

# Sustainable Transportation in the United States

*How to address transportation problems while maintaining mobility.*

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## Introduction

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The current state of transportation in the United States is both a blessing and a curse. An increasingly mobile society is convenient and leads to economic development. However, the current transportation system also creates significant social costs, such as congestion, accidents, noise, pollution, and resource depletion.<sup>1</sup>

These social costs are severe, and they are not entirely borne by their creators. For example, a car driver bears significant costs when involved in an accident or stuck on a congested freeway. However, the same individual does not pay for the environmental impact of oil extraction when filling up at a gas station, or the increased congestion created by driving to work instead of taking the subway.

Because some costs of transportation are not charged directly to the transportation user, an inefficiently high amount of transportation is consumed. This over consumption negatively impacts both society today and future generations. Therefore, current consumption of transportation in the United States is a market failure.

There are three key problems created by the over consumption of transportation. The first is that Earth's liquid fuels stores are being depleted rapidly. Due to excessive consumption of gasoline, oil continues to become more expensive. Furthermore, no equivalent, affordable, practical fuel has emerged to take the place of gasoline. If this problem is not corrected before the supply of oil becomes too scarce, the world economy could be strangled. The second problem is that pollution created by transportation is damaging the environment and accelerating the rate of climate change. Finally, the over

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<sup>1</sup> William Black and Peter Nijkamp, Social Change and Sustainable Transport (Bloomington: Indiana University Press, 2002). 3.

consumption of transportation is creating congestion problems that are puzzling transportation planners worldwide.

This paper begins by reviewing transportation's history, problems, and potential solutions to those problems. Then, specific policies are offered that could mitigate these problems while maintaining the benefits of mobility. The policies aim to avoid immediate and extreme costs, or disproportionate effects on the poor.

Enacting these policies will not be easy. They are a serious departure from the status quo, and will probably be met with political resistance. Still, if nothing is done to remedy these transportation problems, the costs could be catastrophic. Thus, hopefully the ideas contained within this paper will be seriously considered by policymakers.

## Canals to Cars: History of the Transportation Problem

To improve the current system of transportation in the United States, it is important to identify how this system came to be and why it is important. During the 18<sup>th</sup> and early 19<sup>th</sup> centuries, the US had a humble, slow, and expensive transportation system, yet it would evolve rapidly over time.<sup>2</sup> Much of the evolution of transportation was a result of three key factors: the necessity of a fast and affordable means of transportation, increasing per capita income, and the proliferation of the automobile.

Continental transportation was a great burden to the US shipping industry in the 18<sup>th</sup> and early 19<sup>th</sup> century. It suffered from three serious problems: slow speed, high costs, and irregular service.<sup>3</sup> This had serious commercial ramifications. For instance, shipping perishables was often impossible, and shipping goods over long distances infrequently occurred due to high transportation costs. Furthermore, because the United States economy was focused on international trade, internal transportation improvements, such as building and maintaining roads, were ignored.<sup>4</sup>

However, President Jefferson embargoed foreign trade in 1807, thus increasing the importance of domestic commerce and sparking internal improvements in transportation which would be known as the Transportation Revolution.<sup>5</sup> Improvements included the construction of turnpikes, canals, the railroad system, and street railways.<sup>6,7</sup>

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<sup>2</sup> Jeremy Atack and Peter Passel, A New Economic View of American History, 2nd ed. (New York, NY: W.W. Norton and Company, 1994). 143.

<sup>3</sup> Atack and Passel, 143.

<sup>4</sup> Atack and Passel, 144.

<sup>5</sup> Atack and Passel, 144-145.

<sup>6</sup> Atack and Passel, 144-152.

<sup>7</sup> Kent Healey, The Economics of Transportation In America (New York, NY: Ronald Press Company, 1940). 16.

These transportation improvements were primarily made to reduce the costs of transporting goods. In an economic model, the transportation improvements shifted the supply (marginal cost) curve of goods down, increasing the market quantity and lowering the market price of goods.<sup>8</sup> In theory, this results in an increase in societal surplus, and is economically efficient.

In addition to reducing the cost of transporting goods, these innovations made it more convenient to live outside city centers. Street railways began expanding into the countryside,<sup>9</sup> offering some individuals who valued lower-density living highly the opportunity to live outside the city while still holding a job inside it. In effect, transportation improvements increased land values along the new transportation routes, as land in sparsely populated areas near a transportation route became more valuable.<sup>10</sup>

Yet these innovations had a miniscule effect on transportation compared to the proliferation of the automobile. The automobile industry exploded in popularity in the early 1900s. In 1900, 4000 vehicles in total were manufactured, yet by 1909, 10,000 were produced by Ford Motor Company alone.<sup>11</sup> The automobile offered significant advantages over any form of public transit, namely convenience, speed, and comfort. Once Americans had tasted the benefits of owning automobiles, they did not want to return to a reliance on public transportation.

The automobile increased already present incentives to live outside the city. In 1909, the National Conference on City Planning and the Problems of Congestion met. They asserted that “disease, poverty, darkness, and the vice of the industrial city were

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<sup>8</sup> Atack and Passel, 165.

<sup>9</sup> Healey, 16.

<sup>10</sup> Atack and Passel, 167 - 169

<sup>11</sup> Healey, 16.

caused by high-density living.”<sup>12</sup> However, before the invention of the automobile, the costs of moving away from a densely populated city were often greater than the benefits for many individuals, because they would be too far away from work without a cost-effective means of getting in to the city. Yet when the automobile became popular and affordable due to mass production, individuals could move outside the city and commute in to their jobs every day. Thus, automobiles were a *driving* force (pun intended) in the emergence of suburbia.

Finally, increasing per capita income has had a significant effect on the development of American transportation. As per capita income has risen, a two things have happened. First, more individuals have had the ability to purchase cars. Secondly, fuel has become a relatively smaller percentage of an individual’s total budget. These two factors led to the fact that nearly every 21<sup>st</sup> century American owns a car, and there is relatively little concern over fuel economy or the distance one must commute to work.

Today, per capita incomes are growing higher, and automobiles are becoming more prevalent. This has resulted in more people moving from dense urban areas to suburbs, while buying more cars and more fuel per capita. Although this is beneficial in that it increases mobility, the external costs of this transportation system are significant. These external costs should be addressed, while at the same time preserving the benefits of mobility.

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<sup>12</sup> Black and Nijkamp, 23

## Interrelated and Dangerous: Transportation Problems

The current state of transportation in the US has three major problematic characteristics. For one, it relies on crude oil, a resource that is being rapidly depleted. Secondly, increased per capita driving is causing massive congestion problems in major cities and the suburbs. Finally, transportation is causing serious environmental degradation.

### **A. Resource Depletion**

The world is running out of crude oil, also known as petroleum. Crude oil is one of the most important commodities in the world economy. Today, it is being consumed at a rapid and increasing rate. At the same time, it is in finite supply, and projected to run out within the next 30-65 years.<sup>13</sup> Currently, no feasible alternative fuel has been developed in its place. Therefore, the world has a resource depletion problem.

Crude oil is important. It is the primary ingredient in two modern-day essentials: motor fuel (such as gasoline) and non-fuel petroleum products. Motor fuel is essential for modern day personal and commercial transportation. Transportation also enables us to enjoy the benefits of free trade, the freedom to live where we want, and more. Furthermore, non-fuel petroleum products enjoy widespread use across the world. These include plastics, medicines, and food items.<sup>14</sup> Because crude oil is involved in powering transportation and the production of petroleum products, the price of crude oil is monitored very carefully and has a significant impact on the worldwide stock market.<sup>15</sup>

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<sup>13</sup> Black and Nijkamp, 37.

<sup>14</sup> [Petroleum Products Information Sheet](http://www.eia.doe.gov/neic/infosheets/petroleumproducts.htm), 09/2005 2005, 04/30 2007 <<http://www.eia.doe.gov/neic/infosheets/petroleumproducts.htm>>.

<sup>15</sup> [Yahoo! Finance](http://finance.yahoo.com), , 04/30 2007 <<http://finance.yahoo.com>>.

There is a finite amount of crude oil on the planet, and it is being rapidly depleted. The world consumed about 29.2 billion barrels of crude oil in 2003,<sup>16</sup> and that number is projected to increase by 2% per year over the next two decades.<sup>17</sup> Moreover, Earth has only about one trillion barrels of proven oil reserves remaining, and up to an estimated 3.4 trillion barrels “of oil and ‘oil-like’ resources.” At the planet’s projected consumption, one trillion barrels would last only 30 years, and the speculative total of 3.4 trillion barrels would last only 65 years.<sup>18</sup> Furthermore, as oil becomes scarcer, and/or must be derived from “oil-like” resources, its cost will increase.

Michael Wegener and David Greene say it best: “the threat to sustainability is not so much ‘running out’ of oil, but the increasing costs, environmental and economic, of its continued use.”<sup>19</sup> Completely ignoring environmental costs, there are two key factors that will drive up the price of oil over time. The first factor is the interaction of supply and demand. Consider the diamond and water paradox. Living in a first-world country, where clean water is plentiful, one would trade buckets of water for one diamond. However, if one were traveling the desert, dying of thirst, with no water at all, he or she would trade away any number of diamonds for a glass of water. This illustrates the fact that as a good becomes scarce, its value rises. As the supply of oil shrinks, its price will rise dramatically. Furthermore, as demand for a good rises, *ceteris paribus*, the price of a good rises. The demand for oil is rising rapidly, due to increasing population, increasing worldwide living standards, and popularity of SUVs.<sup>20</sup>

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<sup>16</sup> Energy Information Administration, International Energy Outlook 2006 Energy Information Administration, 2006), 04/30/2007.

<sup>17</sup> Black and Nijkamp, 37.

<sup>18</sup> Black and Nijkamp, 37.

<sup>19</sup> Black and Nijkamp, 37.

<sup>20</sup> Energy Information Administration.

The second major factor that will drive up the price of oil is the fact that as oil becomes scarcer, it will be harder to extract and refine into a useful form. This is because, naturally, oil today is refined by extracting from the easiest and cheapest places first. As these sources run out, oil companies are forced to find the “next easiest” places to extract oil from, until the last drops of oil are extracted in some incredibly difficult manner. Secondly, some sources of oil are not exactly oil; they are “oil-like” resources, such as oil shale that need to be refined in a special and more expensive manner to make them useful for the world’s transportation needs.

If the world ignores this resource depletion problem, the consequences will be severe. The United States, in particular, is a society of car reliance. Many individuals live far from their workplaces, and if transportation became unaffordable they would be severely impacted. Food is transported across the country in trucks, and without affordable fuel, food prices would be driven upward, and the variety of food in a given area would shrink dramatically. Everyone in the world would have problems as well. Visiting family far away would become impossible, unless one could afford to pay an astronomical price for a plane ticket. Economies would be significantly weakened, because the increasing costs of transportation would make international trade difficult and many situations of comparative advantage would be lost. Finally, and perhaps most importantly, future generations, who have no say in the rapid pace the current generation is burning oil, would be worse off as a result of energy use today.

The problem of resource depletion is serious. The US and the world cannot burn oil at current rates indefinitely. Although some argue transportation can just continue “business as usual,” and that technological advances will emerge to save the day, this is

not a certainty, and there is no telling when these advances will occur. Policies must be implemented to conserve resources while searching for an alternative source of transportation fuel.

## **B. Congestion**

Urban areas in the United States are becoming very congested. The chief cost of congestion is wasted time. According to the US Census Bureau, the average American spent more than 100 hours per year commuting in 2003. This is longer than the average vacation time that many workers take per year.<sup>21</sup> In total, in 2002, congestion caused about 2.9 billion hours of travel delay. In 2003, this number changed to 3.7 billion hours, an increase of 79 million hours.<sup>22</sup>

Congestion also wastes fuel. It is estimated that congestion in 2003 wasted 87 billion liters of fuel, an increase of 262 million liters from 2002. The estimated cost of lost time and wasted fuel to America was \$63 billion in 2003.<sup>23</sup>

This does not take into account all of the costs of congestion. In addition to lost time and wasted fuel, congestion tends to frustrate drivers and precipitate road rage, which can result in increased car accidents.<sup>24</sup> Furthermore, congestion creates additional pollution, both locally and globally. Locally, pollution can become more severe due to congestion because emissions are more concentrated, making air quality worse.<sup>25</sup> Globally, congestion's excess fuel use creates additional CO<sub>2</sub> emissions which have been shown to exacerbate climate change.

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<sup>21</sup> Americans Now Spend Over 100 Hours a Year Commuting, 04/01/2005 2005, About.com, 04/30 2007 <<http://usgovinfo.about.com/od/censusandstatistics/a/commutetimes.htm>>.

<sup>22</sup> Texas Transportation Institute, City Mayors: Traffic Congestion - USA Texas Transportation Institute, 2005), . Citymayors.com. 04/30/2007.

<sup>23</sup> Texas Transportation Institute.

<sup>24</sup> The Subcommittee on Surface Transportation, Road Rage: Causes and Dangers of Aggressive Driving, trans. House of Representatives, ed. The Committee on Transportation and Infrastructure, 1997).

<sup>25</sup> Clean Commute Annapolis, 04/30 2007, 04/30 2007 <<http://www.annapolis.gov/info.asp?page=2613>>.

Congestion is getting worse. According to the Texas Transportation Institute: “congestion endured by travelers and businesses grow to those of the next largest population group. So in ten years, medium-sized regions will have the traffic problems that large areas have now, if trends do not change.”<sup>26</sup>

If the United States does nothing to solve its congestion problem, there will be severe consequences. The rate of fuel use will be accelerated, exacerbating both environmental and resource depletion problems facing the world today. Also, it will be harder to raise economic productivity levels if workers are often stuck doing nothing in traffic every day. Furthermore, general morale might fall significantly, due to the fact that people would be spending more time sitting in cars and less time doing something they enjoy.

The problem of congestion must be dealt with carefully. Solutions to congestion in the US have not been very successful to date, so newer solutions must be innovative to succeed.

### **C. Environmental Degradation**

Transportation is damaging the environment. Obtaining, transporting, and burning oil harms the environment in various ways. Furthermore, the construction of a transportation infrastructure also taxes the environment.

The current transportation fuel of choice, gasoline, is derived from crude oil. Crude oil is an exceptionally “dirty” fuel in two key respects: obtaining and transporting the oil causes environmental damage, as does burning the fuel. According to an Oil Production Case research paper at American University, “Oil production, and/or transportation, can disrupt the human population, and the animal and fish life of the

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<sup>26</sup> Texas Transportation Institute.

region. Oil waste dumping, production pollution, and spills wreak havoc on the surrounding wildlife and habitat. It threatens the extinction of several plants, and has already harmed many land, air, and sea animal and plant species.”<sup>27</sup> Oil production is also strongly linked with an increase in military conflict, which can harm the environment.<sup>28, 29</sup>

Burning oil also creates environmental problems. According to a paper by Martin Wachs, the two most prevalent pollutants produced by automobiles today that have not been effectively addressed by regulation in the US are particulates and carbon dioxide emissions.<sup>30</sup> Particulate matter has been linked with an increased risk of cancers and various other health problems. Carbon Dioxide, or CO<sub>2</sub>, is a greenhouse gas that, when emitted, increases the rate of climate change.<sup>31</sup> Estimates show that transportation accounts for about 20% of worldwide CO<sub>2</sub> emissions.<sup>32</sup>

Constructing our transportation infrastructure harms the environment as well. Water systems are altered for the construction of highways and transit routes. In particular, paving large amounts of land can create flooding and drainage problems. Furthermore, the construction of cars, causes pollution and costs energy and supplies.<sup>33</sup>

The costs of ignoring the environmental impacts of transportation are astronomical. According to the International Governmental Panel on Climate Change, human CO<sub>2</sub> emissions are very likely to be contributing to climate change. The IPCC

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<sup>27</sup> W. Corbett Dabbs, Oil Production and Environmental Damage, Research Mnemonic ed. (American University, Washington, DC:, 1996).

<sup>28</sup> W. Corbett Dabbs, Oil Production and Environmental Damage, Research Mnemonic ed. (American University, Washington, DC:, 1996).

<sup>29</sup> Thomas L. Friedman, "The Power of Green," NY Times Magazine 04/15/2007 2007.

<sup>30</sup> Black and Nijkamp, 19-20.

<sup>31</sup> Black and Nijkamp, 19-20.

<sup>32</sup> Black and Nijkamp, 19-20.

<sup>33</sup> Green Cars, 05/04 1999, 04/30 2007

<<http://www.environmentaldefense.org/article.cfm?ContentID=928>>.

predicts that climate change will result in droughts, flooding, collapse of many ecosystems and extinction, famines, and increased health problems.<sup>34</sup> The increase in particulate matter will only exacerbate health problems associated with climate change. Furthermore, extensive road networks being built in flood-prone areas could increase damages from natural disasters.

The effect of transportation on the environment will most likely become greater over time, as humans continue to become increasingly reliant upon cars and international trade continues to grow. An efficient and effective policy must be set into action as soon as possible to mitigate this problem.

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<sup>34</sup> Intergovernmental Panel on Climate Change, Climate Change 2007: Impacts, Adaptation, and Vulnerability Summary Report for Policymakers, 2007), 04/30/2007.

## Proposed Transportation Solutions

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The world needs to answer a serious question. **How can the problems of resource depletion, congestion, and environmental degradation be addressed without sacrificing the benefits of mobility?** No doubt, this question is a global one. These three problems exist across the planet.

Nevertheless, it is important for developed nations to lead the way. There have been a number of policies enacted within Europe intended to address these problems, however, in the United States, national action has been lethargic. For global progress to be made, the US must step forward and take leadership on this issue by exploring various sustainable transportation policies.

There have been many proposals for solutions to these transportation problems. Each of these has various costs and benefits, and some are more politically feasible than others. The following is a consideration of the details, benefits, costs, and shortcomings of a number of policies that could be enacted within the United States.

### **1. Raise the CAFE Standards**

#### *Background Information*

The Corporate Average Fuel Economy Standards were created in 1975 as part of the Energy Policy Conservation Act. The purpose of the CAFE standards was to increase fuel economy in automobiles to conserve oil that was in short supply, due to the 1973-1974 Arab Oil Embargo.<sup>35</sup>

CAFE standards apply to an automobile manufacturer if it sells more than 10,000 vehicles in the United States. The standards require the manufacturer to have a sales-

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<sup>35</sup> [CAFE Overview - Frequently Asked Questions](http://www.nhtsa.dot.gov/cars/rules/cafe/overview.htm), 03/02/2005 2005, 04/30 2007  
<<http://www.nhtsa.dot.gov/cars/rules/cafe/overview.htm>>.

weighted fuel economy of 27.5 miles per gallon for cars and 20.7 miles per gallon for “light trucks,” such as vans and sport utility vehicles. If the automaker does not comply with the standard, they are fined \$55 per vehicle per mile per gallon under the standard.<sup>36</sup>

### *Potential Benefits*

Some individuals believe that raising the CAFE standards to a higher mile per gallon rating would help save oil and protect the environment. In principle, this seems like a good idea. The CAFE standards are at the same levels as they were in 1985,<sup>37</sup> and proponents of an efficiency increase point to this level as outdated. They claim that if the standards were increased, automakers would make more efficient automobiles and consumers would buy them instead of gas guzzlers, therefore reducing oil demand and helping save the environment.

### *Potential Costs and Shortcomings*

Raising CAFE standards could also have many downsides. For instance, this proposal is expensive. It is projected that increasing the standards by 3 mpg would cost \$1.841 billion in US consumer surplus, and increasing by 50% would cost \$17.603 billion, in addition to huge financial losses by US automakers.<sup>38</sup>

In addition to expense, increasing the CAFE standards would be ineffective. One reason for this is that the penalties for violation are not harsh. According to Andrew Kleit, BMW views the \$55 per car per mile per gallon fine as a tax, and does not even attempt to achieve CAFE standards.<sup>39</sup> Another reason for ineffectiveness is that the standards contain loopholes. Although car fleets must comply with a 27.5 mile per gallon

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<sup>36</sup> Andrew Kleit, "CAFE Changes, by the Numbers," *Regulation* 2002: 32-5.

<sup>37</sup> National Highway Traffic Safety Administration.

<sup>38</sup> Kleit, 32-5

<sup>39</sup> Kleit, 32-5

CAFE rating, light truck fleets only need to average 20.7 miles per gallon. In fact, some believe that the discrepancy between cars and light trucks in CAFE standards led to the increased production of SUVs.<sup>40</sup> Furthermore, automobiles that weigh over 8,500 pounds don't have to comply with CAFE at all!<sup>41</sup> An increase in the CAFE standards also might result in rebound effects, where individuals choose to drive more as a result of having a more fuel efficient automobile. This would not only cancel out the positive resource conservation and environmental effects of fuel efficiency, but it could exacerbate congestion problems by putting more cars on the road at a given time.

Finally, raising the CAFE standards takes away some consumer choice. There might be a reasonable portion of the US population that absolutely needs to have a particular type of automobile that gets 10 miles per gallon. These individuals might be willing to pay a substantial premium to have the automobile, but if CAFE standards are increased, an automaker may avoid manufacturing the automobile so as to not affect the average fuel economy of its fleet.

### *Conclusion*

In principle, raising the CAFE Standards in order to save oil and protect the environment sounds like a good idea. But in practice, increasing the standards might be expensive and ineffective.

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<sup>40</sup> [The Pigou Club Manifesto](http://gregmankiw.blogspot.com/2006/10/pigou-club-manifesto.html), 10/20/2006 2006, 04/30 2007  
<<http://gregmankiw.blogspot.com/2006/10/pigou-club-manifesto.html>>.

<sup>41</sup> National Highway Traffic Safety Administration.

*Summary Chart*

Resource Depletion	Congestion	Environment
+ Less fuel used, in theory - In practice, some believe CAFE has increased fuel use	- People might drive more if their cars are more efficient, exacerbating congestion problems	+ Fewer emissions, in theory - Producers might skimp on clean production technologies and damage the environment during production of a fuel efficient vehicle.

**2. Increase the Excise Tax on Gasoline**

*Background Information*

Gasoline seems to become more expensive every year. However, the tax on gasoline in the United States is far lower than almost all other developed nations.<sup>42</sup> In 2005, taxes amounted to only about 19% of the total cost of a gallon of gasoline. In 2006, federal excise taxes on gasoline were about 18.4 cents per gallon, whereas state taxes averaged about 21 cents.<sup>43</sup>

*Logic Behind Taxing Gasoline*

Proponents believe that increasing the gas tax will correct an externality created by gas consumption. Basic economic theory states that an individual will consume an additional unit of a good until the price of that good becomes greater than the benefit of consuming one more unit of the good. Furthermore, it is economically efficient for an individual to consume as long as the true marginal benefit the good imposes on the individual and society from consumption is greater than the true marginal cost it imposes

<sup>42</sup> NBC6.net, U.S. Versus the World: How Do Gas Prices Compare?, 2006).

<sup>43</sup> A Primer on Gasoline Prices, 08/02/2006 2006, Energy Information Administration, 04/30 2007 <[http://www.eia.doe.gov/bookshelf/brochures/gasolinepricesprimer/eia1\\_2005primerM.html](http://www.eia.doe.gov/bookshelf/brochures/gasolinepricesprimer/eia1_2005primerM.html)>.

on that individual and society. This is always the case when an individual faces the true marginal costs and true marginal benefits.

However, in some cases, consuming a good creates a negative externality. In other words, consumption of that good creates an external cost on a third party. Since these costs are not accounted for by the individual, unless there is market intervention, an individual will over consume. This results in what economists call a market failure, and is inefficient.

Proponents of an increased gasoline tax believe that gasoline creates a negative externality on society in many ways. One of these is an environmental externality. The consumption of gasoline creates emissions which contribute to climate change, smog, and other forms of environmental degradation. Consuming gasoline also creates an externality of increasing geopolitical instability. For instance, Saudi Arabia, one of the US's top sources of oil imports, has been linked to funneling money to Sunni insurgents in Iraq.<sup>44</sup> Another major externality associated with gasoline consumption is that of increasing congestion. When one consumes gasoline, he or she is most likely in a car, and the more cars that are on the road, the more congestion.

One method economists use to address a negative externality is to levy a tax on the good creating the externality, equal to the negative external cost of consuming one unit of that good. If the tax is levied, it causes the consumer to pay the full cost of the good, resulting in efficient consumption rather than over consumption.

### *Potential Benefits*

There are a vast number of benefits that could result from increasing the excise tax on gasoline. If an increased gas tax results in decreased driving, the environment

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<sup>44</sup> Friedman.

would be protected through reduced emissions, crude oil would be conserved, and congestion would be reduced due to fewer automobiles being on the roads.<sup>45</sup> National security could be aided as well, as the United States will be able to buy less oil from Saudi Arabia, a country suspected of aiding insurgents in Iraq.<sup>46,47</sup>

In addition, an increase in the gas tax could improve the national economy. According to the CBO, a 50 cent per gallon increase in the excise tax on motor fuels would increase federal revenues by \$49.3 billion in 2008 and \$320.8 billion over five years, after taking into account reductions in income and payroll taxes that could be taken.<sup>48</sup> The decrease in payroll and income taxes would encourage saving and investment, thus encouraging economic growth.<sup>49</sup>

#### *Potential Costs and Shortcomings*

Although the benefits of increasing the excise tax on gasoline are numerous, this plan is not without its critiques. First, some individuals claim that the demand for gasoline is highly inelastic.<sup>50,51</sup> This means that changes in the price of gas do not tend to have much of an effect on the quantity of gas people consume. This may be true in the short run. It takes time to switch to a more fuel efficient car, map out a public transit route, find a carpool partner, or set up a telecommuting arrangement with one's workplace. Because these things take time, cutting back one one's fuel demand in the

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<sup>45</sup> Mankiw.

<sup>46</sup> Mankiw.

<sup>47</sup> Friedman.

<sup>48</sup> Congressional Budget Office, Budget Options, 2007) 323.

<sup>49</sup> Mankiw.

<sup>50</sup> Kristin N. Sipes and Robert Mendelsohn, "The Effectiveness of Gasoline Taxation to Manage Air Pollution," Ecological Economics 36.2 (2001): 299-309.

<sup>51</sup> This Isn't Your Parent's Demand For Gas, 04/20/2007 2007, 04/30 2007 <[http://www.env-econ.net/2007/04/this\\_isnty\\_your.html](http://www.env-econ.net/2007/04/this_isnty_your.html)>.

short run is difficult. However, in the long run, all of these things are much easier, indicating long-run gasoline demand is relatively elastic.

Some claim that an increase in the gas tax would disproportionately hurt the poor.<sup>52</sup> If this were the case, increasing the gasoline tax would be very inequitable. However, the poor tend to use public transportation more often than the rich.<sup>53</sup> Secondly, for the poor who do drive, this equity problem can be solved using the Earned Income Tax Credit. Just as businesses can report miles driven on their taxes, individuals who are eligible for the EITC could report miles driven and receive an income credit. This could be funded with some of the revenue generated by the gas tax increase.

Some critics argue that gasoline, even when taxed, does not cost enough compared to American incomes to make a significant impact on gasoline consumption. This does not appear to be the case, considering the extensive media coverage that gasoline price increases have received over the past few years and the dramatic decrease in profits and market share of America's major automakers such as GM.<sup>54</sup>

Another critique states that taxing gasoline is a form of paternalism, and thus should be discouraged. This critique claims that raising the tax on gasoline is just a means to get people to do "what is good for them,"<sup>55</sup> and thus limits free choice. This does not appear to be a valid critique. The purpose of a gasoline tax is not to get people to do what is good for themselves, but to get people to pay the full cost of gasoline rather than over consuming and creating excessive negative externalities that harm others.

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<sup>52</sup> Sipes and Mendelsohn, 299-309

<sup>53</sup> Commuting Expenses: Disparity for the Working Poor, 01/05/2002 2002, 05/01 2007  
<[http://www.bts.gov/publications/issue\\_briefs/number\\_01/html/commuting\\_expenses\\_disparity\\_for\\_the\\_working\\_poor.html](http://www.bts.gov/publications/issue_briefs/number_01/html/commuting_expenses_disparity_for_the_working_poor.html)>.

<sup>54</sup> Financial Statements for General Motors Corporation, 05/01/2007 2007, 04/30 2007  
<<http://finance.google.com/finance?fstype=ii&cid=14194>>.

<sup>55</sup> The 600,000th Democrat in San Francisco, 02/25/2007 2007, 04/30 2007  
<[http://www.onlyrepublican.com/orinsf/2007/02/trading\\_gas\\_tax.html](http://www.onlyrepublican.com/orinsf/2007/02/trading_gas_tax.html)>.

Finally, a gasoline tax is criticized because it is hard to know the correct amount to charge.<sup>56</sup> If the US is to create a “perfect” gasoline tax, it must tax gasoline at the same price as the externality gasoline consumption creates. Taxing too highly could create an inefficient situation, just as taxing too low does today. Although this is a reasonable critique, there are many gasoline consumption externality estimates available.<sup>57,58,59</sup> If the US uses these estimates, and can tax an amount close to the true external cost of gasoline, the situation will be more efficient than the current situation of massive over consumption.<sup>60</sup>

*Conclusion*

Increasing the excise tax on gasoline can result in resource conservation, reduced congestion, and an improved environment, among other benefits. It holds sincere promise, and should be seriously considered by US politicians.

*Summary Chart*

Resource Depletion	Congestion	Environment
+ People drive less + People buy more fuel efficient cars	+ People live closer to work or carpool or just generally drive less, due to increased cost of driving	+ Fewer CO <sub>2</sub> emissions + Smaller cars built, requiring fewer materials.

**3. Encouraging Proliferation of Hybrid, Plug-In Hybrid, and Electric Vehicles**

*Background Information*

<sup>56</sup> Resources for the Future, The Stern Review and the Economic Analysis of Climate Change, 2007), 04/30/2007.

<sup>57</sup> Michael J. Schauer, "Estimation of the greenhouse gas externality with uncertainty," Environmental and Resource Economics 5.1 (2004): 71-82.

<sup>58</sup> International Center for Technology Assessment, Gasoline Cost Externalities: Security and Protection Services, 2005).

<sup>59</sup> Robertson Williams, An Estimate of the Optimal Second-Best Gasoline Tax Considering Both Efficiency and Equity, Research Paper ed., 2006).

<sup>60</sup> Williams.

In the US, hybrid-electric cars, such as the Toyota Prius, have become very popular. They have two engines: one powered by gasoline and the other powered by electricity. The electricity is generated by means of regenerative braking: when the driver uses the brakes to slow down the car, the on-board battery is charged. This power enables the car to shut off its engine at stop lights, and use only the electric engine for initial acceleration, resulting in improved fuel economy. Because of increased popularity, hybrid-electric technology has spread from cars to SUVs.<sup>61</sup>

Some individuals have converted their hybrid-electric cars into plug-in hybrids. Plug-in hybrids have a much larger and more powerful battery pack than traditional hybrid-electrics. The battery pack is charged by connecting the plug to an electrical outlet when the vehicle is not being used. This enables the vehicle to travel a certain number of miles entirely on electric power. After the electric battery is depleted, the internal combustion engine powers the car. Because electricity is a much cheaper and more efficient form of vehicle propulsion compared to gasoline, driving a plug-in hybrid can save fuel and alleviate pollution problems. Plug-in hybrids are not officially sold in the US, but some major manufacturers claim they will introduce them soon.<sup>62</sup>

Electric vehicles run entirely on electricity and do not have an internal combustion engine. They run on a battery pack, one that is substantially more powerful than the battery pack that exists in hybrid and plug-in hybrid cars. Although they use very little energy per mile, electric vehicles have a limited range before they must be recharged. They are also currently substantially more expensive than gasoline-based

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<sup>61</sup> [Petroleum electric hybrid vehicle](http://en.wikipedia.org/wiki/Petroleum_electric_hybrid_vehicle), 04/30/2007 2007, 04/30 2007 <[http://en.wikipedia.org/wiki/Petroleum\\_electric\\_hybrid\\_vehicle](http://en.wikipedia.org/wiki/Petroleum_electric_hybrid_vehicle)>.

<sup>62</sup> [Plug-in hybrid](http://en.wikipedia.org/wiki/Plug-in_hybrid_electric_vehicle), 05/01/2007 2007, 05/01 2007 <[http://en.wikipedia.org/wiki/Plug-in\\_hybrid\\_electric\\_vehicle](http://en.wikipedia.org/wiki/Plug-in_hybrid_electric_vehicle)>.

cars. In the past, General Motors manufactured an electric car called the EV-1,<sup>63</sup> and currently a company called Tesla Motors is selling an electric car called the Tesla Roadster.<sup>64</sup>

Various incentives exist that promote hybrid-electric vehicles. Consumers who purchase hybrid-electric vehicles receive a federal tax credit, for instance. In addition, some areas of the country allow hybrids to travel in the HOV Lane with one driver, and currently a federal law has been passed but not yet implemented that would allow hybrids across the country with certain efficiency ratings to use all HOV lanes. Some insurance companies and hotels offer discounts for hybrid drivers, and some employers and public parking facilities have designated hybrid parking spots.<sup>65</sup>

#### *Justification for Encouraging Proliferation of These Vehicles*

In theory, because hybrid-electric vehicles, plug-in hybrids, and electric vehicles require less energy per mile to drive compared to pure gasoline vehicles, replacing the current car fleet with these types of vehicles could reduce fuel consumption. Moreover, increased business for advanced-technology vehicle manufacturers will result in increased research and development on these technologies, resulting in further gains in efficiency. Increased vehicle manufacturer business could have a downstream effect which would boost the sales of battery manufacturers. The increased battery sales could lead to increased R&D funding for batteries, which would make the vehicles themselves more efficient.

#### *Benefit Cost Analysis of Encouraging Proliferation of:*

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<sup>63</sup> Who Killed the Electric Car: GM and Chevron, 05/01/2007 2007, 05/01 2007 <<http://ev1.org/>>.

<sup>64</sup> Tesla Motors, 05/01/2007 2007, 05/01 2007 <[http://www.teslamotors.com/index.php?js\\_enabled=1](http://www.teslamotors.com/index.php?js_enabled=1)>.

<sup>65</sup> State and Federal Hybrid Incentives, 05/01/2007 2007, 05/01 2007 <<http://go.ucsusa.org/hybridcenter/incentives.cfm>>.

### *A. Hybrid-Electric Vehicles and Plug-in Hybrids*

Hybrid-electric and plug-in hybrid vehicles, in theory, save gasoline, therefore also protecting the environment by limiting emissions. Some empirical evidence exists to suggest this is the case. A study in Switzerland by Haan et al (2005) examined whether the Toyota Prius was actually effective at lowering fuel consumption, after accounting for “rebound effects.” Rebound effects are, for example, a Prius owner driving more miles because he has a more efficient car than before, or purchasing a Prius as an extra car rather than a replacement vehicle. The study concluded that the Prius is not only fuel efficient, but effective in lowering annual fuel sales.<sup>66</sup>

Plug-in hybrids are even more efficient. Individuals who have converted their Toyota Prius to a plug-in hybrid achieve around the equivalent of 100 miles per gallon,<sup>67</sup> about double that of a Prius, while driving in electric mode.

Furthermore, the more these vehicles are sold, the more manufacturers will take them seriously and invest in their research and development as well as that of their batteries. This can result in further efficiency gains. For instance, the 2008 Toyota Prius, the upcoming version of the most popular model of hybrid-electric vehicle today, is rumored to use lithium-ion batteries and get close to one-hundred miles per gallon.<sup>68</sup>

However, there are costs associated with this technology. Due to the necessity of batteries, an electric motor, and other technologies, there is a substantial price premium on hybrid-electric and plug-in hybrid vehicles compared to their gasoline-only

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<sup>66</sup> Peter de Haan, Michel G. Mueller, and Anja Peters, "Does the hybrid Toyota Prius Lead to rebound effects? Analysis of size and number of cars previously owned by Swiss Prius Buyers," *Ecological Economics* 58.3 (2006): 592-605.

<sup>67</sup> [How We Green-Tuned an '04 Prius into a PRIUS+ Plug-In Hybrid!](http://www.calcars.org/priusplus.html), 05/01/2007 2007, 05/01 2007 <<http://www.calcars.org/priusplus.html>>.

<sup>68</sup> [First Look at Next Prius?](http://www.evworld.com/article.cfm?storyid=1222), 05/01/2007 2007, 05/01 2007 <<http://www.evworld.com/article.cfm?storyid=1222>>.

counterparts. This can make the benefits of these vehicles cost-ineffective. A study by Robert Hahn (1995) found that the price premium associated with low-emissions vehicles and zero-emissions vehicles caused them to fail a test of cost-effectiveness.<sup>69</sup> However, Hahn's study was from 1995, and technology as well as pollution costs have dramatically changed since then. Regardless, the point still remains that the price premium on vehicles with hybrid-electric technologies does negatively impact their cost-benefit analysis.

Batteries used by these vehicles can be problematic. The batteries themselves are not only costly, but they have a limited lifespan. Some estimate the lifespan of a hybrid-electric vehicle's battery at only three to four years.<sup>70</sup> After the battery no longer works, it must be replaced, which is a considerable expense. Furthermore, many of these batteries are made with lead or nickel, which is environmentally harmful to produce or dispose of.<sup>71</sup> On the flip side, manufacturers claim that the batteries are designed to last the life of the car,<sup>72</sup> they are not environmentally dangerous to dispose of if recycled, and the batteries of the future for hybrids will use lithium instead of nickel or lead, which is much more environmentally friendly.<sup>73</sup>

There is also evidence that hybrid-electric vehicles, the Prius in particular, may use much more energy per mile over its lifetime than conventional gasoline vehicles to build, operate, and dispose of. A study from 2005 entitled "Dust to Dust: The Energy

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<sup>69</sup> Robert W. Hahn, "Choosing among Fuels and Technologies for Cleaning Up the Air," Journal of Policy Analysis and Management 14.4 (1995): 532-54.

<sup>70</sup> Black and Nijkamp, 289

<sup>71</sup> Toyota factory turns landscape to arid wilderness, 11/18/2006 2006, 05/01 2007 <[http://www.mailonsunday.co.uk/pages/live/articles/news/news.html?in\\_article\\_id=417227&in\\_page\\_id=1770](http://www.mailonsunday.co.uk/pages/live/articles/news/news.html?in_article_id=417227&in_page_id=1770)>.

<sup>72</sup> Capital Times, "Honda Says Battery Pack in Hybrid Is Designed for Life of the Car," Capital Times 06/21/2002 2002.

<sup>73</sup> Are Hybrid Batteries Toxic?, 05/01/2007 2007, 05/01 2007 <<http://www.hybridcars.com/environmental-stories/hybrid-battery-toxicity.html>>.

Cost of New Vehicles from Concept to Disposal” evaluated a vehicle’s cost in dollars per lifetime mile. This study found that a Hummer H3 cost only \$1.95 per lifetime mile, whereas a Prius cost \$3.25 per lifetime mile.<sup>74</sup> Although this study is useful because it sheds light on the fact that the production and disposal of a vehicle should be considered in its impacts on fuel consumption and the environment, this particular study appears to be biased. For instance, it rates the Prius’s expected life at 109,000 miles, yet assumes the Hummer will last 207,000, which seems unreasonable. Moreover, the study spreads the costs of “design, development and manufacturing energy” across more than one model for the Hummer and other gasoline-based cars, but not the Prius.<sup>75</sup>

In the short run, promoting these vehicles may have greater cost than benefit. However, in the long run, a net benefit should emerge.

### *B. Electric Vehicles*

Electric cars share similar benefits and costs of hybrid-electric vehicles and plug-in hybrids. However, pure-electric cars are much more energy efficient than any other automotive fuel source. The May 2006 issue of Popular Mechanics compared the cost of driving across the country with different fuel sources:

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<sup>74</sup> George F. Will, "George Will: Thinking globally, but not clearly, on warming," UnionLeader 04/12/2007 2007.

<sup>75</sup> CNW Research, Why 100,000 Miles for Prius? (CNW Research, 2007).

“The benchmark drive cost is \$212 in a Honda Civic. The VW Diesel Golf came close at \$230. E85 ethanol (85% ethanol, 15% gasoline) came in at \$425; methanol cost \$619; the hydrogen fuel cell drive cost a whopping \$804! Compressed Natural Gas looked pretty good at \$110. And the electric car? \$60.”<sup>76</sup>  
- Popular Mechanics, May 2006

Furthermore, electric cars can be powered by any energy source. If it is plugged into an electrical grid that is powered by solar energy, in effect, driving a mile creates zero emissions. Electric cars are also beneficial in that individuals do not need to go to a gas station to refuel. All an owner must do is charge the car when they are near an outlet.

However, electric cars have many costs and shortcomings. Obviously, they are limited by their range. The highest quality electric cars today can travel just a little over 200 miles. They are also very expensive, about 25 - 30% more expensive than non-electric counterparts,<sup>77</sup> as a result of their need for powerful battery packs. Battery cost accounts for 30-35% of the price of most electric vehicles.<sup>78</sup>

Fortunately, in the long run, these costs and shortcomings can be mitigated as battery technology improves. As batteries become more affordable, more reliable, longer lasting, more compact, and faster charging, the quality of electric cars will improve as well. Battery technology improvements should occur at a fast pace, especially due to the growth of hybrid-electric vehicle popularity and the emergence of plug-in hybrids and electric cars. The cost of batteries should fall as well, due to economies of scale from increased production.

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<sup>76</sup> The Future of Cars is Electric, 08/16/2006 2006, 05/01 2007  
<[http://www.teslamotors.com/blog2/index.php?p=12&js\\_enabled=1](http://www.teslamotors.com/blog2/index.php?p=12&js_enabled=1)>.

<sup>77</sup> Black and Nijkamp, 289

<sup>78</sup> Black and Nijkamp, 289

In conclusion, although the short-run benefit cost analysis test on promoting these vehicles might fail, in the long run, electric vehicles should become more favorable.

*How Can These Vehicles be Promoted?*

To promote hybrid-electrics, plug-in hybrids, and electric cars, the US government can do a number of things. These include offering and increasing subsidies for research and production of these types of cars and their batteries, offering and increasing tax breaks for purchases, allowing owners of these vehicles to use the HOV lane and perhaps pay lower tolls on roads, and using public service announcements to give positive stigma to drivers of these automobiles.

*Conclusion*

The US government should consider encouraging the proliferation of hybrid-electrics, plug-in hybrids, and electric cars. Although in the short-run, the cost-benefit analysis on selling these advanced technology vehicles might be negative, the technology holds promise. Promoting these vehicles might further the development of battery technology and could lead to dramatic reductions in resource consumption and polluting emissions from automobiles.

*Summary Chart (for electric cars)*

Resource Depletion	Congestion	Environment
+ Less fuel consumed, doesn't need fuel from oil, just any electricity - The materials used to create electric car batteries are not in infinite supply	- Could make congestion worse, because driving would become cheaper to people, so they would drive more	+ Fewer emissions + Transportation, in theory, could come from completely zero emissions sources, such as solar or wind energy.

## 4. Powering Automobiles with Ethanol

### *Background Information*

Ethanol is a “biofuel”, created by converting biomass into fuel. It can be made from corn, switchgrass, wood biomass, sugarcane, and other natural products.<sup>79</sup> To make ethanol, natural products are grown, then taken to an ethanol plant where they are broken down and fermented, purified to the desired concentration, and then mixed with gasoline. This mixture can be used in an automobile in virtually the same way as gasoline. A concentration of 10% ethanol and 90% gasoline can be used in any car in the US, but a concentration greater than 10% requires a special engine.<sup>80</sup>

Ethanol production can be accomplished through dry-milling or wet-milling, and each process results in different valuable secondary products. Dry-milling, for instance, can result in the production of dried distillers grains with solubles which can be used as livestock feed.<sup>81</sup>

Currently, the federal government looks favorably upon corn-based ethanol. In 2006, about 4.8 billion gallons of ethanol were produced, primarily from corn.<sup>82</sup> In addition, the US government has provided over \$3 billion in subsidies each year to fuel that production (pun intended).<sup>83</sup> Conversely, ethanol is heavily produced in Brazil, but it is primarily derived from sugarcane.<sup>84</sup>

### *Benefits*

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<sup>79</sup> David Pimentel and Tad W. Patzek, "Ethanol Production Using Corn, Switchgrass, and Wood; Biodiesel Production Using Soybean and Sunflower," Natural Resources Research 14.1 (2005): 65-76.

<sup>80</sup> American Coalition for Ethanol, 05/01/2007 2007, 05/01 2007 <<http://www.ethanol.org/index.php?id=50&parentid=8>>.

<sup>81</sup> How Ethanol is Made, 05/01/2007 2007, 05/01 2007 <<http://www.ethanolrfa.org/resource/made/>>.

<sup>82</sup> Ethanol Industry Statistics, 05/01/2007 2007, 05/01 2007 <<http://www.ethanolrfa.org/industry/statistics/>>.

<sup>83</sup> Pimentel and Patzek, 65-76

<sup>84</sup> Pimentel and Patzek, 65-76

Proponents of ethanol use in the US point to many potential benefits. The most significant of these is that the use of ethanol could reduce US dependence on oil. This can result in improved national security, as well as relieving the world's resource depletion problem. Furthermore, proponents claim that ethanol is a renewable resource, so the world will not need to worry about "running out" of ethanol, like oil. In addition, ethanol is produced within the United States, so its production could create domestic jobs and improve the US trade balance.<sup>85,86</sup>

In addition, proponents believe the use of ethanol as automotive fuel is affordable. For one, there are lower upfront costs to switch the nation over to using it as a primary fuel source. Many vehicles on the roads today can drive using high concentrations of ethanol, and the cost of building new vehicles with this capability is relatively low.<sup>87</sup> Moreover, gasoline stations would not need to be significantly modified to serve ethanol. Proponents also claim that ethanol is more than 30 cents cheaper per gallon than gasoline.<sup>88</sup> Furthermore, its production also yields a by-product of dried distillers grains, which can be used to feed livestock.<sup>89</sup>

Finally, supporters claim that ethanol is more environmentally friendly than gasoline. Burning ethanol creates 10-15% fewer CO<sub>2</sub> emissions, and a very large reduction in carbon monoxide emissions, for instance.<sup>90</sup>

### *Costs/Shortcomings*

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<sup>85</sup> Ethanol's Benefits, 06/01/2003 2003, 05/01 2007 <<http://www.ethanol-gec.org/summer97/easum9709.htm>>.

<sup>86</sup> Ethanol Benefits, 09/14/2006 2006, 05/01 2007 <[http://www.eere.energy.gov/afdc/altfuel/eth\\_benefits.html](http://www.eere.energy.gov/afdc/altfuel/eth_benefits.html)>.

<sup>87</sup> Richard J. Newman, "Ethanol Explained," US News and World Report 04/25/2006 2006.

<sup>88</sup> Andrea Hahn, "Corn-based E85 Fuel Runs Cleaner, Cheaper than Gas," The Southern 07/21/2005 2005.

<sup>89</sup> Comparison of USDA and Pimentel Net Energy Balances, 08/22/2001 2001, National Corn Grower's Association, 05/01 2007 <[http://www.ncga.com/public\\_policy/issues/2001/ethanol/08\\_22\\_01b.htm](http://www.ncga.com/public_policy/issues/2001/ethanol/08_22_01b.htm)>.

<sup>90</sup> EPA Recognizes Carbon Monoxide Benefits of Ethanol, 07/02/2001 2001, 05/01 2007 <<http://www.ethanolrfa.org/policy/papers/view.php?id=51>>.

Unfortunately, ethanol is far from a perfect fuel source. One major ethanol critic in the US is David Pimentel. In a paper he wrote in 2005, he found that ethanol made from corn, wood biomass, and switchgrass each required significantly more fossil energy to produce than they yielded, even after accounting for the by-product of dry distillers grains.<sup>91</sup>

Counter-critiques have been raised against Pimentel's negative energy balance claims, yet they seem unfounded. The US Department of Energy asserts that Pimentel does not take the by-product of ethanol production, dry distillers grains, into his calculations.<sup>92</sup> This is false: Pimentel explicitly states the effect dry distillers grains have on his energy calculations.<sup>93</sup> The US Department of Energy and other critics also claim Pimentel's work is based on old data and thus is ineffective.<sup>94,95</sup> This does not appear to be true, either. Very few data sources in his paper are from before 1995, and of those sources, they do not account for a significant portion of his costs.<sup>96</sup>

Ethanol production also yields a very small amount of energy per acre. Even if 100% of all US corn were used to produce ethanol, only 7% of total oil use would be offset.<sup>97</sup> Under current technological conditions, there is not enough land in the US to feasibly supply our demand for transportation fuel with ethanol, regardless of whether corn or another type of biomass is used.<sup>98, 99</sup>

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<sup>91</sup> Pimentel and Patzek, 65-76

<sup>92</sup> Net Energy Balance of Ethanol, 04/18/2007 2007, 05/01 2007  
<[http://www.eere.energy.gov/afdc/altfuel/eth\\_energy\\_bal.html](http://www.eere.energy.gov/afdc/altfuel/eth_energy_bal.html)>.

<sup>93</sup> Pimentel and Patzek, 65-76

<sup>94</sup> US Department of Energy

<sup>95</sup> Grabowski

<sup>96</sup> Pimentel and Patzek, 65-76

<sup>97</sup> David Pimentel, Ethanol Talk (College of William and Mary:, 2007).

<sup>98</sup> Pimentel and Patzek, 65-76

<sup>99</sup> Pimentel

The use of ethanol as fuel is ethically questionable. Consider the fact that approximately 3.7 out of the 6.5 billion people in the world today are malnourished. Burning food as fuel means that there is less food available for the world and these malnourished individuals.<sup>100</sup> In addition, the use of ethanol drives up food prices for food, livestock, milk, and more, making it harder for families to afford food.<sup>101</sup>

Ethanol production is not environmentally friendly. Corn production, in particular, harms the environment due to its extensive use of nitrogen fertilizers. Furthermore, the production of ethanol often uses fossil fuels, and creates all of their associated pollutants.<sup>102</sup> If ethanol production truly has a negative energy balance, then more fossil fuels could be used with an ethanol-based transportation system than a gasoline-based one, which is rather self-defeating.

Ethanol may only seem affordable today due to massive federal subsidies and a weak energy density. There are over \$3 billion of federal subsidies for ethanol production each year. Moreover, ethanol contains less energy per gallon than gasoline, so buying a gallon of ethanol is really like buying less than a gallon of gasoline. If ethanol subsidies did not exist, the cost of producing an equivalent amount of ethanol to gasoline would be \$7.12 per gallon.<sup>103</sup>

### *Conclusion*

Ideally, the United States would be able to create its own fuel within its own borders, from a renewable energy source that is environmentally friendly. However, if

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<sup>100</sup> Pimentel

<sup>101</sup> Pimentel and Patzek, 65-76

<sup>102</sup> Pimentel and Patzek, 65-76

<sup>103</sup> Pimentel and Patzek, 65-76

ethanol possesses the negative characteristics mentioned, then it should not be pursued as an alternative fuel source.

Resource Depletion	Congestion	Environment
+ Alternative source of fuel means less dependence on oil, in theory - Oil is used as a source of power to produce ethanol and is contained in the mixture of ethanol put in an engine	No effect, could be positive if fuel is expensive and people drive less, negative if fuel is cheap and people drive more	+ Ethanol is slightly better for the environment in terms of CO <sub>2</sub> and more cleaner burning in terms of carbon monoxide

## 5. Congestion Pricing

### *Background Information*

Currently, tolls in the United States are set at static rates. However, in London, a system has been implemented called congestion pricing.<sup>104</sup> Congestion pricing means that the price one has to pay to drive on a toll road changes depending on traffic levels at the time. During rush hour, for instance, a driver pays a much higher toll than if he is driving on a quiet Sunday evening.

The logic behind congestion pricing is that a driver imposes more of an external cost on others by choosing to drive during highly congested times. It is theorized that if individuals must pay more to drive during busy periods, they will do things like find another time to drive to work, carpool to reduce costs, or telecommute, thus cutting down on congestion and fuel use.

### *Benefits*

Congestion pricing, as opposed to a static toll system, has many benefits. Principally, it should alleviate congestion, which in turn will reduce pollution. With high

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<sup>104</sup> Sewell Chan, "Driving Around Manhattan, You Pay, Under One Traffic Idea," New York Times 11/11/2005 2005.

tolls during rush hour, many individuals who used to drive on toll roads alone might be persuaded to drive with a partner, go to work earlier or later, take public transportation, or simply telecommute. Because congestion pricing is designed to alleviate congestion, individuals who value rapid car transportation highest can get to where they need to go quickly. Without congestion pricing, no matter how much an individual valued speedy, individual, car-based transportation, he/she could not pay an additional fee to get to a destination faster. With congestion pricing, however, those who are willing to pay high amounts to quickly get to their destination can do so, and this is economically efficient.

Congestion pricing is also relatively cheap to implement. In the US, virtually all toll roads have an option for drivers to use a tag on their car which is connected to a bank account or credit card to pay a toll. This system could simply monitor the total number of individuals that are on the road at a given time and adjust the toll accordingly. Changing the computer monitoring and tolling software would likely be a small cost. Additionally, it would be very cheap and easy to adjust tolls during a “code red” day or if a road were under construction.

#### *Costs/Shortcomings*

Congestion pricing would have its share of problems. The most glaring problem related to equity. It could make using toll lanes so expensive that they would become “a racetrack for the rich.”<sup>105</sup> For example, in Northern Virginia, construction of a new high occupancy toll road that uses congestion pricing is being considered. It is estimated that

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<sup>105</sup> Black and Nijkamp, 275

the round trip toll one would pay, if driving the full length of the road during AM and PM rush hour, could be more than \$57.<sup>106</sup> This idea is could be very politically unpopular.

Congestion pricing could also result in environmental harm. This is because if it resulted in new road construction, it could occur in environmentally vulnerable areas or using environmentally unsound materials.

*Conclusion*

Congestion pricing, if implemented, could result in less congestion while conserving resources and protecting the environment. However, it will be politically difficult to implement and could be considered highly inequitable.

Resource Depletion	Congestion	Environment
+ Will reduce fuel usage, as congestion involves a lot of idling, and this should reduce congestion at least a little + Will reduce fuel usage even more because people might carpool, use public transit.	+ Could dramatically reduce congestion by encouraging people to carpool, go to work at different times, and use public transit.	+ Reduce fuel usage, thus reducing emissions + Helpful on code red days - New road construction could cause environmental harm

**6. Encouraging Telecommuting**

*Background Information*

Reducing the number and length of car trips one needs to make can result in resource conservation, decreased congestion, and environmental protection. Most car trips in the US are related to work. Therefore, a good way to reduce the total number and length of car trips would be to alter the current norm of driving to work.

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<sup>106</sup> [A \\$57 Daily Commute](http://www.env-econ.net/2007/03/a_57_daily_comm.html), 03/23/2007 2007, 05/01 2007 <[http://www.env-econ.net/2007/03/a\\_57\\_daily\\_comm.html](http://www.env-econ.net/2007/03/a_57_daily_comm.html)>.

Recently, in the United States, there have been a growing number of individuals who have decided to telecommute instead of drive to work every day. Telecommuting entails working outside of a central company office. Instead, an individual drives to a local satellite office or works at home. They use the internet to connect to the company mainframe, and can do work without physically being in the office. Some individuals do this five days a week, and others telecommute occasionally.<sup>107</sup>

#### *How Could Telecommuting be Encouraged?*

To encourage telecommuting, the government could offer tax incentives to firms who are willing to allow their workers to telecommute. If firms receive a financial incentive for encouraging telecommuting, they will be more likely to set up satellite offices or help employees connect to the company network from home. In addition, employees could receive tax incentives for telecommuting.

#### *Benefits of Promoting Telecommuting*

An increased rate of telecommuting could be very beneficial. Initially, it will result in decreased congestion, as fewer people would drive their cars to work. This will result in decreased fuel usage and decreased tailpipe emissions. It could also result in a more enjoyable work experience for employees, who would regain lost commuting time, which may result in increased productivity. In addition, employees would be closer to their families, and can run errands if needed, which is important, especially in a family with children.

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<sup>107</sup> Telecommuting, 04/30/2007 2007, 05/01 2007 <<http://en.wikipedia.org/wiki/Telecommuting>>.

In the long run, telecommuting would slow the rate a new vehicle ownership and relieve the demand for new road capacity.<sup>108</sup> In addition, firms could hire employees they value highly that would otherwise not accept employment for geographic reasons.<sup>109</sup>

### *Costs/Shortcomings*

Unfortunately, telecommuting could result in lower productivity. Obviously, when telecommuting, an employee does not have face to face contact with coworkers or clients. This can decrease productivity, and certain interactions may be difficult or impossible without face to face contact. However, it is possible that this problem will be mitigated over time as technology improves.

Telecommuting from home also might be distracting, which could lower productivity. If an individual is at home with one's spouse or children, there is a chance that they could be distracted with family members' wants and needs, and might not work as productively as they might in the office.

Telecommuting also heavily relies on the speed and reliability of the internet. If there are outages or times when the internet is running slowly, an employee will not be able to work as efficiently as if they were in the office.

Finally, telecommuting has resulted in outsourcing of domestic jobs abroad,<sup>110</sup> and could continue to do so. Although some do not believe this is a major problem, many Americans are politically resistant to anything that eliminates domestic jobs. Because of this, promoting telecommuting might be politically difficult.

### *Conclusion*

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<sup>108</sup> Black and Nijkamp, 279

<sup>109</sup> Wikipedia

<sup>110</sup> Wikipedia

Ideally, telecommuting could result in an improved environment, congestion, and reduced use of oil. However, its success is highly dependent upon technology and its effects on worker productivity.

Resource Depletion	Congestion	Environment
+ Less fuel usage because fewer people are driving to work	+ Less congestion because fewer people need to drive to work	+ Fewer emissions because less fuel usage.

## 7. What About Public Transportation?

Public transportation is a great way to reduce congestion and emissions while conserving resources. However, public transportation will not be as important in the United States as it is elsewhere in the world. For one, the US is a very car-centric culture. In North America, there are more registered cars per licensed driver than any other society in the world.<sup>111</sup> To get people to switch over to public transit in large numbers would require a huge and costly creation of various incentives. Secondly, urban sprawl exists throughout the US. Because this means there is very low population density, public transportation must cover a lot of ground to effectively serve a large percentage of Americans. This can be very costly, and sending a bus out into a suburban area that will collect few passengers can be very inefficient.

Public transportation should continue to operate, and efforts should be made to increase the number of passengers that use it. However, in the United States, it will act as more of a complement to personal transportation rather than a substitute, because using it requires a major sacrifice of mobility that most citizens are not willing to accept.

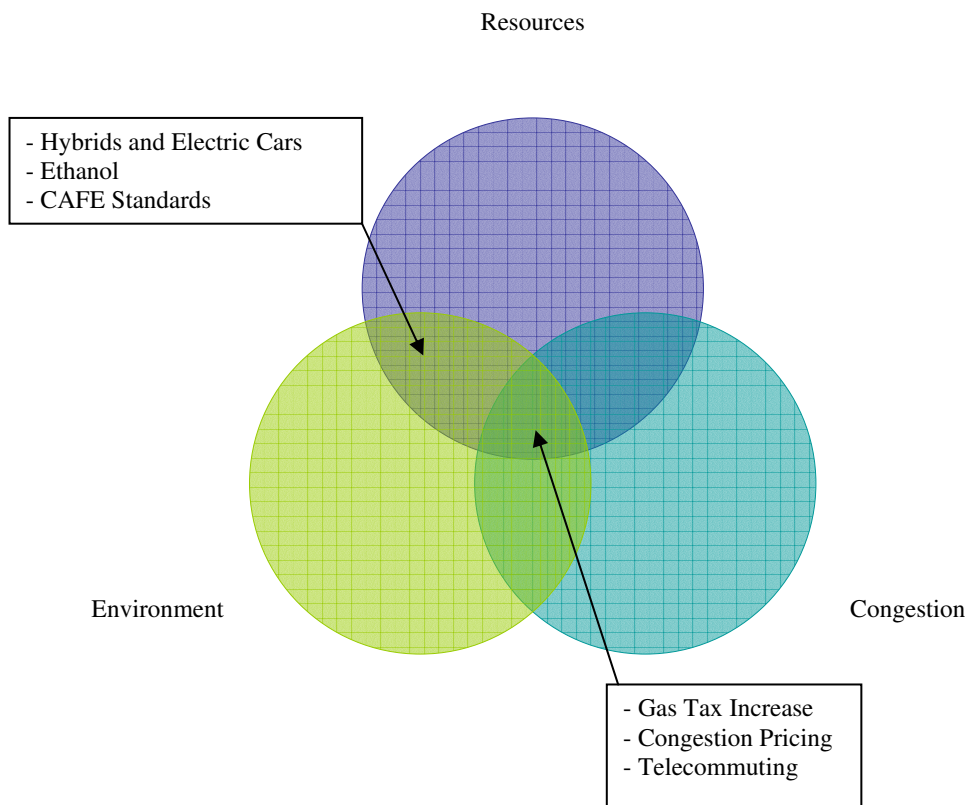
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<sup>111</sup> Black and Nijkamp, 24

# Policy Proposals

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The goal of the following policy proposals is to mitigate the problems of resource depletion, congestion, and environmental degradation without sacrificing the many benefits of mobility. In addition, these policies intend to avoid any immediate, extreme costs, or a disproportionate effect on the poor. It is important to note that policies intended to address one of these three problems will likely have some effect on the other two.



*Figure 1: Interconnection of the Three Problems*

These policy proposals should not be implemented instantly or simultaneously. One reason for this is that it may be easier to gain political support for one policy at a

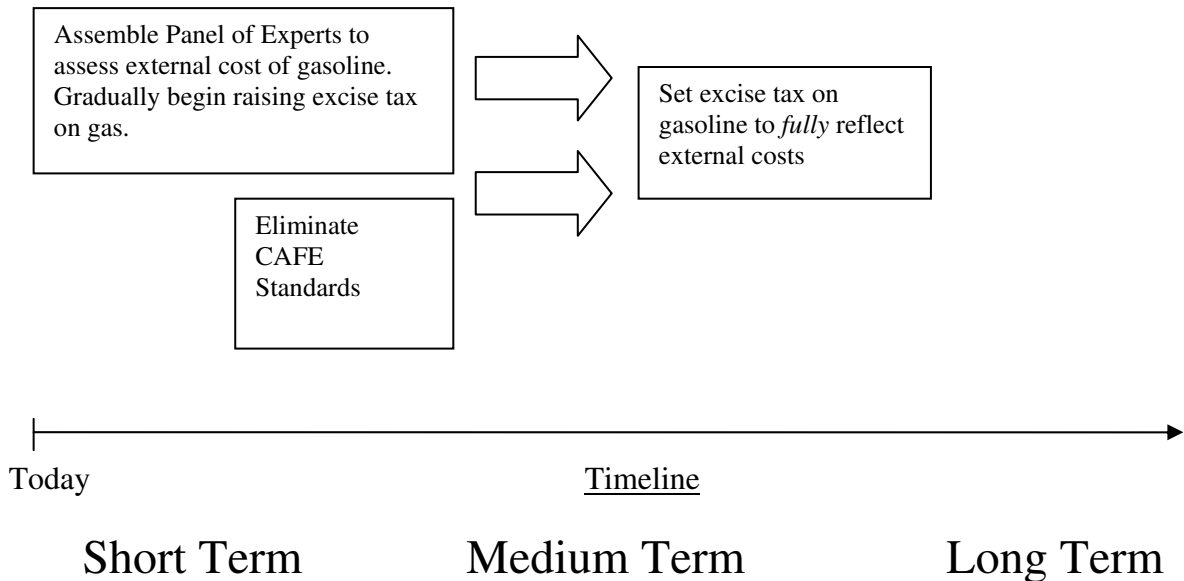
time rather than an entire set of policies at once. The second reason is to facilitate ease of consumption smoothing. Milton Friedman argued that individuals tend to try to maintain a constant standard of living over time, by smoothing consumption.<sup>112</sup> In other words, people like to gradually consume over time, rather than consuming a lot in good times and little in bad times. If Friedman is correct, it follows that individuals would prefer a cost spread over time rather than a sharp shock in costs, because a spread cost would make it easier to smooth consumption.

The following policy proposals are a recommendation for US policymakers. They are by no means the only way to accomplish the goal of this paper. Still, based upon the research presented, it would be useful to seriously consider the following.

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<sup>112</sup> The Permanent-Income Hypothesis, 05/01/2007 2007, 05/01 2007  
<<http://www.ingrimayne.com/econ/FiscalDead/PermIncome.html>>.

## A. Increase the Excise Tax on Gasoline



*Figure 2: Proposals 1 and 2: Gas Tax and CAFE Standards*

The United States should assemble a panel of experts to establish an estimate of the external cost of gasoline consumption. Then, the excise tax on gasoline should gradually be raised, over the course of five years, until it is equal to the external cost estimate of gasoline. At the same time, the Earned Income Tax Credit should be modified to allow individuals of lower incomes to report miles driven, and receive partial reimbursement for those miles.

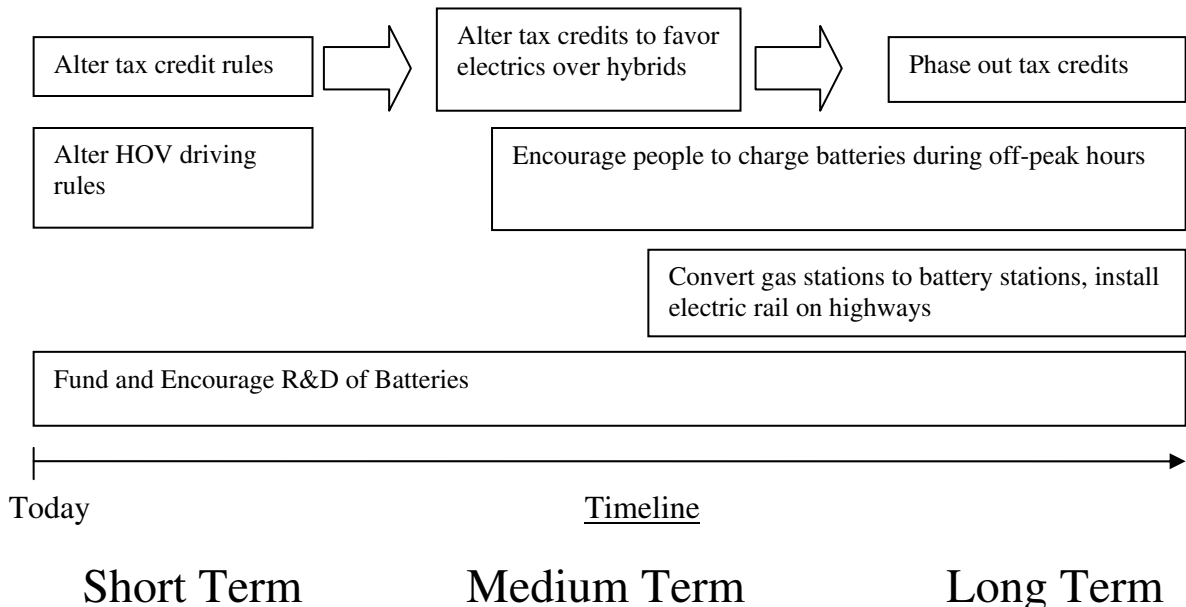
By raising the gasoline tax over the course of five years, it gives individuals time to react, rather than face an instant financial challenge. Before gasoline prices reflect full external costs, individuals can buy more fuel efficient cars, find a carpool route, move closer to work, set up a telecommuting plan, or take advantage of other such options.

By using the EITC to partially reimburse the poor for the increase in fuel costs, the tax increase is made equitable. Without modifying the EITC, the poor who need to drive would face a very large financial challenge compared to the rest of society.

## **B. Eliminate Cafe Standards**

CAFE standards are ineffective and inefficient at reducing gasoline consumption due to loopholes and exceptions. Furthermore, they limit consumer choice. In addition, updating the standards will be close to impossible due to intense resistance by automakers and oil companies. Finally, after the excise tax on gasoline is increased, the CAFE standards will be essentially useless. Therefore, the CAFE standards should be eliminated after the initial increase in the excise tax on gasoline.

### C. Encourage the Proliferation of Hybrid, Plug-in Hybrid, and Electric Vehicles



*Figure 3: Proposal 3: Hybrids, Plug-in Hybrids, and Electric Cars*

#### *Short Term*

In the short term, the federal government should continue giving tax credits for purchase of hybrid-electric and electric vehicles, and tax credits should be provided for plug-in hybrid conversion. In addition, tax credit rules should be modified so that consumer tax credits are not phased out for a particular manufacturer once that manufacturer sells 60,000 hybrids. The US government should also help fund the research and development of batteries and their recycling. Finally, HOV driving rules should be modified so that to drive in a HOV lane with a single passenger car, the car must average a certain number of miles per gallon, regardless of whether it is a hybrid or not.

The tax credit phase-out rule should be eliminated because it does not seem to serve a positive purpose. If one manufacturer makes a superior hybrid compared to the

rest of the market, and that hybrid sells more units than other manufacturers, it should not be penalized by having its hybrid tax credit phased out. This is happening with Toyota right now. Toyota has sold over 60,000 hybrids, so its consumer tax credit is being phased out, while other manufacturers can still offer their buyers full tax credits upon hybrid purchase.<sup>113</sup> This makes no sense, especially because the Prius is the most fuel efficient hybrid on the market today.<sup>114</sup>

Research and development of batteries should receive government funding because the most important part of a hybrid or electric vehicle is the battery. Therefore, an improvement in batteries can result in a dramatic improvement in these vehicles. In addition, the government should fund research and development of better methods of battery recycling to minimize environmental impacts from batteries.

HOV driving rules should be modified to encourage manufacturers to make fuel efficient hybrids. Since hybrids are often allowed to travel in HOV lanes regardless of their fuel economy, manufacturers can offer consumer incentives to buy a hybrid with pitiful fuel economy purely so the consumer can drive in the HOV lane. The standard for driving in an HOV lane should be based on miles per gallon rather than hybrid status, to encourage fuel efficiency, rather than an elitist pass into the fast lane.

### *Medium Term*

In the medium term, the tax credit for electric vehicles should increase relative to tax credits for hybrids and plug-in hybrids. The government should also increase funding of research and development for batteries. Finally, the government should enact

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<sup>113</sup> [Toyota Hybrid Begins Phaseout on October 1](http://www.irs.gov/newsroom/article/0,,id=162562,00.html), 09/20 2006, 05/01 2007  
<<http://www.irs.gov/newsroom/article/0,,id=162562,00.html>>.

<sup>114</sup> [Compare Hybrid Cars](http://www.fueleconomy.gov/feg/hybrid_sbs_cars.shtml), 05/01/2007 2007, 05/01 2007  
<[http://www.fueleconomy.gov/feg/hybrid\\_sbs\\_cars.shtml](http://www.fueleconomy.gov/feg/hybrid_sbs_cars.shtml)>.

legislation that encourages individuals to charge electric vehicles at night during off-peak electrical hours.

The reason electric vehicle tax credits should increase relative to other vehicles is because electricity will likely play a larger role in reducing fuel usage as time passes. This assumes that batteries will improve enough to make electric vehicles a viable primary transportation option.

The government should provide incentives for individuals to charge electric vehicles at night during off peak hours to lessen strain on the electrical grid. If most individuals charge their vehicles during the day, it would place excessive strain on the electrical grid and may require additional power plant construction. If individuals charge at night, on the other hand, when most power plant capacity is unused, there would be a much smaller societal cost.

### *Long Term*

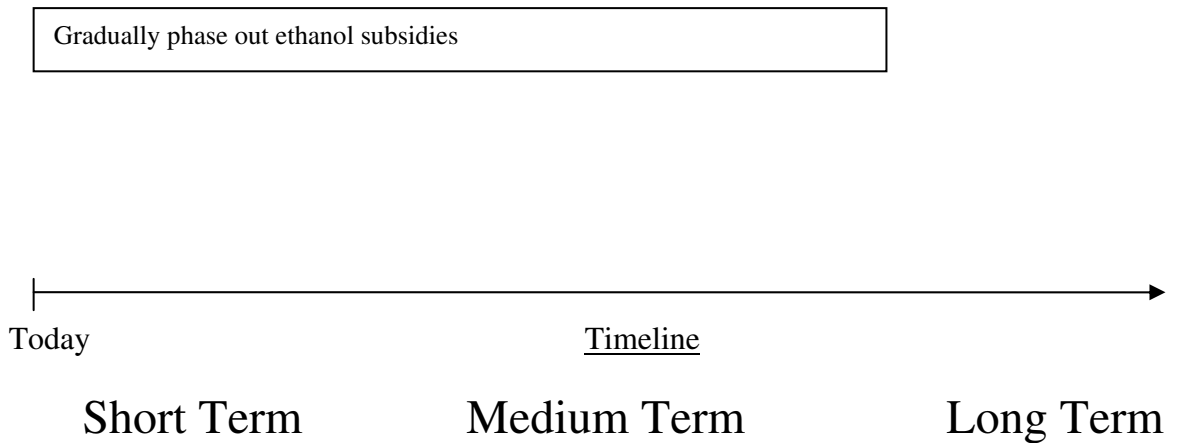
Once the price premium on electric vehicles is substantially reduced compared to all other vehicles, tax credits for the production and purchase of electrics, plug-ins, and hybrids should be phased out. The reason for this is to remove market distortions in the event that a newer, better technology for fueling transportation arrives, and it can compete with electricity. The federal government, however, should still continue to encourage and fund research and development of battery technology.

If battery technology has not improved enough to allow electric vehicles to take long road trips, two ambitious infrastructure changes could be made. One is to convert gas stations to battery-exchange stations. If necessary, a driver could “fill up” by exchanging their drained car battery for a fully charged battery for a fee. This would

allow individuals who do not have time to charge their battery, or who are going on a road trip, to instantly regain power in their car.

Another ambitious infrastructure change would be to install an electric rail along the side of major highways. Power could be drawn from this rail by electric cars who are traveling on the road. They would simply attach to the rail while driving, and could remain in an auto-pilot mode while charging their vehicle until they need to exit the highway. A fee would be charged for the electricity in the same manner electronic tolls are assessed today: with a smart tag on the car linked to a credit card. In addition to enabling electric cars to travel on long road trips, this would make the roads safer by allowing drivers to “ride the rail” in autopilot.

## D. Don't Power Vehicles with Ethanol

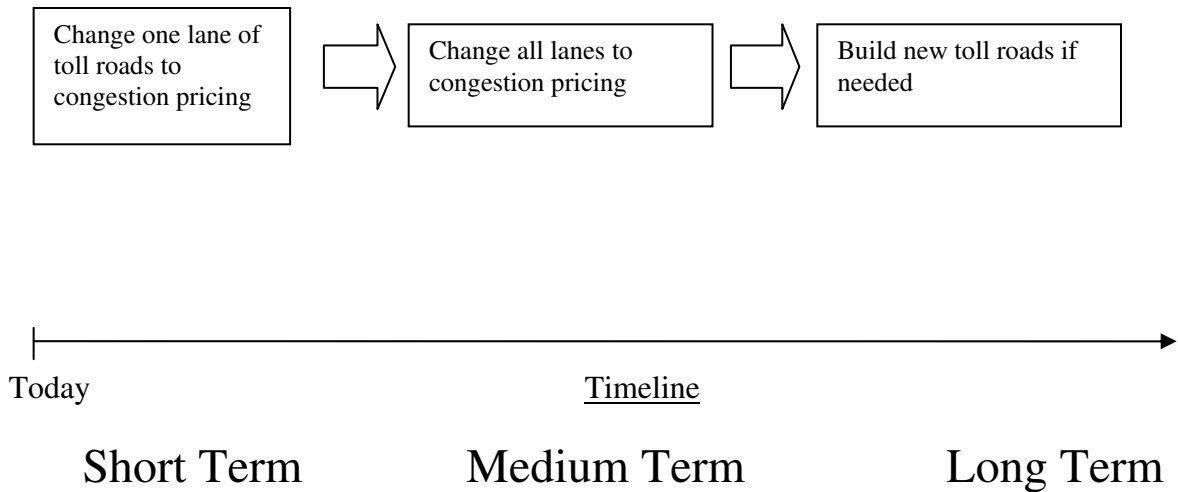


*Figure 4: Proposal 4: Eliminate Ethanol Subsidies*

Ethanol subsidies should be gradually phased out. David Pimentel asserts that ethanol has a negative energy balance: it requires more energy to produce than it yields. However, even if ethanol had a positive energy balance, the massive amount of land required to fuel the US's energy needs with ethanol is a cost that is not worth the potential benefit.

Yet because so much federal money is sunk into ethanol subsidies annually, removing the subsidies all at once would cause significant harm. Instead, federal ethanol subsidies should be gradually reduced to zero over the period of five to ten years.

## E. Shift to a System of Congestion Pricing



*Figure 5: Proposal 5: Congestion Pricing*

### *Short Term*

In the short term, one lane of every toll road in the US should be changed to a congestion pricing system. In other words, drivers will have a choice on toll roads between driving on a toll road lanes with a flat toll, or they can drive in an “exclusive” congestion pricing lane with a price that changes depending on the traffic on the toll road. During high traffic hours, this lane should cost more than the flat toll to drive on, but during low traffic hours, it should be cheap or free. Furthermore, public transportation busses should be allowed to use the congestion pricing lane for free.

### *Medium Term*

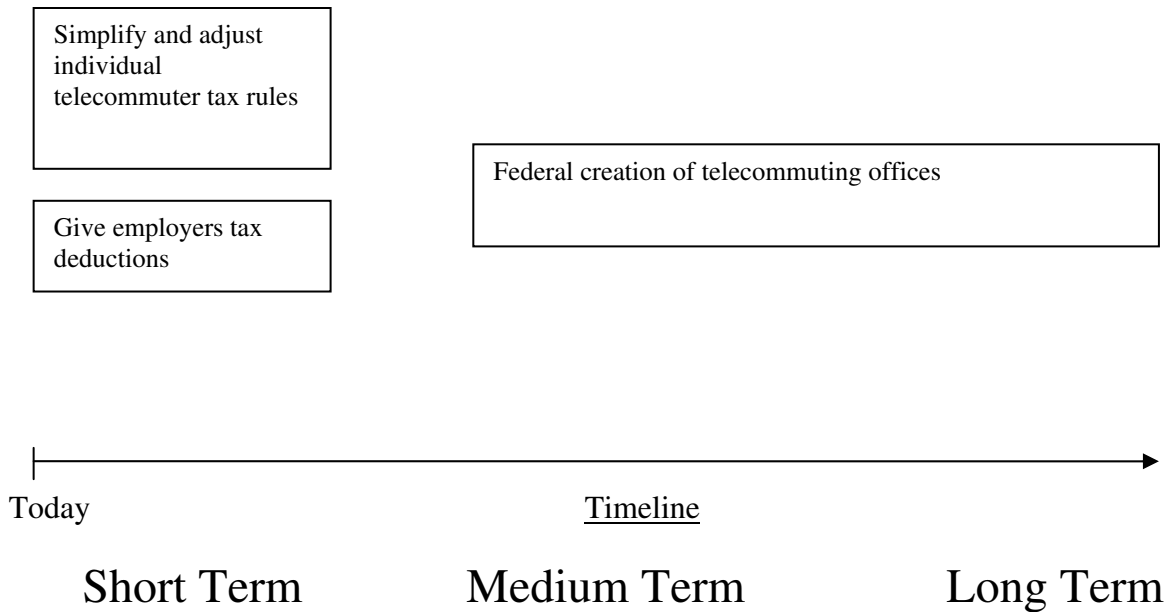
In the medium term, if one-lane congestion pricing is successful, toll roads should be completely changed over to a congestion pricing system. The revenue generated can

be used to fund a free or very cheap public bus system that uses the congestion priced toll roads.

*Long Term*

In the long term, new toll roads should be built, if necessary, using funds generated from the congestion pricing program.

## F. Encourage Telecommuting



*Figure 6: Proposal 6: Encourage Telecommuting*

### *Short Term*

Individuals currently may receive a federal telecommuting tax deduction, but it is very complicated and difficult to qualify for. For instance, for an individual working from home, the tax deduction only applies if the telecommuting is “at the convenience of the employer.” In other words, if an individual asks to work from home, rather than the employer, the tax deduction will probably be denied.<sup>115</sup> This is too complicated and should be made simpler. Moreover, employers do not currently receive federal tax deductions for allowing telecommuting,<sup>116,117</sup> but they should. These two problems could

<sup>115</sup> [Tax Benefits Give Added Incentives to Telecommuting](http://www.groco.com/readingroom/tax_telecommuting.aspx), 05/01/2007 2007, 05/01 2007 <[http://www.groco.com/readingroom/tax\\_telecommuting.aspx](http://www.groco.com/readingroom/tax_telecommuting.aspx)>.

<sup>116</sup> Greenstein, Rogoff, and Olsen.

<sup>117</sup> [2007 Press Releases](http://news.nase.org/nase_about/PressRelease.asp?PRID=198), 05/01/2007 2007, 05/01 2007 <[http://news.nase.org/nase\\_about/PressRelease.asp?PRID=198](http://news.nase.org/nase_about/PressRelease.asp?PRID=198)>.

be remedied by passing the telecommuting portions of Representative Lee Terry's Parents' Tax Relief Act into law.<sup>118</sup>

Making tax deductions simpler and applying tax deductions to employers increases the incentives for individuals and firms to make use of telecommuting. Therefore, more people might consider trying it.

#### *Medium to Long Term*

The government should fund the creation of local telecommuting offices for employees that want to work close to home, but not at home, or need faster internet service. This could improve productivity and increase the total number of people able to telecommute.

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<sup>118</sup> Parents' Tax Relief Act of 2007, 03/08/2007 2007, 05/01 2007  
<[http://leeterry.house.gov/Legislation\\_Details.aspx?NewsID=1464](http://leeterry.house.gov/Legislation_Details.aspx?NewsID=1464)>.

## *Conclusion*

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The three major costs of transportation: resource depletion, congestion, and environmental degradation; are serious. If no action is taken to mitigate these problems, the consequences will be severe. However, optimally, the actions taken to address these costs should not *force* individuals to give up their mobility. Nor should they impose immediate extreme financial costs on the US economy as a whole, or disproportionately large costs on the poor. The policies mentioned in this paper satisfy the above criteria.

No policy forces individuals to give up their mobility. Instead, several of the policies make it more attractive to eliminate excessive use of mobility. For example, an increased gasoline tax does not make gasoline completely unaffordable to anyone in the country, poor or rich. Rather, it makes individuals pay the full costs of their gasoline consumption, making conservation more attractive. Individuals can still, if they value driving highly, purchase the same amount of gasoline as before the tax increase.

The policies mentioned do not have immediate and extreme financial costs, because they can all be implemented incrementally. A gradual conversion to electric cars can be accomplished over 20 years, for example. Ethanol subsidies can be phased out gradually. A gasoline tax can be implemented incrementally over time as well.

These policies also avoid disproportionately harming the poor. An increased gasoline tax, in theory, might be disproportionately borne by the poor but a modification to the Earned Income Tax Credit could solve this problem easily.

The US should take action despite the international characteristics of transportation problems. For instance, due to the fact that the problems of resource depletion and environmental degradation have a global scope, US domestic policies alone

might not solve them. Although this is true, it does not follow that the US should ignore the problems. In addition, if the US can show economic success by adopting sustainable transportation practices, other countries might follow suit. Finally, improvements in technology such as electric vehicles might reduce their price enough to make them financially attractive for other countries to use. Still, because there is a chance that other countries will not follow suit, the US should be prepared, in the long run, to create or agree to international policies to mitigate these problems. It is likely that these policies will extend well beyond the realm of transportation.

There is still a major hurdle to clear in order to enact transportation policies like the ones in this paper: politics. Breaking away from the status quo is extraordinarily difficult. Today, many powerful corporations' profits depend on the transportation status quo, so there is great incentive for them to prevent major changes. In a working paper entitled "Big Business Stability and Economic Growth: Is What's Good for General Motors Good for America?" it was found that what is good for big business does not generally improve the economy. In fact, big businesses might go out of its way to ensure the status quo by lobbying against sustainable transportation policies, for example.<sup>119,120</sup>

Citizens might not support these policies, either. Implementation of these policies would involve increased taxes, and taxes are not a popular idea in politics. Furthermore, these policies require that people give something up now for benefits in the future. Research shows that individuals and politicians tend to be myopic,<sup>121</sup> which reduces the political popularity of these proposals. Additionally, many individuals who are voting

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<sup>119</sup> Alan S. Blinder, "Is Government Too Political?" *Foreign Affairs* (1997): 115.

<sup>120</sup> Blinder, 115

<sup>121</sup> Blinder, 115

today would be the ones who faced the costs of these transportation policies, yet many of the benefits would accrue to the next generation, rather than these individuals.

Politics create a significant challenge for proponents of the transportation policies suggested in this paper. Yet politics are a hurdle the country must clear to ensure our standard of living is preserved. The longer nothing is done, the greater the problems of resource depletion, congestion, and environmental degradation will become. In turn, this means that to correct these problems, more severe actions will need to be taken. If the problems grow out of hand, mobility might be severely limited or completely eliminated for many Americans. Smart, incremental policies should be enacted as soon as possible so the country can avoid staggering costs in the future.

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