjusted and research and development must be encouraged by subsidizing such projects. Policymakers must understand the importance of these changes in order for alternative fuels to become the norm in our society.

Tax Credits And Deductions

One of the easiest ways to encourage alternative fuel vehicle purchases is to increase the price of petroleum products. However, taxes on petroleum products are politically unpopular. Absent large changes in political will, this policy decision is unlikely to be chosen.

Tax credits and deductions *are* politically popular, and could have a large effect on encouraging consumer transition to alternative fuel sources. In the Energy Policy Act of 2005, dollar for dollar tax credits are allowed for purchasers of new alternative powered vehicles, or highly efficient vehicles. The policy implications of this Act is that consumers who can afford to purchase new alternative fuel-powered vehicles may be rewarded for doing so.[23] Some states have also enacted similar tax incentives for the purchase of alternative vehicles. However, the downstream market of used-vehicles purchases is largely unaffected, limiting the overall impact that such policies may have. Regardless, tax credits and deductions are still mechanisms for policymakers to convince American consumers to consider alternatively powered automobiles.

Additional Incentives To Promote Alternative Fuel Vehicles

Other laws can be enacted to provide small incentives to encourage more consumers to utilize alternative fuels. For example, many states have carpool lanes in metropolitan areas, designed to relieve traffic congestion. In California, owners of alternative fuel vehicles and hybrid vehicles are allowed to use the carpool lanes regardless of the number of passengers.[24] Similar programs in other metropolitan areas, along with the inclusion of all kinds of alternative vehicles in these programs, could provide further encouragement. Additionally, minor local tax incentives can encourage parking lots to allow preferential parking for alternative fuel vehicles, or cities could waive parking meter payments for alternative vehicle owners. Even though such policies would require enforcement mechanisms to be instituted to protect against fraud, the fines collected from offenders could help to mitigate the program's costs.

The Importance Of Subsidies

Another method to promote a policy change is to encourage the government to support the development of alternatives as viable substitutes. Absent major breakthroughs in research, all of the renewable energy sources will require government subsidies in order to develop into permanent solutions.

At the federal level, the Energy Policy Act of 2005 is subsidizing alternative energy development by slowly increasing the minimum percentage of alternative automotive fuel sold or dispensed to consumers.[25] Grants have been authorized to fund research on improving hybrid utilization,[26] improving traditional fuel efficiency,[27] as well as other programs. Funding alternative fuel infrastructure and development will continue to increase, as it becomes a more prevalent concern among the electorate.[28]

Hydrogen[29] and ethanol[30] have received the lion's share of the distributed subsidy funds. This may reflect that these alternative fuel sources are favored by interest groups capable of influencing the political system; it may also reflect piqued consumer interest.

Common Problems

Despite the policy efforts taken by the government, alternative fuel sources still represent a small portion of the automotive fuel market. While increasing interest in alternatives may ensure continued funding for projects, vital technological innovations will be necessary for alternatives to compete with traditional fuels on a large-scale. Political decisions are often made based on the political popularity of an idea, and popular ideas are not always technologically viable.

Conclusion

The greatest challenge poised to policymakers tackling energy security and climate change issues is time. Everyday more carbon is emitted in the atmosphere, and more non-renewable energy sources are depleted. Quick action is necessary, which will likely result in utilization of new technology without knowing all of the possible complications that may arise. To prevent this, and the backlash that would likely ensue, policymakers must provide additional funding for study of the environmental impacts of alternative fuels in their current stages of development, especially accounting for the wide range of variability of the impacts based on the method of production.

In short, policymakers must continue to promote the development of alternative fuel sources, but remain mindful of the dangers involved in promoting alternatives without adequate study. While the evaluation of many of these alternative sources may have appeared pessimistic at times, we can only hope that one of these sources will provide the answer to society's increasing energy demands.

Endnotes: Fueling the Future *on page 73*

ENDNOTES: FUELING THE FUTURE *continued from page 24*

[1] *See* Mike Allen, *Crunching the Numbers on Alternative Fuel*, POPULAR MECHANICS, May 2006, *available at* http://www.popularmechanics.com/science/earth/2690341.html (last visited Apr. 6, 2007).

[2] Allen, *id.*

[3] Allen, *id.*

[4] Allen, *id.*

[5] *See* U.S. ENVTL. PROTECTION AGENCY, CHEMICAL IN THE ENVIRONMENT: METHANOL (1994), http://www.epa.gov/chemfact/f_methan.txt (last visited Apr. 13, 2007); *see* MALCOLM PIRNIE, INC., EVALUATION OF FATE AND TRANSPORT OF METHANOL IN THE ENVIRONMENT (1999), *available at* http://www.methanol.org/pdf/evaluation.pdf (last visited Apr. 13, 2007).

[6] *See* METHANOL FOUNDATION, METHANOL FUEL CELLS TRANSPORT REGULATIONS, *available at* http://www.methanol.org/pdf/METHANOLFCTRANSPORTREGSNov2005.pdf (last visited Apr. 13, 2007).

[7] *See* George A. Olah, *The Methanol Economy*, CHEMICAL & ENGINEERING NEWS, Sept. 22, 2003, at 5, *available at* http://www.methanol.org/pdf/meth_econ.pdf (last visited Apr. 13, 2007).

[8] *See* U.S. Dept. of Energy, How is Methanol Made, http://www.eere.energy.gov/afdc/altfuel/meth_made.html (last visited Apr. 13, 2007) [hereinafter Methanol Made] (stating that natural gas is the common energy source for methanol production).

[9] *See* Jeff Wise, *The Truth About Hydrogen*, POPULAR MECHANICS, Nov. 2006, *available at* http://www.popularmechanics.com/technology/industry/4199381.html (last visited Apr. 13, 2007).

[10] Wise, *id.*

[11] Olah, *supra* note 7.

[12] Olah, *supra* note 7.

[13] *See* Telsa Motors, Charging & Batteries, http://www.teslamotors.com/performance/charging_and_batteries.php?js_enabled=1 (last visited Apr. 13, 2007).

[14] *See* Rathbone Energy, Lithium Ion Battery Packs: The Negatives of Lithium Ion Batteries, http://www.rathboneenergy.com/batteries/lithium_ion/lithium.htm (last visited Apr. 7, 2007) (elaborating on the problems with lithium ion batteries); *see also* Stan Beer, *Lithium Ion batteries Under Fire*, IT WIRE (Sept. 22, 2006), *available at* http://www.itwire.com.au/content/view/5706/983 (last visited Apr. 13, 2007); *see also*, BatteryUniversity.com, Recycling Batteries, *available at* http://www.batteryuniversity.com/partone-20.htm (last visited Apr. 13, 2007).

[15] Allen, *supra* note 1, at 6.

[16] Wise, *supra* note 9, at 3 (comparing the sources for hydrogen generation), *see* ENERGY INFO. ADMIN, ELECTRIC POWER ANNUAL (2006), *available at* http://www.eia.doe.gov/cneaf/electricity/epa/epa_sum.html (last visited Apr. 17, 2007) (illustrating the sources of conventional energy production for the year of 2005); *see also* Methanol Made, *supra* note 8.

[17] *See* Alex Kirby, *Water Power 'Fuels Climate Change'*, BBC NEWS, May 31, 2000, *available at* http://news.bbc.co.uk/1/hi/sci/tech/771465.stm (last visited Apr. 13, 2007); *see also* Wise, *supra* note 9, at 5.

[18] *See generally* Rebecca Smith, *The New Math of Alternative Energy*, WALL ST. J. , Feb. 12, 2007, at R1 .

[19] *See* CBS News, *Study says Ethanol Inefficient, Researchers Claim Process Uses More Energy Than it Provides*, (July 19, 2005), *available at* http://www.cbsnews.com/stories/2005/07/19/tech/main709983.shtml (last visited Apr. 13, 2007).

[20] *See generally* Texas State Energy Conservation Office, Cellulosic Ethanol - Gasoline of the Future, http://www.seco.cpa.state.tx.us/re_ethanol_cellulosic.htm (last visited Apr. 13, 2007) [hereinafter Cellulosic].

[21] *See* Union of Concerned Scientists, The Impact of Land Use on Climate Change, http://www.ucsusa.org/global_warming/science/land-use-and-climate-changeimpacts.html (last visited Apr. 13, 2007).

[22] *See* ABC Science News, *The Hidden Cost of Bio-fuels,* (Sept. 27, 2005), *available at* http://abc.net.au/science/news/stories/s1468698.htm (last visited Apr. 13, 2007).

[23] *See* www.fueleconomy.gov, *Fuel Efficient Vehicle Tax Incentives Information Center*, http://www.fueleconomy.gov/feg/taxcenter.shtml (last visited Apr. 13, 2007).

[24] *See* San Francisco Chronicle, *California: Carpool Lane Open to Hybrids* (Aug. 11, 2005), *available at* http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2005/08/11/BAG4AE63I81.DTL (last visited Apr. 13, 2007).

[25] *See* S. Rep. No. 109-78, 109th Cong. (2005).

[26] Energy Policy Act of 2005, Pub. L. No. 109-58, 119 Stat. 594 [hereinafter Energy Policy Act].

[27] Energy Policy Act, *id.*

[28] *See* Press Release, United States Department of Energy, DOE Announces Over $8 Million to Increase Use and Availability of Alternative Fuels (Oct. 25, 2006), *available at* http://www.energy.gov/news/4404.htm (last visited Apr. 7, 2007).

[29] *See* U.S. Dept. of Energy, Hydrogen Program Budget, http://www.hydrogen.energy.gov/budget.html (last visited Apr. 13, 2007).

[30] *See generally* Cellulosic, *supra* note 20.