U.S. Energy Policy: Impacts of an Increased Federal Revenue Neutral Gasoline Tax

By
Aaron Kraus

A thesis submitted to Johns Hopkins University in conformity with the requirements for the degree of Master of Government.

Baltimore, Maryland
May, 2008

Abstract

The future holds significant challenges for the United States with regard to clean, inexpensive, and reliable energy resources. Of these energy challenges, issues relating to transportation fuels appear to be some of the most acute and serious. The price of gasoline does not reflect the true societal costs due to a variety of market externalities. Domestic energy policy must investigate new proposals that offer insight into possible solutions.

The following thesis reviews geopolitical risks associated with current U.S. petroleum consumption trends. It also discusses the role gasoline taxes might have in mitigating certain amounts of demand growth. The gasoline taxes that are investigated are revenue neutral. This concept entails returning all revenue raised by any increased tax to consumers with reductions in other tax burdens. While this idea is somewhat radical in nature and politically complex, the consequences of increased gasoline taxes may be socially beneficial.

The following study finds that gasoline is one of the most important products in modern society. As such, reducing its consumption is extremely difficult. However, increasing the cost of gasoline by raising taxes can influence demand to some degree. An increased revenue neutral gasoline tax could prove to be part of an effective overall U.S. energy policy.

This thesis is dedicated to my mother, father, stepmother, and brother Ethan. In addition I would like to thank Adam, Warren and Ndeye for all of their support.

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Chapter 1 – Introduction

This thesis examines the likely impacts and consequences of an increased tax on gasoline consumption within the United States. The tax in question will be revenue neutral. All funds raised by any marginal increase in gasoline taxes will be offset with a decrease in other taxes and fees making this proposal more politically feasible. The overall goal of an increased gasoline tax is not to raise additional funds for federal coffers, but instead it is meant to correct significant market failures found within the energy industry.

The central argument is that current gasoline prices do not reflect true societal costs. The primary issue to be analyzed in this study will be the current and likely future geopolitical costs associated with U.S. oil consumption within the transportation field.

1.1 The Problem

Energy is quickly becoming one of the most serious issues facing world governments, economies, and societies. Energy is a fundamental resource that is required to

perform almost every function of an advanced society. Charles Hall in his Nature article “Hydrocarbons and The Evolution of Human Culture” stated that “the history of human society can be viewed as the progressive development of new energy sources and their associated conversion technologies.”[1] It is becoming increasingly clear that the stability and growth of a nation’s economy and society rests with the supply of reliable and fairly inexpensive energy. To achieve this goal, national governments will often utilize many levers of their power, including military force. Climate change, as a result of the burning of fossil fuels, will be another serious concern for national government and the world community.

Additional issues relating to the current U.S. energy situation include the increased reliance on the politically unstable Middle East for a substantial quantity of imported oil. In addition, possible “peak oil” in certain geographic areas of the planet will likely create new obstacles. The overall supply problem involving petroleum will eventually act as a cap on the total amount of energy that can be produced. Juxtaposed to these issues are issues relating to

1 Charles Hall. "Hydrocarbons and the Evolution of Human Culture." *Nature* no. 6964 (November 20 2003): 426.

demand. The increase in energy demand from countries such as China and India will likely begin to strain the world's energy supply chain.

There are other seemingly intractable problems in other fields of energy, notably that of electricity generation. However, this thesis will abstain from addressing these problems with any real depth. Instead, it will attempt to discover how to decrease oil consumption within the United States by increasing gasoline consumption taxes. It will also investigate the geopolitical impacts of such a reduction.

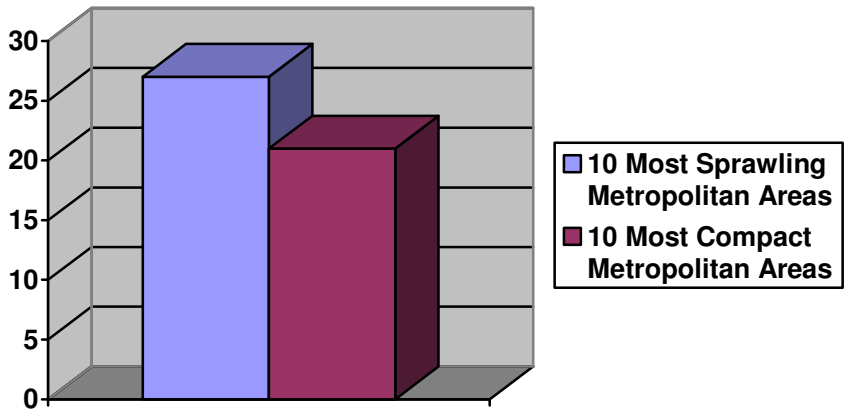
1.2 Other Proposals

There have been numerous policy proposals and research conducted to decrease American oil consumption. For example, proposals to encourage "Smart Growth" attempt to decrease the total miles driven by Americans. The central idea behind Smart Growth is to create "livable communities," places of work, recreation, and commerce are in close proximity to residences. This reduces the demand for lengthy car trips and thus decreases gasoline demand.

Figure A[2] shows that drivers in the 10 most compact metropolitan areas drive an average of 21 Daily Vehicle Miles (DVM) as opposed to those who live in the 10 most sprawling metropolitan areas that drive and average of 27DVM. In other words, those in more densely populated

Figure A

Average Daily Vehicle Miles Traveled



Source: R. Ewing, R. Pendall, and D. Chen. "*Measuring Sprawl and its Impact.* Washington, D.C." *Smart Growth America/U.S. Environmental Protection Agency* (2002).

regions drive, on average, 22% less than those in areas with greater sprawl. While this idea seems to hold certain merits, it is unlikely that it could be usefully deployed

2 R. Ewing, R. Pendall, and D. Chen. "Measuring Sprawl and its Impact. Washington, D.C." Smart Growth America/U.S. Environmental Protection Agency (2002).

on a macro level. This approach would likely only work in niche cases and, by itself, is not a comprehensive policy.

Another option for reducing gasoline consumption involves the further strengthening of the U.S. Corporate Average Fuel Economy (CAFE) standards. CAFE is a standard for the average fuel economy for a manufacturer's fleet of passenger cars or light trucks with a Gross Vehicle Weight Rating (GVWR) of 8,500 lbs. or less.

In 2007, the U.S. Congress and President Bush enacted the "Clean Energy Act." The law mandates increases in CAFE standards beginning in 2011, resulting in a combined passenger and non-passenger fleet-wide average of 35 mpg by 2020. This average represents a 40% increase over current fuel economy standards. According to the Environmental Law Update,

> Domestic manufacturers must meet a minimum fuel economy standard of the greater of 27.5 mpg or 92 percent of the projected average fuel economy for the combined U.S. manufactured domestic and non-domestic passenger automobile fleets for that model year.[3]

CAFE has had some significant successes. For example, in his book Freedom from Oil, David Sandalow explains that

3 Hill, M. and Demirjian, H. "2007 Energy Act Presents Opportunities" Blank Rome LLP. http://www.blankrome.com/index.cfm?contentID=37&itemID=1418.

fuel efficiency savings from CAFE have been considerable. He states that recent estimates of CAFE show that the policy saves U.S. consumers more than 3.2 million barrels of oil per day. At $100 per barrel of oil, annual savings from CAFE can be calculated to exceed $100 billion.[4]

A 2002 Congressional Budget Office (CBO) report states that while CAFE standards could offer benefits by regulating fuel efficiency found in American automobiles, the overall consumption patterns in gasoline are far less certain. If reducing U.S. oil consumption is ones normative goal, raising CAFE standards is only a partial solution. By itself, raising CAFE standards would not be a cost-effective way to cut gasoline consumption because it would not encourage all potential gas-saving activities. By focusing solely on the fuel economy of vehicles, it would give many people little incentive to make gas-saving changes in their lifestyle and driving behavior. By making vehicles more fuel efficient and thus lowering the cost of driving, higher CAFE standards could lead to more driving rather than less. CBO explains that,

4 Sandalow, D. *In Freedom from Oil, How the Next President Can End the United States Oil Addiction*(New York: McGraw Hill, 2008), 113.

> Research suggests that a 10 percent increase in CAFE standards would result in roughly a 2 percent increase in the number of miles driven. That effect would reduce, though not eliminate, the gasoline savings caused by the improvement in fuel economy.[5]

Other options for decreasing gasoline consumption include the further development of biofuels and hydrogen as well as the implementation of Plug-in Hybrid Electric Vehicles (PHEVs). Supporters of these options point to the fact that the American transportation infrastructure must begin to completely divert large percentages of its primary fuel use to other energy sources. For example, fuel from biomass, hydrogen or electricity which is usually generated from coal, nuclear power, and natural gas could offer significant advantages.

For example, studies indicate that if all American cars were PHEV20s, gasoline consumption could be reduced by approximately 40%. PHEV20s would be able to use electrical charge for the first 20 miles of travel, reducing gasoline consumption by more than 60%.[6] A Pacific Northwest National Laboratory (PNNL) reports finds that the current U.S.

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5 Reducing Gasoline Consumption: Three Policy Options Congressional Budget Office, November 2002, http://www.cbo.gov/doc.cfm?index=3991&type=0&sequence=1.

6 Sandalow, D., 62

electricity infrastructure has sufficient capacity to charge up to 84% of the nation's cars, pickup trucks, and SUVs (198 million vehicles) or approximately 73% of the light duty fleet (about 217 million vehicles) for a daily drive of 33 miles on average. In addition, the PNNL finds that, based on 2005 statistics, a maximum current implementation of PHEVs could reduce the gasoline consumption by up to 6.5 MMBpd, which was equivalent to 52% of the U.S. petroleum imports in 2005.[7]

PHEVs do have major barriers for further development. PHEV batteries must have sufficient charge and capacity to drive the automobile dozens of miles. In addition, they must withstand and operate under conditions that include thousands of deep discharge cycles. Currently, batteries for PHEVs can be manufactured for $8,000 to $11,000.[8] While the advancement of battery development will likely drive down costs, creating proper market signals for conventional automobiles may also make PHEVs more affordable in comparison.

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7 *Plug-in Hybrid Vehciles on Electric Utilities and Regional U.S. Power Grid Part 1: Technical Analysis* Pacific Northwest National Laboratory, November 2007, http://www.pnl.gov/energy/eed/etd/pdfs/phev_feasibility_analysis_combined.pdf.

8 Ibid.

1.3 Political Difficulty

It is not likely, under current conditions, that Congress will raise gasoline taxes in the magnitude mentioned within this thesis. Neither the Bush administration nor any major candidate running for President in 2008 has made raising the gas tax a major campaign theme. It appears that neither major American political party can be perceived as being too likely to raise taxes that might negatively impact consumers.

Additionally, there does not seem to be an overwhelming amount of public support for a gas tax increase. However, when the benefits of a gas tax increase are explained, the popular support rises significantly. A coalition of willing interests would likely be needed to fund educational outreach to help persuade the general public to support a revenue-neutral gasoline tax increase.

A New York Times/ CBS News poll conducted in February 2006 with a sample size of 1,018 Americans asked various questions pertaining to gas tax levels.

"In order to cut down on energy consumption and reduce global-warming, which would you prefer -- requiring car

manufacturers to produce cars that are more energy efficient OR imposing an increased federal tax on gasoline?"[9]

87% answered with more energy efficient cars and only 8% replied with a federal tax on gasoline.

"Would you favor or oppose an increased federal tax on gasoline?"[10]

12% answered that they would support it while 85% said they would oppose it.

"What if your payroll taxes or income taxes were reduced as a result of the increased gasoline tax, then would you favor or oppose an increased federal tax on gasoline?"[11]

28% said they would favor it while 63% reported that they would oppose it.

"What if the increased tax on gasoline would reduce the United States' dependence on foreign oil, then would you favor or oppose an increased federal tax on gasoline?"[12]

55% reported that they would support it while 37% explained they would oppose it.

"What if the increased tax on gasoline would cut down on energy consumption and reduce global warming, then would you favor or oppose an increased federal tax on gasoline?"[13]

59% said they would support it while 34% said they would oppose it.

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9 "New York Times / CBS News Poll." *New York Times*, February 28, 2006, 2006, http://www.nytimes.com/packages/pdf/national/20060228_poll_results.pdf.

10 Ibid.

11 Ibid.

12 Ibid.

13 Ibid.

This thesis investigates three radically aggressive tax increase proposals. It can be reasonably assumed that there would be significant interests opposed to substantially raising gasoline taxes. Presumably, these interests would include the automobile manufacturing industry and the petroleum discovery, refining, and distribution industry. In addition, those who advocate against government intrusion into the marketplace would be likely to oppose gasoline tax hikes. However this opposition might be somewhat tempered with the revenue neutral approach.

A coalition of environmental and security organizations could possibly support increased gasoline taxes. Sandalow explains that many notable figures have argued for and support higher gasoline tax rates. They include: Gregory Mankiw, President George W. Bush's Chair of Council of Economic Advisors from 2003 to 2005; Alan Greenspan, Chair of the Federal Reserve Board from 1987 to 2006; Martin Feldstein, Chair of the Council of Economic Advisors under President Ronald Reagan; Larry Summers, Treasury Secretary under President Clinton; Joe Stiglitz,

winner of the Nobel Prize in Economics; Tom Friedman, a New York Times columnist; and many others.[14]

Even with strong support from the environmental field and from former high ranking figures, any gas tax hike would be a political challenge. The federal gas tax rate has not been changed since 1993. Since that date, the Consumer Price Index has increased by more than 40%.[15] Thus, gas taxes have not even kept up with inflation. In general, it is more than likely that a gas tax proposal would create a tense and acute political battle in Washington.

1.4 Outline of Thesis

This thesis first reviews the history of gasoline usage in the United States. It will then outline the current trends, policies, and tax structure in place. Next, it will examine different tax increase levels and how they could impact consumption levels. This thesis will then discuss the potential geopolitical consequences of current and projected gasoline consumption levels in a variety of key areas: climate change, peak oil and increasing

14 Sandalow, D., 123

15 Sandalow, D., 122

international demand, the Organization of Petroleum Exporting Countries (OPEC), and other international oil supply concerns.

Chapter 2 – The History of Oil and Gasoline

Energy consumption throughout the world has grown significantly as societies have become more complex and industrialized. "In 1850, about 88 percent of the world's energy was coming from the biomass sources–mostly fuel wood and charcoal, augmented by crop waste and dung. The remaining 12% came from coal."[16]

> In the ensuing century, from 1850 to 1950, world use of primary energy grew by a factor of 4.3, and this growth was supported mostly by a tremendous expansion in the use of coal. The growth of oil and natural gas became important only in the latter part of this period; by 1950, oil was supplying just over half as much energy as coal, and natural gas was supplying only a sixth as much as coal.[17]

During the second half of the 20th century, world energy use grew at more than twice the rate that had characterized its growth during the previous one hundred years. The increase during this time period was by a factor of 4.7, making the increase over the one hundred fifty years from 1850 to 2000 a factor of 4.3 x 4.7, or approximately 20.[18]

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16 Holdren, J. "Environmental Change and the Human Condition." *Bulletin of the American Academy of Arts and* 57, no. 1 (Fall 2003, 2003): 27.

17 Ibid.

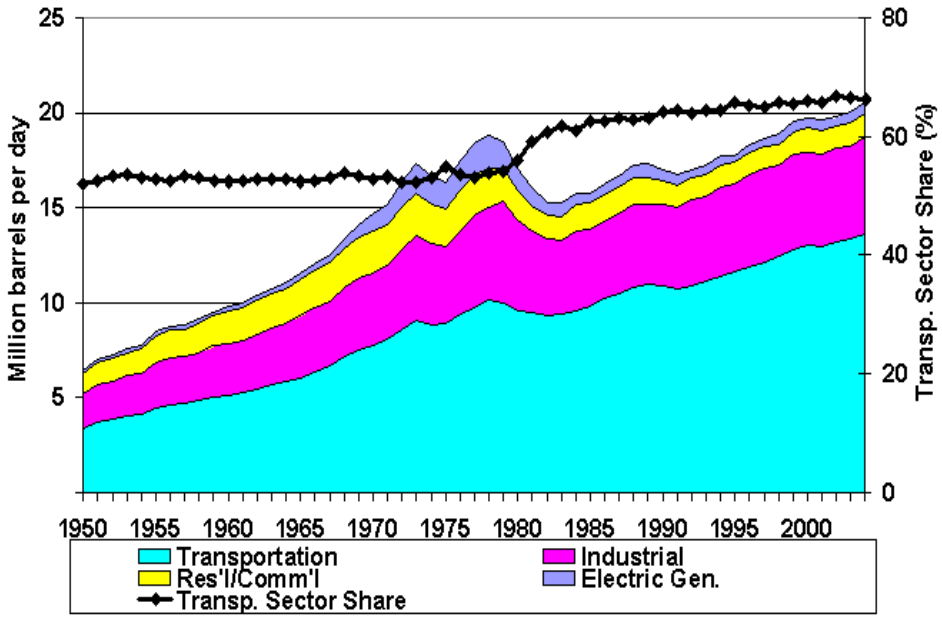
18 Ibid.

In the United States, the increase in energy demand has been equally dramatic, especially for petroleum. Energy demand for electricity generation, manufactured goods, heating, agriculture and transportation fuels has risen substantially. For example, in 1870, the United States used a total of 1.059 Quadrillion British Thermal Unites (QBTUs) of energy. Of that total energy, only 0.11 QBTUs were from petroleum.[19] Those numbers compare with a consumption rate in 2006 where the total amount of energy consumed was over 100.691 QBTUs with 39.748 QBTUs of petroleum consumed.[20] As evident in Figure C, between 1950 and 2004, petroleum, one the leading sources of energy in the United States, has increased by a factor of approximately four.

19 Annual Energy Review Energy Information Administration, 2006, http://www.eia.doe.gov/aer/pdf/aer.pdf.

20 Ibid.

Figure B



Source: U.S. Oil Demand by End-use Sector, 1950-2004, Energy Information Administration, 2008, http://www.eia.doe.gov/pub/oil_gas/petroleum/analysis_publications/oil_market_basics/dem_image_us_cons_sector.htm.

2.1 19th Century U.S. Oil

The modern oil age in the United States began in 1859 when "Colonel" Edwin L. Drake drilled the world's first working oil well in Titusville, Pennsylvania.[21] "The flats

21 Arabe, K. "How Oil Refining Transformed U.S. History & Way of Life." Industrial Market Trends. http://news.thomasnet.com/IMT/archives/2003/01/how_oil_refinin.html.

in the narrow valley of Oil Creek, averaging only around 330 m (~1000 feet) wide were quickly leased, and hastily constructed derricks erected."[22] According to the Paleontological Research Institution, Pennsylvania was responsible for about half of the world's production of oil until the East Texas oil boom of 1901.[23]

During the 19th century, the U.S. entered into the industrial revolution which accelerated the consumption of energy. As evident in Figure D, U.S. energy demand spiked around the exact time that many industrial processes began. Petroleum began to be consumed for a variety of functions including manufacturing, agriculture and heating.[24]

During the 19th century, petroleum had not been consumed in great quantities for transportation. During this century, railroads dominated transportation throughout the country. According to a December 30, 1901 *New York Times* article, The U.S. Treasury Bureau of Statistics

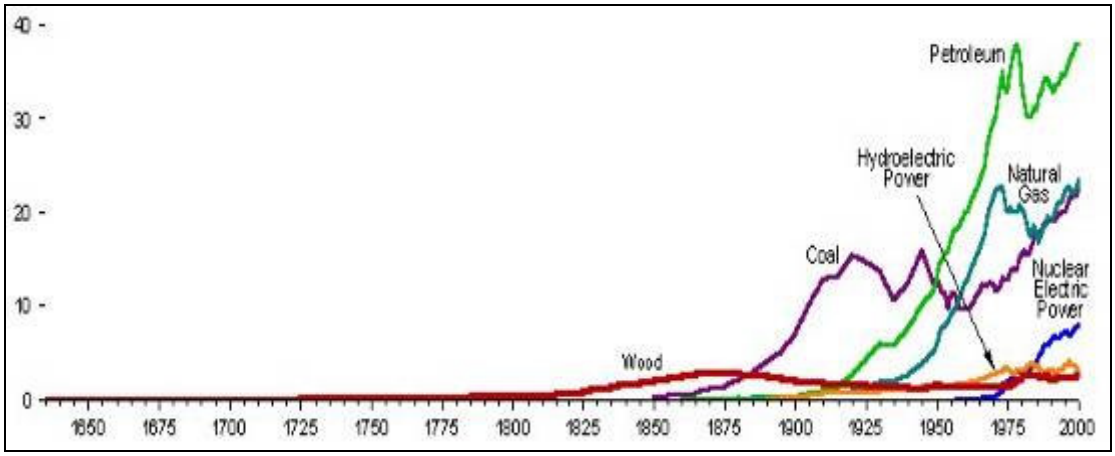
22 "The Story of Oil in Pennsylvania ." The Paleontological Research Institution. http://www.priweb.org/ed/pgws/history/pennsylvania/pennsylvania.html 2008).

23 Ibid.

24 "Estimated Energy Consumption in the United States, Selected Years, 1635-1945." Energy Information Administration. http://www.eia.doe.gov/aer/txt/ptb1701.html.

Figure C

History of Energy Usage in the United States (QBTUs)



Source: *Annual Energy Review 2001*, Appendix F, Tables F1a and F1b

stated that in 1900, the United States held over 194,000 miles of railway. In 1830, the total miles of railway within the United States totaled no more than 25.[25] However, as the 19th century came to a close, a new transportation method would emerge and with it, the rapid rise in demand for petroleum.

25 Growth of Country's Railway Business." *New York Times*, December 30, 1901, 1901, http://query.nytimes.com/mem/archive-free/pdf?_r=1&res=9E0CEEDF1F39E733A25753C3A9649D946097D6CF&oref=slogin.

2.2 The Birth of the Automobile

The Automobile Revolution began with the appearance of automobile manufacturing at the end of the 19th century. By that time, Europeans and North Americans had the technology needed to produce a mechanically powered road vehicle.[26] While experiments with steam-powered highway vehicles in Great Britain date back to the beginning of the nineteenth century, the internal combustion engine was of German origin. The distinctive American contribution of automobile production was made after the stage of pioneering invention had been passed. The U.S. perfected mass production techniques to the manufacture of automobiles to such a degree as to constitute a technological and economic revolution.[27]

The period from 1895 to 1908 marked the first automobile boom. During these years, France dominated the industry as the leading producer and exporter of automobiles. Technical and marketing methods soon spread to other European countries and, to a lesser degree, to the

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26 The Impact of an Industry. " In . Translated by J. Laux, 3. Chapel Hill, NC: University of North Carolina Press, 1982.

27 Rae, R. "American Automobile Manufacturers: The First Forty Years." In , 1. Philadelphia, PA: Chilton, 1959.

United States. From this time until the First World War, the industry in Britain and Germany grew at a faster rate than in France. More importantly, a challenge came from the United States, where manufacturers began to find a mass market for automobiles and sought to create new methods of production to satisfy it. New revolutionary innovations would make the United States the center of the industry from 1908 on through the 20th century.[28]

2.3 The Beginning of the Car Culture

With further developments into the combustion engine and with mass production being applied to automobile manufacturing, the number of cars in America increased drastically. By the early 1900s, gasoline cars started to outsell all other types of motor vehicles. The market was growing for economical automobiles and the need for industrial production was pressing. The first automobile to be mass produced in the United States was the 1901 Curved

28 The Automobile Revolution: The Impact of an Industry, 14.

Dash Oldsmobile, built by the American car manufacturer Ransome Eli Olds.[29]

In the early 20th century, the American industrialist Henry Ford perfected the assembly line and started producing much lager quantities of consumer automobiles. His trademark car, the "Model T," was manufactured at record rates. Moreover, due to economies of scale, these cars became relatively less expensive which allowed a greater portion of the general public to purchase them. As evident in Chart A, the number of "Model T's" purchased in 1916 totaled 577,036. This equates to nearly a 3,000% increase in just six years.[30]

Chart A

Model T Statistics from 1910-1916

Year	Retail Price	Model T Production	Model T Sales
1910	$780	20,727	19,293
1912	$600	82,388	78,611
1914	$490	230,788	260,720
1916	$360	585,388	577,036

Source: Hounshell, D. "From the American System to Mass Production, 1800-1932." In , 224. Baltimore, MD: Johns Hopkins Press, 1985.

29 Bellis, M. "The History of the Automobile." http://inventors.about.com/library/weekly/aacarsassemblya.htm 2008.

30 Hounshell, D. "From the American System to Mass Production, 1800-1932." In , 224. Baltimore, MD: Johns Hopkins Press, 1985.

2.4 Cars in the Mainstream and Suburban Growth

During the 20th century, automobile usage in the United States grew significantly. Certain public policies and demographic phenomena contributed to the automobile's rise. As the usage of automobiles increased, the demand for and consumption of gasoline increased as well. It was during this time period that the United States became a net importer of petroleum products as demand outstripped domestic production. As evident in Chart B, the number of vehicles registered in the U.S. more than doubled from 1960 to 1980. In addition, the amount of fuel consumed for transportation also more than doubled during this time period.[31]

31 "Motor Vehicle Fuel Consumption and Travel." U.S. Department of Transportation. http://www.bts.gov/publications/national_transportation_statistics/html/table_04_09.html.

Chart B

U.S. Automobile Statistics 1960-1980

	1960	1965	1970	1975	1980
Vehicles registered (thousands)	73,858	90,358	111,242	137,913	161,490
Vehicle-miles traveled (millions)	718,762	887,812	1,109,724	1,327,664	1,527,295
Fuel consumed (million gallons)	57,880	71,104	92,329	108,984	114,960

Source: "Motor Vehicle Fuel Consumption and Travel." U.S. Department of Transportation. http://www.bts.gov/publications/national_transportation_statistics/html/table_04_09.html.

One of the leading causes of the rise of car culture was the growth of American suburbia. One of the many stimuli in suburban growth was the rapid increase in highway and road construction which facilitated automobile traffic. During the 1950's, under the Eisenhower administration, the federal government led a national effort to drastically increase interstate highway development.

> The Federal-Aid Highway Act of 1952 authorized the first funding specifically for System construction, but it was only a token amount of $25 million a year for fiscal years (FY) 1954 and 1955. Legislation in 1954 authorized an additional $175 million annually

for FY 1956 and 1957.Under the leadership of President Eisenhower, the question of how to fund the Interstate System was resolved with enactment of the Federal-Aid Highway Act of 1956. It served as a catalyst for the System's development and, ultimately, its completion.[32]

Chart C

Highway Mileage in the United States

Year	Number of Highways
1960	3,545,693
1970	3,730,082
1980	3,859,837
1990	3,866,926
2000	3,936,229

Source: Obenberger, J. "Dwight D. Eisenhower National System of Interstate and Defense Highways." U.S. Department of Transportation. http://www.fhwa.dot.gov/programadmin/interstate.cfm.

As of 2002, the U.S interstate highway system included over 46,000 miles of roads.[33] Together with other highway and road system, the U.S. has nearly 4 million miles of public roads.

32 Obenberger, J. "Dwight D. Eisenhower National System of Interstate and Defense Highways." U.S. Department of Transportation. http://www.fhwa.dot.gov/programadmin/interstate.cfm.

33 Ibid.

A Brookings Intuition study states:

> Given that metropolitan areas are decentralizing for reasons that might be unrelated to transportation, highways certainly have the potential to influence the geographic character of that decentralization.

The paper cites evidence, especially census tract population and employment studies, that suggest that "highways can be conduits for decentralization, helping to channel urban growth in some places rather than others."[34]

"While the metropolitan population grew rapidly during the [20th century], most of that growth occurred in the suburbs, with little change in the percentage of population living in central cities."[35] As evident in Figure E, the share of the U.S. population living in a suburban setting increased from 7.1% in 1910 to 50% in 2000.

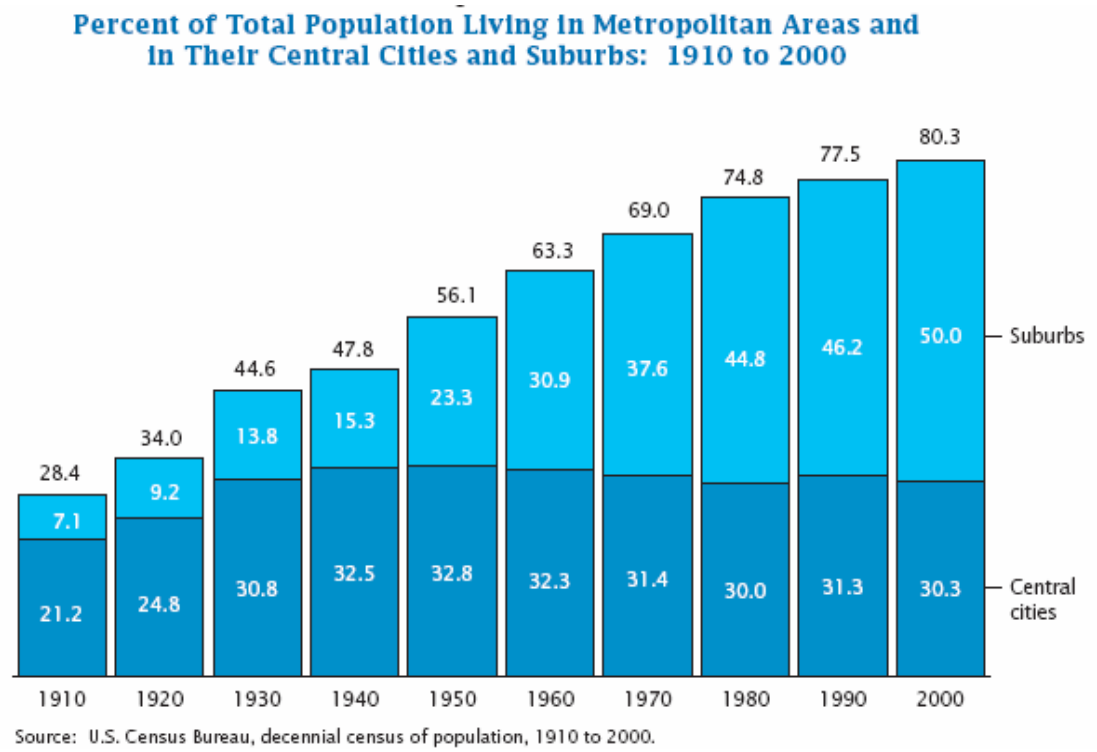
The trend of decentralization has strong correlations with the number of miles driven by the average American. Figure F[36] displays the average number of miles driven by

34 Haughwout, A. and M. Boarnet. "Do Highways Matter? Evidence and Policy Implications of Highways' Influence on Metropolitan Development." (August 2000, 2000): 9.

35 Demographic Trends in the 20Th Century." U.S. Census Bureau. http://www.census.gov/prod/2002pubs/censr-4.pdf.

36 Lidderdale, T. "Gasoline Demand Trends." Washington, DC, Energy Information Administration, March 28, 2007, 2007, http://www.eia.doe.gov/oiaf/aeo/conf/pdf/lidderdale.pdf.

Figure D



Source: "Demographic Trends in the 20Th Century." U.S. Census Bureau. http://www.census.gov/prod/2002pubs/censr-4.pdf.

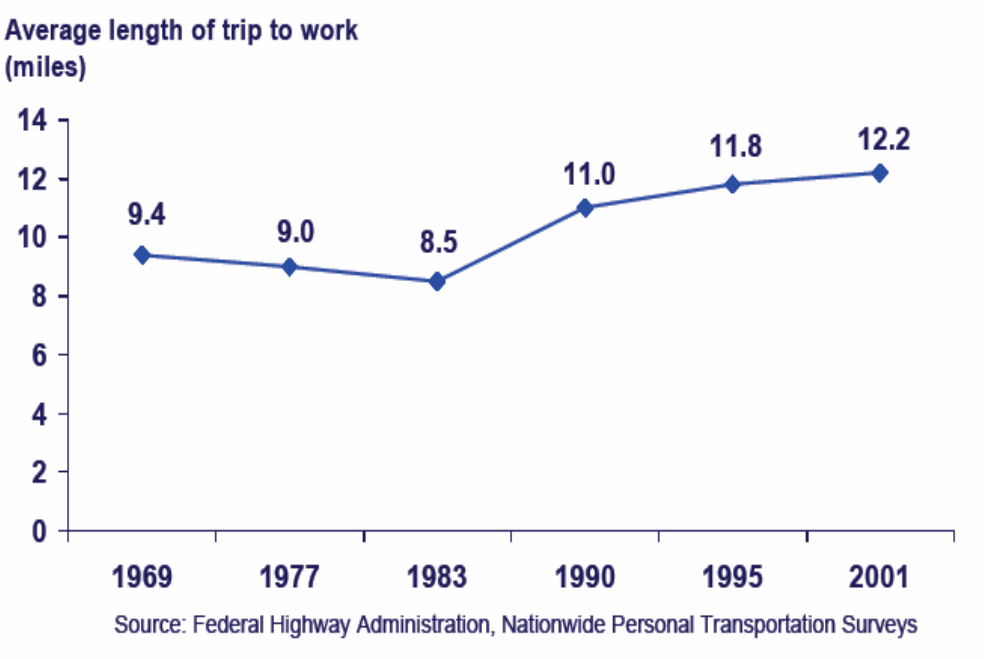
American commuters on their trips from their homes to their employment.

American drivers increased their total commute by 29.7% between 1969 and 2001. In total, Cambridge Energy Research Associates found in 2007 that Americans are driving 41% more than they were 25 years ago.[37]

37 Veno, W., Brady, A., Burkhard, J. and Yergin, D. "Gasoline and the American People 2007." Cambridge Energy Research Associates. http://www2.cera.com/gasoline/summary/.

Figure E

Average Commute Distance



Source: Lidderdale, T. "Gasoline Demand Trends." Washington, DC, Energy Information Administration, March 28, 2007, 2007, http://www.eia.doe.gov/oiaf/aeo/conf/pdf/lidderdale.pdf.

Chapter 3 – Gas Tax

The gas tax can best be described as a user fee or excise tax. The gas tax resembles other user fees such as highway tolls or federal park pass fees. Excise taxes have long been a part of U.S. revenue history. As for gasoline taxation, the states led the way with Oregon enacting the first tax on motor fuels in 1919. By 1932, every state and the District of Columbia had followed suit with tax rates that ranged between two and seven cents per gallon.[38]

When a consumer purchases of typical commercially available gasoline at one of the 168,987 retail gasoline stations throughout the United States they are paying for a variety of different costs.[39] The principal cost of each gallon is the raw crude oil needed for its refinement. Refining and distribution expenses make up approximately another 20% of the overall cost. As of January 2008, overall taxes made up roughly 13% of the overall cost of a gallon of regular gasoline.

38 Talley, L. "The Federal Excise Tax on Gasoline and the Highway Trust Fund: A Short History." http://www.ncseonline.org/NLE/CRSreports/Transportation/trans-24.cfm?&CFID=8539261&CFTOKEN=71797464

39 "A Primer on Gasoline Taxes." Energy Information Administration. http://www.eia.doe.gov/bookshelf/brochures/gasolinepricesprimer/eia1_2005primerM.html.

As evident in Appendix A,[40] the percentage of taxes making up the total cost of a gallon of regular gasoline has fallen sharply in the past decade. The total percentage of cost associated with taxation decreased from 32.1% in January 2000 to 13.1% in January 2008. This was mostly due to the fact that overall prices more than doubled. Crude oil costs increased from 47.1% to 67.9% during that same time period.

3.1 The History of the Gas Tax

The federal excise tax on gasoline was enacted with the passage of the Revenue Act of 1932. At that time, the total tax rate was one-cent per gallon. According to CBO, the gasoline tax was imposed to help offset a federal budgetary imbalance. Since its inception, the tax has been extended and raised numerous times.[41]

CBO continues to explain that in 1956, Congress established the Highway Trust Fund and revenue receipts

40 Gasoline Components History, Energy Information Administration, <http://tonto.eia.doe.gov/oog/info/gdu/gaspump.html >

41 Talley, L. and B. Cashell. Excise Taxes on Alcohol, Tobacco, and Gasoline: History and Inflation Adjusted RatesCongressional Research Service, 1997, http://www.ncseonline.org/nle/crsreports/transportation/trans-28.cfm#13.

from the gasoline tax were dedicated for highway programs. Currently, the federal gas tax rate is 18.4 cents per gallon. Since its inception, the allocation of revenues from the gasoline tax have been distributed to a variety of programs.

Chart D

History of the Gasoline Tax

		Purpose			
Date	**Tax Rate in cents per gallon**	**General Revenues**	**Highway Account**	**Mass Transit Account**	**Other Trust Funds**
June 21, 1932	1.0	1.0	–	–	–
June 17, 1933	1.5	1.5	–	–	–
Jan. 1, 1934	1.0	1.0	–	–	–
July 1, 1940	1.5	1.5	X	–	–
Nov. 1, 1951	2.0	2.0	X	–	–
July 1, 1956	3.0	–	3.0	–	–
Oct. 1, 1959	4.0	–	4.0	–	–
Apr. 1, 1983	9.0	–	8.0	1.0	–
Jan. 1, 1987	9.1	–	8.0	1.0	0.1
Sep. 1, 1990	9.0	–	8.0	1.0	–
Dec. 1, 1990	14.1	2.5	10.0	1.5	0.1
Oct. 1, 1993	18.4	6.8	10.0	1.5	0.1

Oct. 1, 1995	18.4	4.3	12.0	2.0	0.1
Jan. 1, 1996	18.3	4.3	12.0	2.0	–
Oct. 1, 1997	18.4	–	15.44	2.86	0.1

Source: Buechner, W. "The History of the Gas Tax." American Road and Transportation Builders Association, http://artba.org/economics_research/reports/gas_tax_history.htm.

3.2 Current Gas Tax Levels

In addition to the federal gasoline tax of 18.4 cents per gallon, states have a variety of tax rates. The gasoline rates vary from a low of 7.5 cents per gallon to a high of 34 cents with an average of 20.4 cents per gallon. Six states provide for full or partial exemptions for gasohol, a blend of 90% gasoline and 10% fuel alcohol. Diesel fuel rates vary from 7.5 cents to 38.1 cents per gallon.

Traditionally, state fuel tax rates could only be changed with legislation, but 10 States now have variable rate motor fuel taxes.[42] A full list of state tax rates can be found at Appendix B.

42 "Motor Fuel Trends." U.S. Department of Transportation. http://www.fhwa.dot.gov/ohim/mmfr/sep07/mftrends.htm.

3.3 Potential Federal Revenue Impacts of a Gas Tax Increase

An increase in the federal gasoline tax would result in additional revenue due to the fact that a higher tax rate would be charged on each gallon of gasoline consumed. While the marginal tax rate would increase, the overall cost increase would likely discourage gasoline consumption from typical consumers. The more inelastic gasoline tends to be, the less likely it is that people will reduce their usage.

CBO reported that the federal government could raise significant income with a relatively small gas tax increase.

> It was estimated the additional revenue that would result from raising the federal gasoline tax by 15 cents per gallon--which would represent about a 10 percent price increase, at current prices. (That tax increase is not suggested as optimal but was chosen for illustrative purposes.) Accounting for both the expected growth in gasoline consumption (in the absence of the tax increase) and the effect of the tax increase on that growth (using the elasticities described in Chart F), CBO estimated that a 15-cent-per-gallon rise in the gasoline tax today would add nearly $16 billion to federal gasoline-tax revenue in

2003, an amount that would grow to between $17 billion and $20 billion in 2012.[43]

CBO continues to explain that any additional revenue gained from this 15 cent gas tax increase could be used for other tax offsets, resulting in a revenue neutral decision. “The total cost that the gasoline-tax increase would impose on the economy would depend, in part, on the way the government chose to use the revenue. For example, using gasoline-tax receipts to offset existing taxes on capital and labor--such as payroll taxes and the corporate income tax--could benefit the economy by reducing those taxes' adverse incentives.”[44] Revenue impacts from further taxes are discussed further in Chapter 7.

Chart E

Revenue Effects of a 15-Cent Increase in the Federal Gasoline Tax

	Total Federal Revenue Collected (Billions of dollars)		Increase in Federal Revenue Because of the Tax Increase (Billions of dollars)
	Without Tax Increase	With Tax Increase (15 cents)	

43 "Other Policy Implications: Distributional and Revenue Effects." Congressional Budget Office. http://www.cbo.gov/ftpdoc.cfm?index=3991&type=0&sequence=7.

44 Ibid.

Short Term (2003)	20.7	36.5	15.8
Longer Term (2012)	26.5	43.9 to 46.2	17.4 to 19.7

Source: "Other Policy Implications: Distributional and Revenue Effects." Congressional Budget Office. http://www.cbo.gov/ftpdoc.cfm?index=3991&type=0&sequence=7.

3.4 Elasticity of Gasoline

In the paper "Evidence of a Shift in the Short-Run Price Elasticity of Gasoline Demand," the authors note that gas is a fairly inelastic good. In addition, they find that its elasticity has been decreasing in recent times.

> The results presented here strongly support the existence of a structural change in the demand for gasoline. Estimates of the short-run price elasticity of gasoline demand for the period from 1975 to 1980 range from -0.21 and -0.34 and are consistent with estimates from the literature that use comparable data. However, estimates of the price elasticity for the more recent period are significantly more inelastic ranging from -0.034 to -0.077. This result has important policy implications.[45]

In a more in-depth study, a calculation of a variety of different estimations of the price elasticity of gasoline is conducted. "A Meta-analysis of the Price

45 Hughes, J., C. Knittel, and D. Sperling. Evidence of a Shift in the Short-Run Price Elasticity of Gasoline Demand2006, http://www.econ.ucdavis.edu/faculty/knittel/papers/gas_demand_083006.pdf.

Elasticity of Gasoline Demand. A System of Equations Approach," shows the distribution of different estimates of the price elasticity gasoline demand. The paper finds that estimated values lie between -2.04 and 0.28, but the vast majority lies between -1.0 and 0.0. The paper later states that, "Based on the estimation of a system of fixed effects equations, we find a mean price elasticity of gasoline demand of -0.53, which indicates that consumers are not very price sensitive to price changes."[46]

Due to the fact that gasoline can be classified as an inelastic good, significant price changes would be necessary to impact consumption levels. When analyzing gasoline usage patterns over the past few decades, it becomes evident that price can and does play a central role in consumer behavior.

As evident in Figure K,[47] consumption tends to decrease as prices increase. Most noteworthy in this comparison is the sharp price increase juxtaposition of the sharp consumption decrease in the late 1970's. This can be mostly attributed to the oil disruption that took place as a

46 Ibid.

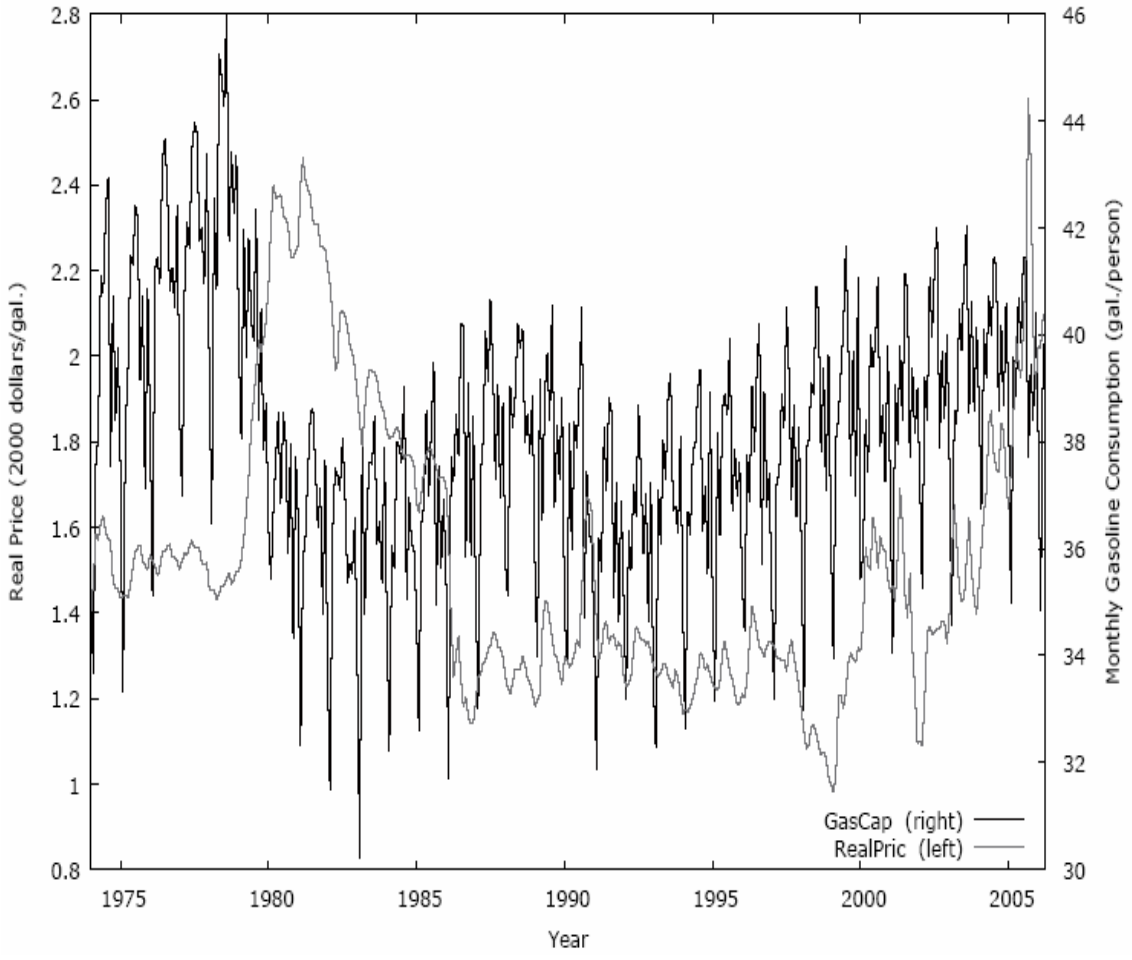
47 Ibid.

result of the Iranian Revolution in 1978. At the beginning of this event, prices for gasoline totaled approximately $1.50 per gallon. During the height of this disruption, prices rose to nearly $2.50 per gallon. During this same price increase, consumption decreased from about 46 gallons per person to roughly 32 gallons purchased.

Figure F

Gasoline Market 1974-2006

Note: Darker line signifies price (Real Price 2000 dollars/gal.). Lighter line signifies consumption (gallon/person)



Source: Hughes, J., C. Knittel, and D. Sperling. Evidence of a Shift in the Short-Run Price Elasticity of Gasoline Demand2006, http://www.econ.ucdavis.edu/faculty/knittel/papers/gas_demand_083006.pdf.

It is clear that Americans will react slowly to the price of gasoline due to its inelastic nature. Gasoline presents itself as an important resource with important utilities. However, even with a -0.51 elasticity, there is potential to impact behavior through price adjustments. The increased costs brought on by oil disruptions demonstrate this fact.

One very noteworthy study simulates the impact of raising the federal gasoline tax by 10, 30, or 50 cents per gallon. The benchmark gross-of-tax price of used for this

Chart F

Consumer Impacts of Gas Tax Increases

Measure		**Gas Tax Increase**		
	Base	**$0.10**	**$0.30**	**$0.50**
Tax-Based Revenue Recycling				
Avg. gas-tax payment		$77.97	$225.40	$362.28
Avg. gas consumption	794.5	-1.86%	-5.43%	-8.80%
Avg. VMT (thousands)	19.2	-1.82%	-5.33%	-8.80%
Income-Based Revenue Recycling				
Avg. gas-tax payment		$77.83	$224.19	$358.09
Avg. gas consumption	794.5	-2.03%	-5.94%	-9.86%
Avg. VMT (thousands)	19.2	-1.99%	-5.82%	-9.64%

Source: "Distributional and Efficiency Impacts of Gasoline Taxes: An Econometrically Based Multi-Market Study." American Economic Review 95, no. 2 (May 2005, 2005): 282.

analysis was $1.45. This means the gas-tax incremental increases imply relative price increases of between 6 and 35%. In addition to these increases, this investigation also explores two types of revenue-recycling: “tax-based recycling,” in which revenues are recycled to households in proportion to their gasoline-tax payments, and “income-based recycling,” where revenues are recycled in proportion to their benchmark income. These revenue-recycling measures are, in effect, revenue neutral tax instruments.[48]

The overall results of a similar study by the same primary authors found that each cent-per-gallon increase in the price of gasoline reduces the equilibrium gasoline consumption by approximately .2%. It also finds that, “the reduction in demand mainly reflects reduced miles traveled by car owners; shifts in demand from low to high miles-per gallon vehicles appear much less important.”[49]

48 "Distributional and Efficiency Impacts of Gasoline Taxes: An Econometrically Based Multi-Market Study." *American Economic Review* 95, no. 2 (May 2005, 2005): 282.

49 Bento, A., L. Goulder, M. Jacobsen, and R. von Haefen. "Distributional and Efficiency Impacts of Increased U.S. Gasoline Taxes." Draft Report, http://www.nber.org/~confer/2006/si2006/ee/goulder.pdf.

Chart G

Impact of a Permanent Increase in Real Fuel Prices by 10%

	Short Run (1 Year) %	**Long Run (5 Years) %**
Traffic volume	-1	-3
Fuel Consumption	-2.5	-6

Source: Kahn Ribeiro, S., S. Kobayashi, M. Beuthe, J. Gasca, D. Greene, D. S. Lee, Y. Muromachi, P. J. Newton, S. Plotkin, D. Sperling, R. Wit, P. J. Zhou, 2007: Transport and its infrastructure. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Finally, the IPCC finds that fuel taxes are about eight times higher in the England than in the United States. This additional tax results in fuel prices that are about three times higher. This correlates to the fact that British drivers drive, on average, about 20% less than Americans. An IPCC study finds that if the price of gasoline rises by 10% and stays at that level, the volume of fuel consumed by road vehicles will fall by about 2.5% within a year, building up to a reduction of over 6% in the longer run.[50]

50 Kahn Ribeiro, S., S. Kobayashi, M. Beuthe, J. Gasca, D. Greene, D. S. Lee, Y. Muromachi, P. J. Newton, S. Plotkin, D. Sperling, R. Wit,P. J. Zhou, 2007: Transport and its infrastructure. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate

Sandalow also documents the inelastic nature of oil demand. He states that "oil's role in the U.S. economy is shaped by the fact that there are no widely available substitutes. The U.S. transportation infrastructure is almost completely dependent on oil."[51] He also agrees that in the long run, the elasticity of oil increases because over the time, drivers are more able to adjust their behavior and habits.

3.5 Tax Increase Models

To consider the impacts of a tax increases on consumption, this analysis will first plug in the average U.S. regular all formulations retail gasoline prices of $3.284 for the week of March 17, 2008.[52] Next, this thesis will use 2005 U.S. consumption levels of 179.1 billion gallons of gasoline as its baseline.[53]

Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

51 Sandalow, 41

52 "Weekly U.S. Retail Gasoline Prices, Regular Grade." Energy Information Administration. http://www.eia.doe.gov/oil_gas/petroleum/data_publications/wrgp/mogas_home_page.html.

53 U.S. Department of Transportation, Bureau of Transportation Statistics, Table 4-9: Motor Vehicle Fuel Consumption and Travel

This thesis will offer three different tax rates to estimate consumption impacts. The low tax rate increase will be 6.9%, the moderate tax rate increase will be 20.7%, and the aggressive tax rate increase will be 34.5%. These numbers reflect the same percentage increase found in Chart H under the income recycling scenarios. These marginal increases will reflect tax increases as compared to the total overall cost of each gallon of gasoline.

Therefore, the low tax rate increase will add $.226 to each gallon of gasoline. The moderate tax increase will add $0.679 to each gallon of gasoline. The aggressive tax increase will add $1.133 to each gallon of gasoline. Thus, gasoline costs will range from $3.51 to $4.42 depending on the tax rate used. The percentage increase as compared to the current federal gas tax rate will be a 122% increase for the low tax rate increase, a 369% increase for the moderate tax rate increase and a 615% increase for the aggressive tax rate increase.

By using estimations found in Chart H, this thesis estimates that the low tax rate increase will reduce consumption by 2.03%, the moderate tax rate increase will

<http://www.bts.gov/publications/national_transportation_statistics/html/table_04_09.html>

reduce consumption by 5.94%, and the aggressive tax rate increase will reduce consumption by 9.86%. By using 2005 U.S. gasoline consumption totals, these tax rates will reduce gasoline consumption by an estimated 3.6 billion gallons for the low tax rate increase, 10.6 billion gallons for the moderate tax increase, and 17.7 billion gallons for the aggressive tax increase.

If this thesis uses the reduction figures estimated by the IPCC and found in Chart J, then the low tax rate increase would decrease gasoline consumption by 1.725% in the short run (< 1 year) and by 4.14% in the long run (> 5 years). The moderate tax increase would decrease consumption by 5.175% in the short run (<1 year) and by 12.42% in the long run (> 5 years). The aggressive tax rate increase would reduce consumption by 8.625% in the short run (< 1 year) and by 20.7% in the long term (> 5 years).

By using 2005 U.S. gasoline consumption totals, and by using Chart J estimations, these tax rates will also have a significant impact on total U.S. consumption. Gasoline use will decrease by an estimated 3.08 billion gallons in the short term and 7.4 billion gallons in the long term for the short term tax increase. Gasoline usage will decrease by approximately 9.27 billion gallons in the short term and

22.24 billion gallons in the long term for the moderate term tax increase. Gasoline use will decrease by an estimated 15.45 billion gallons in the short term and 37.07 billion gallons in the long term for the aggressive tax rate increase.

Chart H

Hypothetical Tax Impacts on Consumption

	Low Tax Rate Increase	**Moderate Tax Rate Increase**	**Aggressive Tax Rate Increase**
Cost per gallon increase ($)	0.226	0.679	1.133
Increase cost compared to total gasoline cost per gallon (%)	6.9	20.7	34.5
Increase in federal tax rate (%)	122	369	615
Chart F Inputs			
Gasoline reduction (billion of barrels)	3.6	10.6	17.7
Gasoline reduction (%)	2.03	5.94	9.86
Chart J Inputs			
Gasoline reduction in the short term of less than 1 year (billion of barrels)	3.08	9.27	15.45
Gasoline reduction in the long term of more than 5 years (billion of	7.4	22.24	37.07

barrels)			
Gasoline reduction in the short term of less than 1 year (%)	1.725	5.175	8.625
Gasoline reduction in the long term of more than 5 years (%)	4.14	12.42	20.7

Chapter 4 – Geopolitical Issue #1: Peak Oil

Oil is a non-renewable resource and thus is finite. Oil, coal and natural gas were formed from the remains of animals and plants from millions of years ago. As such, there is a certain total maximum amount that can be extracted. As discussed in Chapter 2, humans have been extracting oil on a large scale since the 19th century.

Today, oil is being extracted in nearly every area where there are significant deposits. Conventional oil is that which flows at high rates and in good quality, much of it from giant fields found long ago. 90% of oil produced today comes from fields more than twenty years old, and 70% from fields more than thirty years old.[54]

4.1 Hubert's Peak

Dr. Hubbert, a Shell Oil geologist, first developed the theory of "Peak Oil" in the 1950s. He explained that oil reservoirs typically follow a somewhat predictable trajectory from discovery to production to depletion. While each oil well follows this curve, the aggregate

54 Campbell, C. J. Running Out of Gas: This Time the Wolf Is Coming. National Interest Number 51:47-55 Spring 1998.

number of wells in any given country should also mirror the overall theory. In addition, total international production should also follow a similar path. Once global oil production hits its peak of production, output will decline until reservoirs are depleted.

Dr. Herron, President of Petroleum Equities Inc. explains that the median estimate of remaining reserves in known oil fields totals about 830 billion barrels. Approximately 1.64 trillion barrels of oil have been discovered, and approximately 0.83 trillion barrels of this total remain to be produced in known reserves.[55]

According to a 2007 DOE report, "The world has been consuming increasingly more oil than it has been finding. Because oil is a depleting natural resource, world conventional oil production will reach a maximum, called 'the peak,' after which production will go into decline."[56]

55 Herron, H. "The Looming Crisis in Worldwide Oil Supplies." Petroleum Equities Inc. http://www.petroleumequities.com/OilSupplyReport.htm#N_4_.

56 Hirsch, R. Peaking of World Oil Production, Recent ForecastsNETL, 2007, http://www.netl.doe.gov/energy-analyses/pubs/Peaking%20of%20World%20Oil%20Production%20-%20Recent%20Forecasts%20-%20NETL%20Re.pdf

There is difficulty in estimating when “peak oil” will occur. However, many energy industry experts have expressed opinions regarding this topic.

Chart I

Notable Recent Statements Relating to the End of the Era of Easy and/or Cheap Oil.

Commentator	Statement	Reference
David O’Reilly, Chairman, Chevron	“The time when we could count on cheap oil... is clearly ending.”	CERA Energy Conference. February 2005.
Samuel Bodman, U.S. Secretary of Energy	“The era of cheap and abundant petroleum may now be over.”	Christian Science Monitor. July 8, 2006
Jeroen van der Veer, Shell Chief Executive.	“Peak oil does exist for easy-to-drill oil…”	Cummins, C., Williams, M. Shell's Chief Pursues Simple Goals. WALL STREET JOURNAL. January 17, 2006.
Alpha Oumar Konare, African Union Commission Chair.	"The era of cheap oil is over."	Era of cheap oil is over. Reuters. 02/04/2006
Viktor Khristenko, Russian Energy Minister	“... the era of cheap hydrocarbons is over".	Hope, C. RUSSIA: 'ERA OF CHEAP FUEL IS OVER'. The Telegraph. 06/06/2006.

Guy Caruso, Administrator. U.S. EIA	"The era of low cost oil is probably over."	Holmes, J. Four Corners Broadband Edition. Australian Television Program. 10 July 2006.

Source: Hirsch, R. *Peaking of World Oil Production, Recent Forecasts* NETL, 2007, http://www.netl.doe.gov/energy-analyses/pubs/Peaking%20of%20World%20Oil%20Production%20-%20Recent%20Forecasts%20-%20NETL%20Re.pdf

In addition, there have been numerous forecasts as to when "peak oil" might be reached.

Chart J

Important Recent Oil Peak Forecasts

Source	**Affiliation**	**Timeline of Peak**
Pickens, T. Boone	Oil & gas investor	2005
Deffeyes, K	Retired Princeton professor & retired Shell geologist	December 2005
Westervelt, E.T. et al	US Army Corps of Engineers	At hand
Bakhtiari, S.	Iranian National Oil Co. planner	Now
Herrera, R.	Retired BP geologist	Close or past
Groppe, H.	Oil / gas expert & businessman	Very soon
Wrobel, S.	Investment fund manager	By 2010
Bentley, R.	University energy analyst	Around 2010
Campbell, C.	Retired oil company geologist; Texaco &	2010

	Amoco	
Skrebowski, C.	Editor of Petroleum Review	2010 +/- a year
Meling, L.M.	Statoil oil company geologist	A challenge around 2011
Pang, X., et al	China University of Petroleum	Around 2012
Koppelaar, R.H.E.M	Dutch oil analyst	Around 2012
de Margerie, C	Oil company executive	Within a decade
al Husseini, S	Retired Exec. VP of Saudi Aramco	2015
Merrill Lynch	Brokerage / Financial	Around 2015
West, J.R., PFC Energy	Consultants	2015-2020
Maxwell, C.T., Weeden & Co	Brokerage / Financial	Around 2020 or earlier
Wood Mackenzie	Energy consulting	Tight balance by 2020
UBS	Brokerage / Financial	Mid to late 2020s
CERA	Energy consulting	Well after 2030
ExxonMobil	Oil company	No sign of peaking
Browne, J	BP CEO	Impossible to predict
OPEC		Deny peak oil theory

Source: Hirsch, R. *Peaking of World Oil Production, Recent Forecasts* NETL, 2007, http://www.netl.doe.gov/energy-analyses/pubs/Peaking%20of%20World%20Oil%20Production%20-%20Recent%20Forecasts%20-%20NETL%20Re.pdf

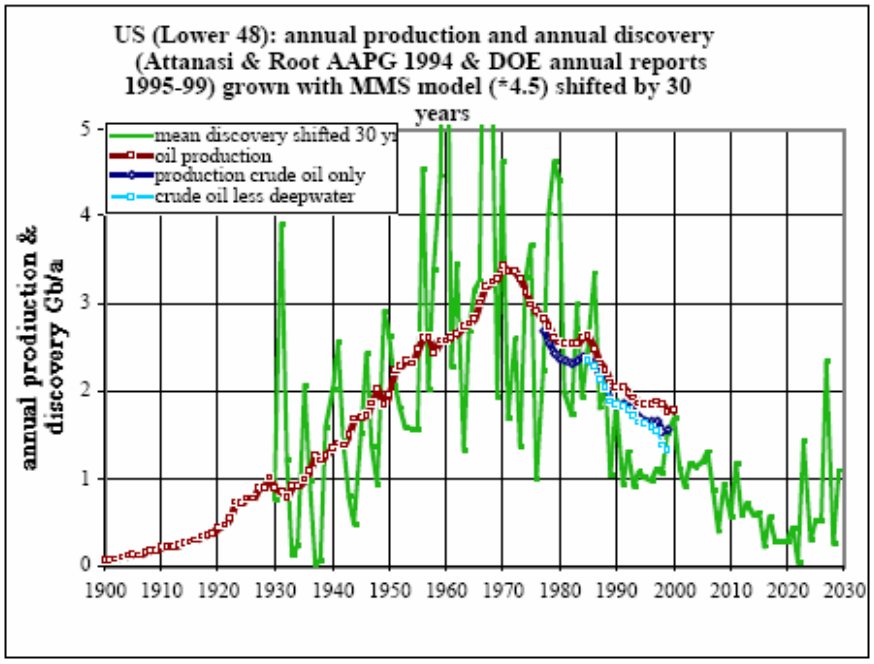
Colin Campbell, founder of the Association for the Study of Peak Oil, stated that, “Peak oil is a turning point for Mankind. The economic prosperity of the 20th

Century was driven by cheap, oil-based energy. Everyone had the equivalent of several unpaid and unfed slaves to do his work for him, but now these slaves are getting old and won't work much longer. We have an urgent need to find how to live without them."[57]

Figure G

US (Lower 48 States) Annual Production and Discovery

Note: Brown Line signifies Production,
Green line signifies discovery



Source: Laherrere, J. "OPEC and the Global Energy Balance: Towards a Sustainable Energy Future." http://www.oilcrisis.com/LaHerrere/opec2001.pdf, Septemeber 28, 2001

57 Campbell , C. "Peak Oil: An Outlook on Crude Oil Depletion." http://www.greatchange.org/ov-campbell,outlook.html.

The phenomenon of “peak oil” has been demonstrated many times before. As evident in Figure F, the lower 48 states in the United States experienced peak oil production around 1970.[58] Since that time, oil production in the United States has been decreasing steadily. Many other oil producing areas of the world have also experienced “peakoil.” For example, Chart K shows the production decline found in some major British fields.[59] Enacting a gas tax may help conserve fuel so that the country may go through an energy transition more smoothly. While consumption reduction from a moderate gas tax increase would not be drastic, it could be significant enough to possibly prolong certain “peak oil” consequences for a certain amount of time.

58 Laherrere, J. "OPEC and the Global Energy Balance: Towards a Sustainable Energy Future." http://www.oilcrisis.com/LaHerrere/opec2001.pdf, Septemeber 28, 2001,

59 Blanchard, R. "The Impact of Declining Major North Sea Oil Fields upon Future North Sea Production " Northern Kentucky University. http://www.hubbertpeak.com/blanchard/.

Chart K

U.K. Major Oil Fields in Decline with Maximum Production Levels Prior to 1994

Fields	Estimated Ultimate Recovery (mbo)	Maximum Production Year	Maximum Production (b/d)	1997 Production (b/d)	Decline from Maximum Prod. to 1997 Prod. (b/d)	% Decline from Maximum Prod. to 1997 Prod.
Auk	>120	1977	58,690	13,301	45,389	77.3
Piper	1,100	1979	276,758	49,334	227,424	82.2
Forties	2,700	1980	523,000	85,660	437,340	83.6
Thistle	420	1982	129,662	8,868	120,794	93.2
Ninian	1,200	1982	304,806	48,323	256,483	84.1
Heather	110	1982	37,767	4,948	32,819	86.9

Source: Blanchard, R. "The Impact of Declining Major North Sea Oil Fields upon Future North Sea Production " Northern Kentucky University. http://www.hubbertpeak.com/blanchard/.

4.2 Demands for Oil in The Future

International oil demand is expected to increase roughly 50% by 2025.[60]

A DOE report explains that,

> To meet that demand, ever-larger volumes of oil will have to be produced. Since oil production from individual reservoirs grows to a peak and then

60 International Energy Outlook. Washington, DC: Energy Information Administration, 2004, http://tonto.eia.doe.gov/ftproot/forecasting/0484(2004).pdf.

> declines, new reservoirs must be continually discovered and brought into production to compensate for the depletion of older reservoirs. If large quantities of new oil are not discovered and brought into production somewhere in the world, then world oil production will no longer satisfy demand.[61]

Oil consumption in China is expected to increase 4% a year, and by 2025 the country is projected to be the second largest oil consuming country in the world, after the United States. Anthony Wayne, Assistant Secretary for Economic and Business Affairs, testified before the U.S. Senate Committee of Foreign Relations and stated that "Demand for energy in China and India is projected to approximately double by 2030, whereas US demand is expected to grow by only 35-50%."[62]

Energy use for transportation in China is projected to grow by 5% every year through 2025. Nearly all of the projected increase is for petroleum products. Personal travel in China has soared in the past two decades, with passenger miles traveled increasing fivefold. China had

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61 Hirsch, R., R. Bezdek, and R. Wendling. Peaking of World Oil Production: Impacts, Mitigation and Risk Management. Washington, DC: NETL, 2005, http://www.netl.doe.gov/publications/others/pdf/Oil_Peaking_NETL.pdf

62 Senate Committee of Foreign Relations. Statement of E. Anthony Wayne, Assistant Secretary for Economic and Business Affairs , Department of State . July 26, 2005.

14.5 million registered vehicles (including passenger cars, trucks and buses) at the end of 2001. According to forecasts conducted by the International Energy Agency, this number could climb to 130 million by 2030. In addition to China, India also is positioned to grow as an energy user. India's energy demand for transportation is projected to grow at an average rate of 4.4% a year, and the transportation sector is expected to account for 20% of the country's total energy consumption in 2025.[63]

63 Ibid.

Chart L

World Liquids Consumption by Region and Country Group, 2004 and 2030
(Million Barrels a Day)

Region	2004	2030
North America	25.0	32.0
Non-OECD Asia	14.8	29.8
OECD Europe	15.6	15.8
OECD Asia	8.5	9.3
Central and South America	5.4	9.7
Middle East	5.7	9.8
Non-OECD Europe and Eurasia	4.8	6.3
Africa	2.8	4.9

Source: International Energy Outlook. Washington, DC: Energy Information Administration, 2004,

As noted in Chart L, every region in the world will see a significant increase in petroleum demand by 2030. Non-OECD Asia, which includes China and India, will see more than double the amount of demand as their large populations continue to industrialize.

4.3 Energy Return on Investment

As the world continues to consume petroleum, new supplies will undoubtedly be sought and developed. However

an important issue to consider is the amount of energy required to produce these new resources. The Energy Return on Investment (EROI) is an economic term that approximates the net energy gain or loss from any energy transaction.

$$EROI = \frac{Quantity\ of\ energy\ supplied}{Quantity\ of\ energy\ used\ in\ supply\ process}$$

For example, a small oil well might produce 100,000 barrels of oil which would equate to 580 billion BTUs. However, the amount of energy required to construct the well, extract the oil, provide for the required labor, and transport the fuel could cost 290 billion BTUs. Thus, the EROI for this hypothetic situation would equal two.

As the EROI falls, so does the net energy gained by any society. Large and easily accessible oil wells have, for the most part, already been found and have been depleted or are in the process of being produced. New, untapped fields in the Arctic or other remote places might require larger investments in energy to develop.

Dr. Thomas Homer-Dixon explained in a November 2006 New York Times article that the EROI of petroleum in the U.S. has been falling for some time. He explained that from the early 1970s to 2006, the EROI of oil and natural

gas extraction in the United States fell from around 25 to about 15. He adds that future unconventional oil reserves might offer significant supplies, but the net energy gain is far smaller than contemporary crude.

> The tar sands of Alberta, likely to be a prime energy source for the United States in the future, have an E.R.O.I. of around 4 to 1, because a huge amount of energy (mainly from natural gas) is needed to convert the sands' raw bitumen into useable oil.[64]

64 Homer-Dixon, T. "The End of Ingenuity." *New York Times,* November 29, 2006.

Chapter 5 – Geopolitical Issue #2: Climate Change

Human induced global warming is caused by the release of Greenhouse Gases (GHGs). Global warming or climate change is a potentially serious threat to world governments and economies.

Chart M

Transportation Related Greenhouse Gas Emissions (Tg CO_2. Eq.)

Gas	2005 Estimates
CO_2	1908.1
CH_4	2.3
N_20	36.5
HFCs	67.1

5.1 GHG from Transportation

Carbon Dioxide (CO_2), one of the primary GHGs, is emitted from a number of sources. CO_2 from combustion engines using fossil fuels in the transportation sector accounted for 26.1% of CO_2 emissions in the United States in 2005.[65]

GHG from Each Auto

(VMT/passenger vehicle avg. MPG) x CO_2 per gallon x (100/95) /1000 =

(12,000/20.3) x 8.8 x (100/95)/1000 = 5.48 metric tons CO2e

65 Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1900–2006 Environmental Protection Agency, 2008, http://www.epa.gov/climatechange/emissions/usinventoryreport.html.

A typical gallon of gasoline is assumed to produce 8.8 kilograms or 19.4 pounds of CO_2. This amount is calculated from values in the Code of Federal Regulations and relies on assumptions consistent with the Intergovernmental Panel on Climate Change (IPCC) guidelines.

The Code of Federal Regulations gives a carbon content value of 2,421 grams (g) of carbon per gallon of gasoline, which produces 8,877 g. of CO_2. This carbon content is then multiplied by the ratio of the molecular weight of CO_2 to the molecular weight of carbon.

Table N

Global Warming Potential of Greenhouse Gases

Gas	GWP
Carbon dioxide (CO_2)	1
Methane (CH_4)	23
Nitrous oxide (N_2O)	296
HFC-23	12,000
HFC-125	3,400
HFC-134a	1,300
HFC-143a	4,300
HFC-152a	120
HFC-227ea	3,500
HFC-236fa	9,400
HFC-4310mee	1,500
CF_4	5,700
C_2F_6	11,900

C4F10	8,600
C6F14	9,000
SF6	22,200

Global Warming Potential (GWP) is defined as the cumulative radiative forcing effects of a gas over a specified time horizon resulting from the emission of a unit mass of gas relative to a reference gas. The GWP-weighted emissions of direct greenhouse gases in the U.S. Inventory are presented in terms of equivalent emissions of carbon dioxide (CO_2), using units of teragrams of carbon dioxide equivalents (Tg CO_2 Eq.)

Source: The U.S. Greenhouse Gas InventoryEnvironmental Protection Agency, 2002, http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/RAMR5CZKVE/$File/ghgbrochure.pdf.

This number is then multiplied by an oxidation factor of 0.99, which assumes that 1% of the carbon remains un-oxidized. This produces a value of 8,788 g or 8.8 kg (19.4 lbs) of CO_2. In addition to carbon dioxide, automobiles produce other GHGs that have higher Global Warming Potential (GWP). As evident in Table N, different gases have higher impacts on overall global warming. [66] Some other gases that automobiles emit include methane (CH_4) and nitrous oxide (N_2O), as well as HFCs. On average, the EPA explains that these other GHGs account for roughly 5-6% of the GHG emissions from passenger vehicles.

66 Ibid.

Using these numbers from the EPA, we can assume that each automobile generates 5.48 metric tons CO_2e (CO_2 equivalent) per year. These calculations assume an overall average fuel economy for passenger vehicles of 20.3 mpg and 12,000 VMT per year.[67]

The EPA explains that from between 1990 to 2005, transportation emissions rose by 32%. There are myriad reasons for the increase. The EPA explains that since the 1970s,

> The number of highway vehicles registered in the United States has increased faster than the overall population, according to the Federal Highway Administration (FHWA). Likewise, the number of miles driven (up 21 percent from 1990 to 2005) and the gallons of gasoline consumed each year in the United States have increased steadily since the 1980s, according to the FHWA and Energy Information Administration, respectively.[68]

According to the Department of Transportation, 98% of transportation-related carbon emissions are from petroleum. Additionally, they find that typical motor gasoline

67 Emission Facts: Greenhouse Gas Emissions from a Typical Passenger Vehicle. Environmental Protection Agency, 2005, http://www.epa.gov/otaq/climate/420f05004.htm.

68 Ibid.

consists of about 60% of the overall emissions level from the transportation sector.[69]

Chart O
U.S. Carbon Emissions from Energy Use in the Transportation Sector, 1990-2004

(million metric tons of carbon dioxide)

	1990		1995		2004	
Fuel	**Emissions**	**Percentage**	**Emissions**	**Percentage**	**Emissions**	**Percentage**
Petroleum						
Motor gasoline	952.1	60.8%	1,019.4	61.2%	1,169.0	60.3%
LPG	1.3	0.1%	1.0	0.1%	1.1	0.1%
Jet fuel	220.4	14.1%	219.9	13.2%	237.4	12.2%
Distillate fuel	265.1	16.9%	303.8	18.2%	429.6	22.2%
Residual fuel	79.3	5.1%	71.0	4.3%	57.7	3.0%
Lubricants	6.5	0.4%	6.2	0.4%	5.6	0.3%
Aviation gas	3.1	0.2%	2.7	0.2%	2.1	0.1%
Subtotal	**1,527.80**	97.5%	**1624.0**	97.5%	**1902.5**	98.1%
Other energy						
Natural gas	35.9	2.3%	38.2	2.3%	32.1	1.7%
Electricity	3.2	0.2%	3.2	0.2%	4.6	0.2%
Total	**1,566.9**	100.0%	**1,666.4**	100.0%	**1939.2**	100.0%

Source: "Emissions of Greenhouse Gases Report." Energy Information Administration. http://www.eia.doe.gov/oiaf/1605/ggrpt/carbon.html#total.

Assuming that motor gasoline is responsible for 60% of CO_2 emission in the transportation sector and that

69 Ibid.

transportation is responsible for 26.1% of all CO_2 emissions in the U.S, then roughly 15.6% of all U.S. emissions are from the combustion of motor gasoline.[70]

In 2005, total U.S. greenhouse gas emissions were 7,260.4 teragrams of carbon dioxide equivalents (Tg CO_2 Eq.). Overall, total U.S. emissions have risen by 16.3% from 1990 to 2005.[71]

5.2 Possible Climate Change Consequences

The National Resource Defense Council claims that the earth's temperature could rise by more than seven degrees Fahrenheit during the 21st century if the world fails to reduce GHG emissions.[72]

> Multiple climate models indicate that sea ice will increasingly retreat as the earth warms. Scientists at the U.S. Center for Atmospheric Research predict that if the current rate of global warming continues, the Arctic could be ice-free in the summer by 2040.[73]

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70 Ibid.

71 *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1900-2006* Environmental Protection Agency, 2008, http://www.epa.gov/climatechange/emissions/usinventoryreport.html.

72 Consequences of Global Warming." National Resource Defense Council. http://www.nrdc.org/globalWarming/fcons.asp.

73 Ibid.

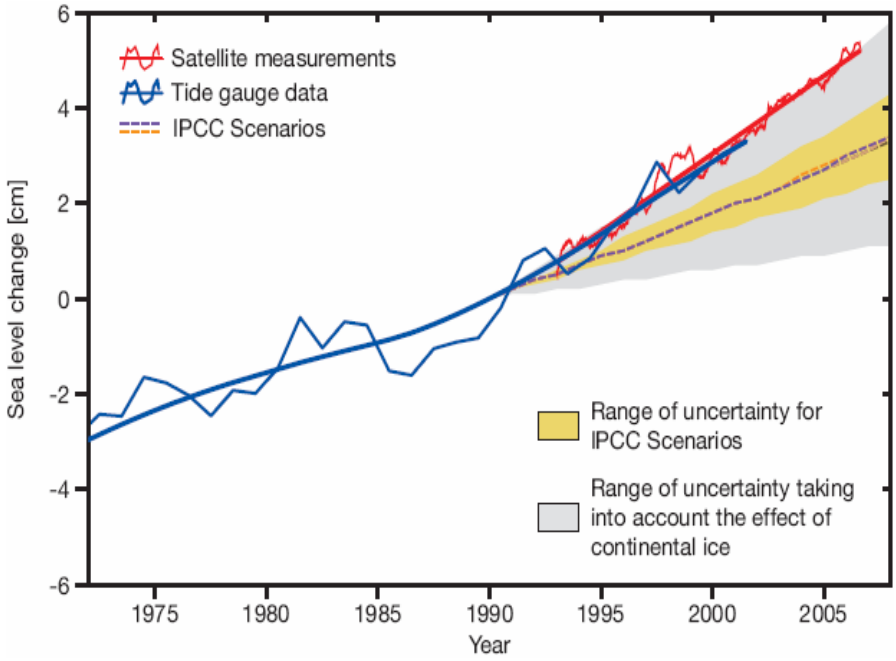
In addition to an ice-free Arctic, climate change could increase concerns relating to extreme weather events, flooding, drought, rising sea levels, retreating glaciers, habitat shifts and crop failure. This thesis will not investigate each possible impact of climate change. Instead, it will outline the possibility that climate change can drastically destabilize national governments and the world community.

Global water shortages as a result from climate change, may prove to be a serious humanitarian and security threat. Currently, large parts of the world are already facing freshwater shortages. By some estimates over half of the projected eight billion people sharing the planet in 2025 will be living in areas experiencing water stress and shortages. Climate change may likely alter the hydrological cycle in significant ways.[74]

74 Murphy, A. and D. Hommel. The Geopolitical Implications of Environmental Change, http://geography.uoregon.edu/murphy/articles/Murphy%20Hommel%20with%20figures.pdf.

Figure P

Sea Level Rise



Source: Schubert, R., H. Schellnhuber, N. Buchmann, A. Epiney, R. Grießhammer, M. Kulessa, D. Messner, S. Rahmstorf, and J. Schmid. . Berlin: German Advisory Council on Global Change, 2006, http://www.wbgu.de/wbgu_sn2006_en.pdf.

Another large concern is sea-level rise. By 2100, sea levels are predicted to rise by between 9 and 88 cm, much of that as a result of thermal expansion as the oceans heat up.[75] About two-thirds of the world's population lives near a coast and thus some of the most important societal infrastructures reside near the sea. Some cities that are vulnerable to sea-level rise include Shanghai, Mumbai,

75 Predictions of Extreme Precipitation and Sea-Level Rise under Climate Change , C. A. Senior, R. G. Jones, J. A. Lowe, C. F. Durman, D. Hudson *Philosophical Transactions: Mathematical, Physical and Engineering Sciences*, Vol. 360, No. 1796, Flood Risk in a Changing Climate (Jul. 15, 2002), pp. 1301-1311.

London, Washington DC, Paris, and New York City.[76] As evident in Figure P, sea levels have been on the rise during the last quarter of the 20th century.[77]

A CAN Corporation report co-written by several retired American military officers, explains that the threat of climate change are significant and different than previous global hazards.

> Unlike most conventional security threats that involve a single entity acting in specific ways and points in time, climate change has the potential to result in multiple chronic conditions, occurring globally within the same time frame. Economic and environmental conditions in already fragile areas will further erode as food production declines, diseases increase, clean water becomes increasingly scarce, and large populations move in search of resources. Weakened and failing governments, with an already thin margin for survival, foster the conditions for internal conflicts, extremism, and movement toward increased authoritarianism and radical ideologies.[78]

The report continues to explain that many governments, specifically in the developing world, are already somewhat

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76 How Climate Change is Pushing the Boundaries of Security and Foreign Policy Cleo Paskal (Chatham House, June 2007) http://www.chathamhouse.org.uk/research/eedp/papers/view/-/id/499.

77 Schubert, R., H. Schellnhuber, N. Buchmann, A. Epiney, R. Grießhammer, M. Kulessa, D. Messner, S. Rahmstorf, and J. Schmid. . Berlin: German Advisory Council on Global Change, 2006, http://www.wbgu.de/wbgu_sn2006_en.pdf.

78 Catarious, D., R. Filadelfo, H. Gaffney, S. Maybee, and T. Morehouse. National Security and the Threat of Climate Change CNA Corporation, 2007, http://securityandclimate.cna.org/report/National%20Security%20and%20the%20Threat%20of%20Climate%20Change.pdf.

unstable. These governments have difficulties providing basic needs for their citizens. Climate change could exacerbate these issues and add to the problems of effective governance. In general, climate change would act as a threat multiplier for global instability.[79]

The Environmental Defense Fund (EDF) lays out some possible geopolitical impacts from climate change as well. The EDF argues that violence and disruption will increase from the stresses created by changes in the climate: that military confrontation may be sparked by national needs for food, water, and other resources. In an EDF paper, "An Abrupt Climate Change Scenario and Its Implications for United States National Security," some hypothetical scenarios are provided. Chart P displays these hypothetical impacts from climate change.[80]

79 Ibid.

80 Schwartz, P. and D. Randall. *an Abrupt Climate Change Scenario and its Implications for United States National Security.* Global Business Network, 2003, http://www.gbn.com/ArticleDisplayServlet.srv?aid=26231.

Chart P

Hypothetical Conflict Scenarios Due to Climate Change

	Europe	**Asia**	**United States**
2010–2020	2012: Severe drought and cold push Scandinavian populations southward, push back from EU 2015: Conflict within the EU over food and water supply leads to skirmishes and strained diplomatic relations 2018: Russia joins EU, providing energy resources 2020: Migration from northern countries such as Holland and Germany toward Spain and Italy	2010: Border skirmishes and conflict in Bangladesh, India, and China, as mass migration occurs toward Burma 2012: Regional instability leads Japan to develop force projection capability 2015: Strategic agreement between Japan and Russia for Siberia and Sakhalin energy resources 2018: China intervenes in Kazakhstan to protect pipelines regularly disrupted by rebels and criminals.	2010: Disagreements with Canada and Mexico over water increase tension 2012: Flood of refugees to southeast U.S. and Mexico from Caribbean islands 2015: European migration to United States (mostly wealthy) 2016: Conflict with European countries over fishing rights 2018: Securing North America, U.S. forms integrated security alliance with Canada and Mexico 2020: Department of Defense manages borders and refugees from Caribbean and Europe.
2020–2030	2020: Increasing: skirmishes over water and immigration	2020: Persistent conflict in South East Asia; Burma,	2020: Oil prices increase as security of supply is

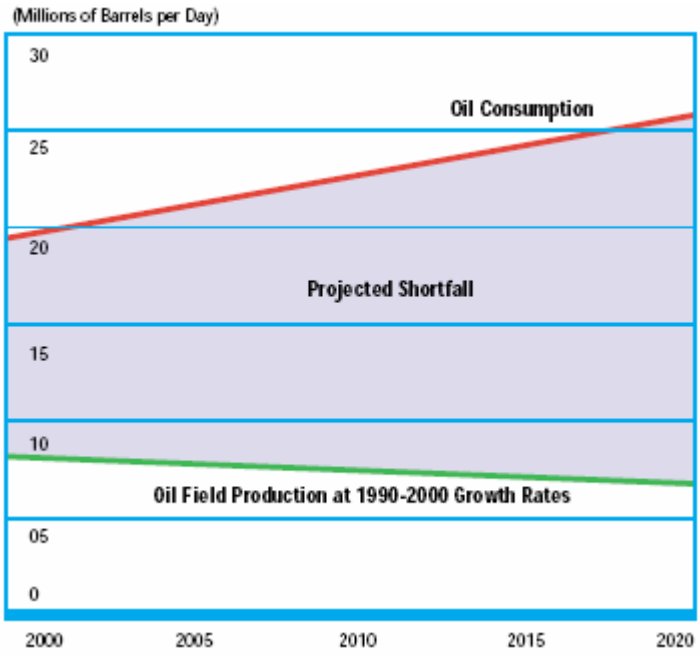
	2022: Skirmish between France and Germany over commercial access to Rhine 2025: EU nears Collapse 2027: Increasing migration to Mediterranean countries such as Algeria, Morocco, Egypt, and Israel 2030: Nearly 10% of European population moves to a different country	Laos, Vietnam, India, China 2025: Internal conditions in China deteriorate dramatically leading to civil war and border wars. 2030: Tension growing between China and Japan over Russian energy	threatened by conflicts in Persian Gulf and Caspian 2025: Internal struggle in Saudi Arabia brings Chinese and U.S. naval forces to Gulf ,in direct confrontation

Source: Schwartz, P. and D. Randall. *An Abrupt Climate Change Scenario and its Implications for United States National Security*Global Business Network, 2003., http://www.gbn.com/ArticleDisplayServlet.srv?aid=26231

Chapter 6 – Geopolitical Issue #3: Oil Imports

Figure I

U.S. Dependence on Imported Petroleum, 2000–2020



Source: National Energy Policy, 2001Executive Office of the President, 2001, http://www.whitehouse.gov/energy/National-Energy-Policy.pdf.

In the 2001 National Energy Policy (NEP) report delivered by Vice President Cheney to President Bush, energy security was listed as a major national security

concern.[81] It noted that as a percentage of total consumption, petroleum imports would continue to increase in the coming decades.

As noted in Figure I, oil consumption in the U.S. will grow by over 6 million barrels per day by 2020.[82] If U.S. production follows the same historical trends of the last 10 years, domestic production will decrease by 1.5 million barrels per day. Therefore oil imports will have to increase by 7.5 million barrels per day in 2020. This would mean that domestic production would fall to 30% of all U.S. needs.[83]

6.1 The National Security of Oil Supply

The United States has one of the most highly mechanized armed forces in the world. The U.S. Army, Air Force, and Navy heavily rely on instruments and machines powered by petroleum. Therefore it can be reasonably assumed that America's global military power rests on an

81 NEP, Pg. X

82 Ibid.

83 Ibid.

adequate, abundant supply of oil.[84] “For economic and military reasons, American leaders have historically and consistently viewed oil as a national security matter to be protected by force when and where necessary.”[85]

Arguably, the beginning of American concern for oil as a national security issue began with President Roosevelt. The President, noting the strategic importance of oil in World War II, began to try and shore up foreign reserves for American use. In February 1945, President Roosevelt met with King Ibn Saud of Saudi Arabia. It is at this first meeting that the U.S. launched a tacit alliance with the first major foreign oil producer.[86]

It was President Carter, however, that established foreign oil as a major national security concern. In his January 23, 1980 State of the Union Address, President Carter stated,

> Let our position be absolutely clear: An attempt by any outside force to gain control of the Persian Gulf region will be regarded as an assault on the vital interests of the United States of America, and such an

84 Klare, M. "Blood and Oil, the Dangers and Consequences of America’s Growing Dependence on Imported Petroleum." In , 36. New York: Metropolitan Books, 2004.

85 Ibid.

86 Ibid.

> assault will be repelled by any means necessary, including military force.[87]

President Carter's remarks, a reaction to a threat to the American oil supply in the Persian Gulf, are the foundation of the Carter Doctrine. This doctrine made it American policy to defend U.S. interests in the Persian Gulf by the use of military strength.

Future administrations would build off the Carter Doctrine as Persian Gulf oil continued to become even more important for American growth and stability. In a tangible expansion of the Carter Doctrine, President Reagan established Central Command (Centcom) in 1983, a theater-level Unified Combatant Command, which has jurisdiction over the Middle East and is charged with protecting American interests in the region. Since its creation, Centcom has fought in four major engagements: The Iran-Iraq War of 1980-88, the Persian Gulf War of 1991, the Afghanistan War of 2001, and the Iraq War of 2003.[88]

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87 Carter, J. "State of the Union Address." http://www.jimmycarterlibrary.org/documents/speeches/su80jec.phtml. January 23, 1980.

88 Blood and Oil, 2.

It can be reasonably argued that Centcom's basic mission was originally taken from the Carter Doctrine from 1980. It was given the task of protecting the flow of Persian Gulf Oil to the United States as a "vital interest."[89]

One could also argue that oil security was a major reason for American involvement in the first Persian Gulf War in 1990. The U.S. and a broad alliance sent troops to Kuwait and Saudi Arabia to hinder Iraqi aggression in the region. "When President Bush spoke on national television on August 8, 1990, he talked about 'drawing a line in the sand,' and went on to say that 'the oil from Saudi Arabia is vital to the national interests of the United States,' and again, 'we'll use any means necessary to protect that oil, and I am informing you that we have begun the deployment of hundreds of thousands of American troops in Saudi Arabia to protect that oil.'"[90]

89 Blood and Oil, 4.

90 Ibid.

6.2 The Economic Consequences of Oil Imports

Two of the largest recessions of the postwar period were associated with disruptions in the world oil market. In 1973, in the context of a fourth Arab-Israeli war, Arab oil producing nations in the Middle East reduced oil production and began an embargo of exports to the United States and other nations in support of Israel.

It can be argued that this OPEC supply cut was the main shock behind the deep recession of 1974-75, depressing the U.S economy. The supply shock siphoned purchasing power away from consumers. In addition, it also supported high inflation during this period.[91]

There have been numerous supply shortfalls during the past 40 years. As noted in Figure J, nine of the 10 major disruptions of the last few decades were caused by foreign political disruption.[92]

According to the IEA, since 1973, the largest oil disruption occurred at the time of the 1978-79 Iranian

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91 Perry, G. *The War on Terrorism, the World Oil Market and the U.S. Economy* Brookings Institution, 2001, http://www.brookings.edu/papers/2001/1024terrorism_perry.aspx.

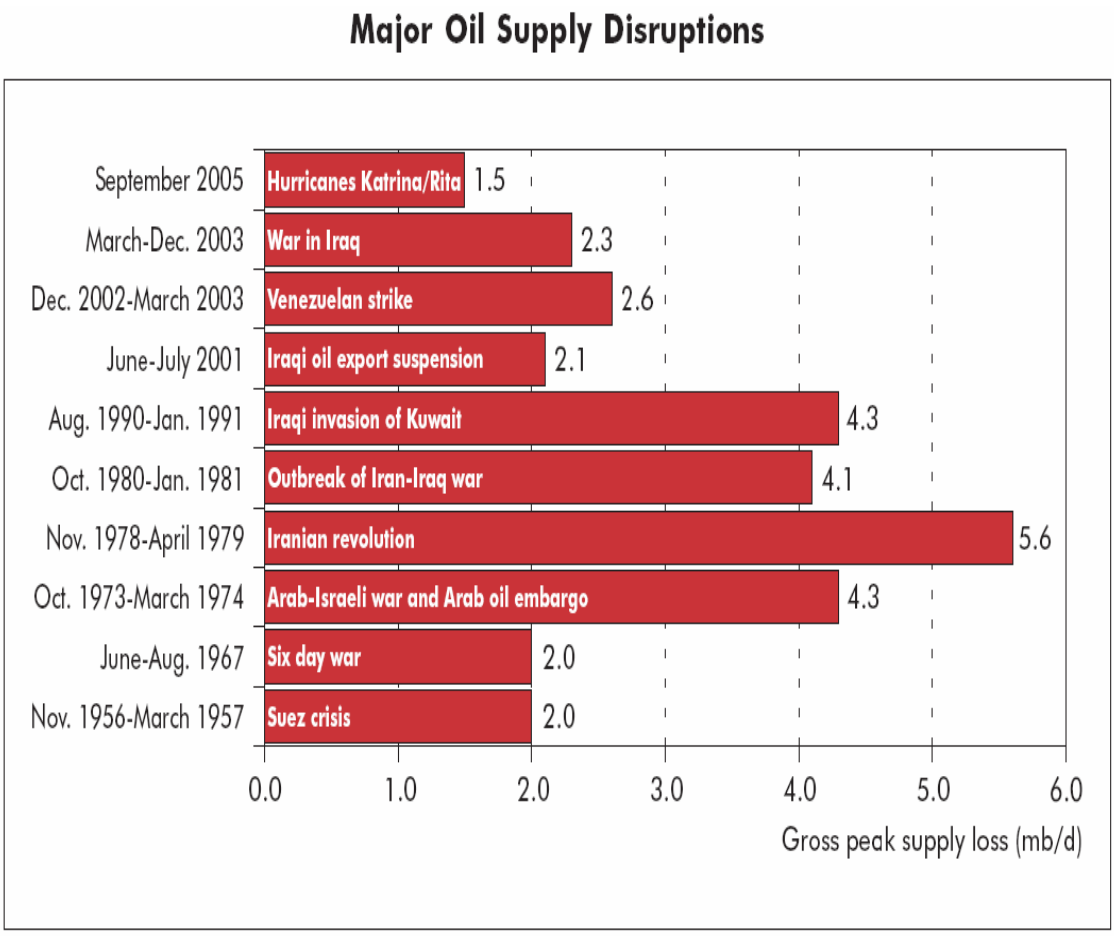
92 "Major Oil Supply Disruptions." International Energy Agency. http://www.iea.org/Textbase/nptable/2007/oilsecurity_f1_2.pdf.

revolution. This resulted in a supply shortfall of approximately 5.6 mb/d for a period of 6 months.[93]

93 "Fact Sheet on IEA Oil Stocks and Emergency Response Potential." International Energy Agency. http://www.iea.org/textbase/papers/2004/factsheetcover.pdf.

Energy price shocks as a result of foreign disruptions could increase unemployment within the U.S. This is due to deductions in worker productivity when energy use is

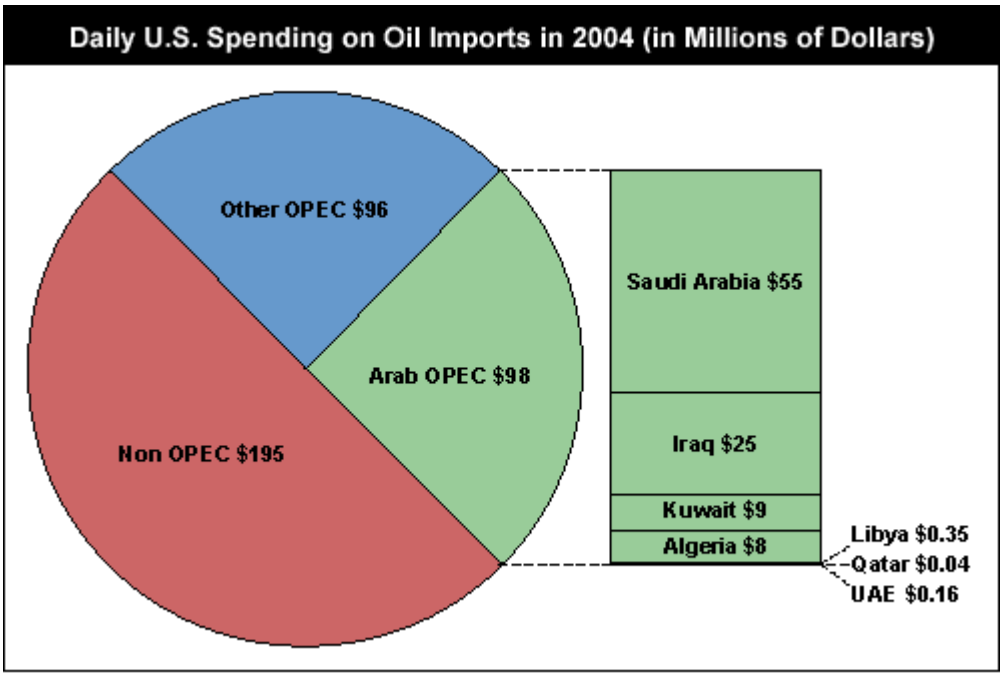
Figure J



Source: "Major Oil Supply Disruptions." International Energy Agency. http://www.iea.org/Textbase/nptable/2007/oilsecurity_f1_2.pdf.

curtailed in the face of rising prices and real wages do not fall along with productivity.[94]

Figure K



Source: "Safe, Strong and Secure: Reducing America's Oil Dependence." National Resource Defense Council. http://www.nrdc.org/air/transportation/aoilpolicy2.asp.

According to the National Resource Defense Council (NRDC), and based on 2003 Energy Information Administration data, the U.S. economy spent more than $200,000 per minute

94 Toman, M. "International Oil Security: Problems and Policies." Brookings Review 20, no. 2 (2002): 20. http://www.api.org/aboutoilgas/security/tomanintloilsecurity.cfm

on foreign oil, and more than $25 billion a year on Persian Gulf imports alone.[95]

By October 2004, Americans had shelled out $249 per capita to foreign oil-interests. The National Resource Defense Council continues to claim that in 2004, for every single day, the U.S. spent $390 million on foreign oil, with half of these funds for OPEC states.[96] With increased oil prices of above $100 per barrel, oil imports could cost the U.S. economy nearly half a trillion dollars per year.

6.3 The Continued Rise of OPEC and the Gulf

The 2001 NEP notes that by 2020, Gulf oil producers are projected to supply between 54 and 67% of the world's oil. The report states that "the global economy will almost certainly continue to depend on the supply of oil from Organization of Petroleum Exporting Countries (OPEC) members, particularly in the Gulf. This region will remain vital to U.S. interests. Saudi Arabia, the world's largest

95 "Safe, Strong and Secure: Reducing America's Oil Dependence." National Resource Defense Council. http://www.nrdc.org/air/transportation/aoilpolicy2.asp.

96 Ibid.

oil exporter, has been a linchpin of supply reliability to world oil markets."[97]

OPEC is an organization made up of oil exporting states whose stated objective is to coordinate petroleum policies among member countries. EIA reports that OPEC was created at the Baghdad Conference in 1960, by founding members Iran, Iraq, Kuwait, Saudi Arabia and Venezuela. The five founding members were later joined by nine other members: Qatar, Indonesia, Libya, United Arab Emirates, Algeria, Nigeria, Ecuador, Gabon and Angola.[98]

OPEC is extremely important because it has the largest share of oil deposits in the world. In 2007, OPEC countries held an estimated 910 billion barrels of petroleum. This equates to roughly 69% of total oil deposits in the world. Of OPEC totals, Middle East OPEC states control 79.7% of total OPEC oil.[99]

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97 NEP, 8-4

98 Monthly Energy Review Energy Information Administration, April 2008, http://www.eia.doe.gov/mer/pdf/mer.pdf.

99 "International Energy Outlook 2007." Energy Information Administration. http://www.eia.doe.gov/oiaf/ieo/oil.html.

In addition, as evident in Chart Q, OPEC production has been increasing faster than American and non-OPEC production.[100]

Chart Q

World Crude Oil Production, 1960-2006
(million barrels per day)

Year	United States	U.S. share	Total OPEC	OPEC share	OPEC +[a]	OPEC +[a] share	Total non-OPEC	Persian Gulf nations	Persian Gulf share	World
1960	7.04	33.5%	8.70	41.4%	12.25	58.3%	12.29	5.27	25.1%	20.99
1961	7.18	32.0%	9.36	41.7%	9.65	43.0%	13.09	5.65	25.2%	22.45
1962	7.33	30.1%	10.51	43.2%	10.82	44.4%	13.84	6.19	25.4%	24.35
1963	7.54	28.9%	11.51	44.0%	11.82	45.2%	14.62	6.82	26.1%	26.13
1964	7.61	27.0%	12.98	46.1%	13.30	47.2%	15.20	7.61	27.0%	28.18
1965	7.80	25.7%	14.35	47.3%	19.83	65.4%	15.98	8.37	27.6%	30.33
1966	8.30	25.2%	15.77	47.8%	16.10	48.8%	17.19	9.32	28.3%	32.96
1967	8.81	24.9%	16.85	47.6%	17.21	48.6%	18.54	9.91	28.0%	35.39
1968	9.10	23.6%	18.79	48.6%	19.18	49.7%	19.84	10.91	28.2%	38.63
1969	9.24	22.2%	20.91	50.1%	21.37	51.2%	20.79	11.95	28.7%	41.70
1970	9.64	21.0%	23.30	50.8%	31.12	67.8%	22.59	13.39	29.2%	45.89
1971	9.46	19.5%	25.21	52.0%	33.58	69.2%	23.31	15.77	32.5%	48.52
1972	9.44	18.5%	26.89	52.6%	35.69	69.8%	24.25	17.54	34.3%	51.14
1973	9.21	16.5%	30.63	55.0%	39.82	71.5%	25.05	20.67	37.1%	55.68
1974	8.77	15.7%	30.35	54.5%	40.16	72.1%	25.37	21.28	38.2%	55.72
1975	8.37	15.8%	26.77	50.7%	37.53	71.0%	26.06	18.93	35.8%	52.83
1976	8.13	14.2%	30.33	52.9%	41.87	73.0%	27.01	21.51	37.5%	57.34
1977	8.24	13.8%	30.89	51.7%	43.09	72.2%	28.82	21.73	36.4%	59.71
1978	8.71	14.5%	29.46	49.0%	42.46	70.6%	30.70	20.61	34.3%	60.16
1979	8.55	13.6%	30.58	48.8%	44.12	70.4%	32.09	21.07	33.6%	62.67
1980	8.60	14.4%	26.61	44.6%	41.07	68.9%	32.99	17.96	30.1%	59.60
1981	8.57	15.3%	22.48	40.1%	37.46	66.8%	33.60	15.25	27.2%	56.08
1982	8.65	16.2%	18.78	35.1%	34.28	64.1%	34.70	12.16	22.7%	53.48
1983	8.69	16.3%	17.50	32.9%	33.15	62.2%	35.76	11.08	20.8%	53.26
1984	8.88	16.3%	17.44	32.0%	33.19	60.9%	37.05	10.78	19.8%	54.49
1985	8.97	16.6%	16.18	30.0%	31.81	58.9%	37.80	9.63	17.8%	53.98

100 Monthly Energy Review, Table 11.1a and 11.1b.

1986	8.68	15.4%	18.28	32.5%	34.05	60.6%	37.95	11.70	20.8%	56.23
1987	8.35	14.7%	18.52	32.7%	34.72	61.3%	38.15	12.10	21.4%	56.67
1988	8.14	13.9%	20.32	34.6%	36.66	62.4%	38.42	13.46	22.9%	58.74
1989	7.61	12.7%	22.07	36.9%	38.50	64.3%	37.79	14.84	24.8%	59.86
1990	7.36	12.2%	23.20	38.3%	39.12	64.6%	37.37	15.28	25.2%	60.57
1991	7.42	12.3%	23.27	38.6%	38.53	64.0%	36.94	14.74	24.5%	60.21
1992	7.17	11.9%	24.40	40.5%	37.67	62.6%	35.81	15.97	26.5%	60.21
1993	6.85	11.4%	25.12	41.7%	37.65	62.5%	35.12	16.71	27.7%	60.24
1994	6.66	10.9%	25.51	41.8%	37.67	61.8%	35.48	16.96	27.8%	60.99
1995	6.56	10.5%	26.00	41.7%	38.24	61.4%	36.33	17.21	27.6%	62.33
1996	6.46	10.1%	26.46	41.5%	39.15	61.5%	37.25	17.37	27.3%	63.71
1997	6.45	9.8%	27.71	42.2%	40.69	61.9%	37.98	18.10	27.6%	65.69
1998	6.25	9.3%	28.77	43.0%	41.61	62.2%	38.15	19.34	28.9%	66.92
1999	5.88	8.9%	27.58	41.9%	40.50	61.5%	38.27	18.67	28.4%	65.85
2000	5.82	8.5%	29.27	42.8%	42.93	62.8%	39.10	19.89	29.1%	68.37
2001	5.80	8.5%	28.34	41.7%	42.53	62.6%	39.64	19.10	28.1%	67.98
2002	5.75	8.6%	26.35	39.3%	40.97	61.2%	40.62	17.79	26.6%	66.98
2003	5.68	8.2%	27.82	40.2%	43.18	62.4%	41.42	19.06	27.5%	69.24
2004	5.42	7.5%	29.92	41.4%	45.81	63.4%	42.3	20.79	28.8%	72.22
2005	5.18	7.0%	31.16	42.3%	46.98	63.8%	42.5	21.5	29.2%	73.65
2006	5.14	7.0%	30.66	41.7%	45.66	62.2%	42.79	21.23	28.9%	73.45
Average annual percentage change										
1960–2006	-0.7%		2.8%		2.9%		2.7%	3.1%		2.8%
1970–2006	-1.7%		0.8%		1.1%		1.8%	1.3%		1.3%
1996–2006	-2.3%		1.5%		1.6%		1.7%	2.0%		1.4%

Source: EIA [a] OPEC+ includes all OPEC nations plus Russia, Mexico, Norway, Oman.

To bridge the statistics of reserves and production, a measurement of reserve to production (r/p) ratio was developed. This ratio describes the number of years of remaining production from current proved reserves at current production rates. According to the EIA, the U.S. r/p ratio has been between 9 and 12 years for the past 2 decades. This compares to the major oil-producing countries

of OPEC which have maintained r/p ratios of 20 to 100 years.[101]

The U.S. is continuing to rely more heavily on OPEC. In 1993 the U.S. imported 1,589,348,000 barrels of petroleum from OPEC. In 2007, that number increased to 2,183,964, a 37.4% increase.[102]

6.4 Disruptions from OPEC

Disruptions in the oil supply from OPEC states, through foreign governmental policy, governmental overthrow or through acts of terrorism could have drastic implications for the U.S. A convincing Brookings Institution report outlines three different and plausible scenarios regarding OPEC oil supply disruption. George Perry, the author, also explains the possible economic implications.[103]

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101 Ibid.

102 Ibid.

103 Perry, G. The War on Terrorism, the World Oil Market and the U.S. EconomyBrookings Institution, 2001, http://www.brookings.edu/papers/2001/1024terrorism_perry.aspx.

Scenario # 1 – Bad Case

In this situation, more than 8 mbd of Arab OPEC oil, but not including the supply from Saudi Arabia and its OPEC core neighbors, Kuwait, the United Arab Emirates, and Qatar, comes under the control of extremists. Control could come about either through overthrow of governments or through coercive threats that secured the cooperation of governments.

In addition, assume further that the extremists seek to damage the industrial nations by cutting output by 90%. Under this condition, 10% of the world oil supply, or 7 mbd, would be removed from the market. Estimates of excess capacity for production in non-impacted OPEC are not fully known, but indications are they could promptly increase production by 3.5 mbd. If these states agreed to increase production by 3.5 mbd, the world would fall under roughly a 3.5 mbd deficit.

Scenario # 2 – Worse Case

In this case, assume that the same disruptions by extremists occur. However, under this scenario, there is no willingness by the Saudis or the rest of the OPEC core to make up any of the production shortfall. Perry notes that,

"it would not be surprising if they chose not to respond to an oil disruption originated elsewhere by the extremists. In this case, 7mbd are taken off the market."

Scenario # 3 – Worst Case

In this situation, assume extremists exert control over the entire 21.7 mbd production in Arab Muslim nations, and that they cut this total production by 10 mbd, or nearly half. Perry notes that this situation is plausible.

> Bin Laden and other extremists want most of all to overthrow the Saudi monarchy and the other dynastic rulers in the region. On the other hand, the United States would be expected to use military force to prevent it. Although a U.S. military occupation of the region could maintain oil supplies, it would have imponderable consequences for our relations with the wider Muslim world and could prove unsustainable. Furthermore, apart from the particular scenario sketched above, 10 mbd of supply could conceivably be lost to some other combination of political takeover or coercion, destruction of facilities, and interruption of distribution. So its consequences are worth examining.

The economic consequences of these three scenarios could be damaging for the United States and its allies. Oil disruptions at this magnitude could cause massive instability in world markets and lead to deep economic problems that could impact national security and welfare.

The bad case or the first scenario poses problems that are somewhat manageable. With oil from the Strategic Petroleum Reserve offsetting most of the supply disruption, oil price may only rise by a few dollars per barrel. However speculation may increase this price further. Perry notes that this is well within non-crisis variations observed in the past.

In the second scenario, the impacts are more significant. Oil prices might double. This shock might add 5% points to the overall inflation rate within the first year in the U.S. In addition, this disruption might likely cause or deepen recessions in the U.S. and throughout the world.

In the worst case or third scenario, the impacts would be devastating. Oil prices could triple or quadruple. Perry notes that the increase in the nation's bill for products of crude oil could rise by about 10% of GDP, which adds approximately 15% to the inflation rate in the first year. In addition, the recession is the steepest and deepest of the postwar period, with GDP declining nearly 5% during the first year.[104]

104 Ibid.

6.5 The Cost of Protecting Persian Gulf Imports

There have been a variety of estimates of how much it costs U.S. taxpayers to defend oil interests abroad. While costs could include non-OPEC countries and OPEC countries such as Venezuela, a breakdown of expenditures for Middle East oil protection provides helpful insight into probable costs for the future.

As the Middle East continues to be a region of political instability, it can be expected that U.S military involvement will continue into the future. As evident in Chart R[105], the cost of defending oil interests in this region cost is tens of billion of dollars each year.

Chart R

Military Expenditures for Defending Oil Supplies from the Middle East

Source	Original estimate (billion USD)	Year of original estimate
General Accounting Office	$33	1990
Congressional Research	$6.4	1990

105 Center for Transportation Analysis, Oak Ridge National Laboratory, Transportation Energy Data Book Edition 26, 2007, Page 1-10 http://cta.ornl.gov/data/tedb26/Edition26_Chapter01.pdf

Service		
Greene and Leiby	$14.3	1990
Kaumann and Steinbruner	$64.5	1990
Ravenal	$50	1992
Delucchi and Murphy	$20-40	1996
National Defense Council Foundation	$49.1	2003

Source: Center for Transportation Analysis, Oak Ridge National Laboratory, Transportation Energy Data Book Edition 26, 2007, Page 1-10 http://cta.ornl.gov/data/tedb26/Edition26_Chapter01.pdf

The wide range in estimate above reflects the difficulty in assigning a precise figure to the military cost of defending U.S. oil interests in the Middle East. The latest study, done by the National Defense Council Foundation (NDCF) puts a price of $49 billion dollars per year for the defense of oil.

In a NDCF report, the organization explains that in 2003, Centcom's conventional forces accounted for roughly $81.08 billion of the Department of Defense's $243.24 billion conventional force Personnel and Operation and Maintenance budget.[106] This equates to roughly 33%. An additional $4.5 billion was spent on Special Operations for

106 Copulos, M. America's Achilles Heel - the Hidden Costs of Imported OilA Strategy for Energy Independence. Washington, DC: National Defense Council Foundation, 2003, http://ndcf.homeip.net/ndcf/energy/NDCF_Hidden_Costs_of_Imported_Oil.pdf.

a total of $85.608 billion in personnel and Operations and Maintenance costs.[107] With some other additional costs and using FY2003 numbers, Centom's baseline is roughly $87.2 billion annually.

According to Copulos, the author of the report, to determine the percentage of the baseline that is allocated to protecting the Persian Gulf's oil fields, it is necessary to examine Centcom's operations. "Slightly more than 70% of recent Centcom operations have been directed at the Middle East."[108] However, Centcom also expected to incur continuing costs for other military operations including Operation Enduring Freedom. Therefore Copulos argues that attributing about half of Centcom's budget to protecting the flow of oil from the Persian Gulf would appear a reasonable assumption.

Using these calculations, Copulos estimates that the total ongoing cost of defending Persian Gulf oil comes to $44.408 billion annually.[109] When one spreads this cost to the total volume of crude oil and refined petroleum

107 Ibid.

108 Ibid.

109 Ibid.

products imported from the region into the U.S, per-barrel costs increase by $44.55 or approximately $1.06 per gallon.[110] It is likely that these costs have increased during the last few years.

Another study pegs the amount of funds used to protect global oil supplies for U.S. consumption at between $47.6 billion 2003 dollars and $113.1 billion 2003 dollars. This 2005 study by the International Center for Technology Assessment includes the costs of protecting non-Middle East oil supplies and includes oil protection cost estimations from the Iraq War.[111] These costs when applied to all OPEC imports in 2007 from both the Middle East and elsewhere increase barrel costs from between $21.80 to $51.79. This equates to additional OPEC import costs of $0.519 per gallon to $1.233 per gallon using 2003 dollars.

110 Ibid .

111 "Gasoline Cost Externalities: Security and Protection Services." International Center for Technology Assessment. http://www.icta.org/doc/RPG%20security%20update.pdf.

Chapter 7 – Conclusion

7.1 Increased Tax Impacts on Addressed Issues

Market externalities exist for the production and consumption of gasoline. As noted in Chapter 5, climate change from the burning of fossil fuels could prove catastrophic for world stability and the welfare of the United States.

A 2002 UN Environment Programme Finance Initiatives briefing states that "climate change poses a major risk to the global economy. The increasing frequency of severe climatic events, coupled with social trends, has the potential to stress insurers, reinsurers and banks to the point of impaired viability or even insolvency. Worldwide economic losses due to natural disasters appear to be doubling every 10 years and, on current trends, annual losses will reach almost $150 billion in the next decade."[112]

An International Center for Technology Assessment reports explains that climate change externalities from the

112 "Climate Risks to Global Economy *CEO Briefing*." United Nations Environment Programme. http://www.unepfi.org/fileadmin/documents/CEO_briefing_climate_change_2002_en.pdf.

burning of U.S. gasoline could equate to between $3.37 and $30.85 billion 2003 dollars.[113]

In addition to these referenced costs, this analysis can estimate the amount of CO_2 that can be reduced from each tax proposal listed in Chart H. As noted in section 5.1, each gallon of gasoline burned contributes 19.4 pounds of CO_2 into the atmosphere. Using Chart F inputs from Chart H, we can assume that CO_2 emissions can be reduced by 31.68 million metric tons per year using the low tax rate increase. This CO_2 reduction would climb to 93.28 million metric tons per year using the moderate tax rate increase. The aggressive tax rate increase would reduce CO_2 emissions by an estimated 155.75 million metric tons.

According to the EIA, total U.S. CO_2e emissions in 2005 were 7,181.4 million metric tons.[114] These emissions include those from transportation, electricity generation, industrial manufacturing, agriculture and other source. Based on these figures, these tax rate increases could potentially reduce CO_2e emission in the U.S. by 0.4% for the

113 "Gasoline Cost Externalities Associated with Global Climate Change." International Center for Technology Assessment. http://www.icta.org/doc/global%20warming%20rpg%20update.pdf.

114 *Emissions of Greenhouse Gases Report*Energy Information Administration, 2007, http://www.eia.doe.gov/oiaf/1605/ggrpt/carbon.html.

low tax rate increase, 1.3% for the moderate tax rate increase and 2.2% for the aggressive tax rate increase.

While these decreases may appear to be small as compared to overall emission, they are in fact significant. If the United States were to decrease CO_2e emission to 1990 levels, as often mentioned, than these tax related decreases become more sizeable. U.S. CO_2e emissions in 1990 were 6,146.7 million metric tons or 1,034.7 metric tons less than 2005.[115] If the most aggressive tax rate increase were implemented, roughly 15.1% of the desired decrease in emissions could be met. This represents a sizeable amount of this desired goal.

Reducing oil consumption by way of gasoline taxes would also reduce our demand on foreign oil. If by 2010 we were to reduce our oil imports to 1990 levels, approximately 7.2 million barrels per day, we could save approximately $270 billion a year. This is assuming prices are at $105 per barrel.[116]

The federal budget ramifications of these proposed tax rates vary. A simple calculation shows that after the

115 Ibid.

116 Blood and Oil, 193.

demand reduction from an increased marginal tax rate, the low gas tax rate increase would add roughly $39.7 billion to federal revenues, based on 2005 gasoline consumption figures and using Chart H inputs.

The moderate gas tax rate increase would increase federal revenues by $114.4 billion and the aggressive tax rate increase would increase federal revenues by $182.9 billion.

Chart S

Tax Rate Impacts on Federal Revenue

	Low Tax Rate	**Moderate Tax Rate**	**Aggressive Tax Rate**
2005 Gas Consumption (billions of gallons)	179.1	179.1	179.1
Consumption after tax impact (billion of gallons)	175.5	168.5	161.4
Tax rate increase per gallon ($)	0.226	0.679	1.133
Total revenue increase (billions $)	39.7	114.4	182.9

According to the Internal Revenue Service, roughly $1.7 trillion of individual and employment taxes were collected in 2004.[117] Based on these numbers, this thesis

117 "Internal Revenue Gross Collections, by State, Fiscal Year 2004." Internal Revenue Service. http://www.irs.gov/pub/irs-soi/04db06co.xls.

can make an extremely vague estimation that the three tax rate increases could offset individual and employment taxes by 2.3%, 6.7% or 10.8%, depending on the tax rate used. These offsets could be used to make these gasoline tax increase rates revenue neutral.

7.2 Drawbacks and Required Additional Research

It is less clear as to what exact impacts these tax rates would have on oil imports and peak oil. Moreover, it is nearly impossible to estimate where in the world import reduction would take place. While a reduction in oil consumption would reduce the demand for imported oil, it is not clear where that reduction would be made.

Domestic oil production may become more expensive as the EROI continues to decrease. If this is the case, then it is possible that foreign imports will continue to rise as a total percentage of oil consumption. Further research is necessary to determine the likely costs for oil production over the new few decades.

In addition, a further investigation into public policies that could encourage domestic consumption while discourage the consumption from certain foreign states

should also be conducted. For example, these policies could include an implementation of tariffs on foreign petroleum imports.

It is fairly logical to assume that a reduction in oil consumption would prolong the date at which the world were to reach peak oil production. However, a certain economic phenomenon might make this conclusion less certain. With gasoline prices set artificially higher in the U.S., oil prices would likely decrease in the global market. Foreign users might then consume more of the product, thus offsetting any reductions being made in the U.S. This concept is often referred to as a "Tragedy of the Commons." This phenomenon is basically a conflict over a finite resource, such as oil, between individual interests and the collective good. Further research and analysis must be conducted to determine what impacts reduced U.S. consumption would have on international oil demand.

Finally, it must be noted that an increased gasoline consumption tax would be highly regressive in nature. The revenue recycling measure used to make these proposed gasoline taxes revenue neutral must be engineered in such a way as to prevent harm from being inflicted on those with lower income levels. According to Sandalow, for every 10-

cent increase in tax, drivers would incur roughly an additional $60 per year and per car cost. He notes that a $1.00 tax increase for each gallon would be much more financially significant for most American families. He explains that a $1.00 tax increase would cost the average American family about $520 a year.

A nuanced tax revenue recycling system would have to be developed to defend the welfare of those that might be most impacted by a gas tax increase. These groups could include those living in rural areas and those in the lower and middle-lower income groups.

7.3 Recapitulation

Energy is the most vital resource that underpins nearly every function of a post-industrial society. Of all current energy sources, petroleum could be considered the most versatile. “Petroleum provides the basic ‘feedstock’ for paints, plastics, petrochemicals, textile fibers, and a host of other products,” explains Klare, author of Blood and Oil.[118] He goes on to state that the advanced agricultural industry and many manufacturing processes

118 Blood and Oil, 8.

depend on oil for their existence. Conventional American transportation also rests on the foundation of cheap and reliable petroleum. However, neither the producer nor the consumer pays for the full price of gasoline, which is derived from petroleum.

Chart T

Foreign Gas Tax Levels

Country	Tax on Gasoline (cents per gallon)
Belgium	441
France	443
Germany	466
Italy	417
Japan	208
Netherlands	480
United Kingdom	479

Source: "Motor Fuel Tax Rates for Selected Countries." U.S. Department of Transportation. http://www.fhwa.dot.gov/ohim/mmfr/sep07/mftrates.htm.

A gasoline tax increase could help curtail certain market externalities found within the energy industry. Peak oil, climate change and the drawbacks of Middle Eastern oil superiority all exhibit unique challenges to U.S. national security and geopolitical stability. While an increase in gasoline taxes can not alleviate all the problems

associated with these issues, a tax increase could help decrease consumption and can serve as part of a broader more comprehensive national energy policy.

Some foreign nations already have gas tax rates that are more than tens times the U.S. rate.[119] The United States could implement a higher gasoline tax and return additional federal revenue by reducing payroll, income, or other excise taxes. The impacts that this revenue neutral gasoline tax would have would be far reaching and significant.

119 "Motor Fuel Tax Rates for Selected Countries." U.S. Department of Transportation. http://www.fhwa.dot.gov/ohim/mmfr/sep07/mftrates.htm.

Appendix A

What We Pay for in A Gallon of Regular Gasoline					
Mo/Year	**Retail Price (Cents per gallon)**	**Refining (%)**	**Distribution & Marketing (%)**	**Taxes (%)**	**Crude Oil (%)**
Jan-00	128.9	7.8	13.0	**32.1**	47.1
Feb-00	137.7	17.9	7.5	**30.1**	44.6
Mar-00	151.7	15.4	12.8	**27.3**	44.6
Apr-00	146.5	10.1	20.2	**28.3**	41.4
May-00	148.5	20.2	9.2	**27.9**	42.7
Jun-00	163.3	22.2	8.8	**25.8**	43.1
Jul-00	155.1	13.2	15.8	**27.2**	43.8
Aug-00	146.5	15.8	7.5	**28.8**	47.8
Sep-00	155.0	15.4	9.0	**27.2**	48.3
Oct-00	153.2	13.7	10.1	**27.5**	48.6
Nov-00	151.7	10.4	11.8	**27.8**	50.0
Dec-00	144.3	8.0	17.9	**29.2**	44.8
Jan-01	144.7	17.8	10.4	**29.2**	42.7
Feb-01	145.0	17.3	11.0	**29.1**	42.6
Mar-01	140.9	18.8	9.7	**30.0**	41.5
Apr-01	155.2	31.6	4.6	**27.1**	36.7
May-01	170.2	26.4	14.0	**24.7**	35.0
Jun-01	161.6	13.2	24.1	**26.0**	36.7
Jul-01	142.1	10.0	20.0	**30.0**	40.0
Aug-01	142.1	20.0	9.0	**30.0**	41.0
Sep-01	152.2	18.0	17.0	**28.0**	37.0
Oct-01	131.5	10.0	20.8	**31.9**	37.2
Nov-01	117.1	10.0	18.0	**36.0**	36.0
Dec-01	108.6	11.7	12.7	**38.7**	36.9
Jan-02	110.7	13.0	11.8	**37.9**	37.2
Feb-02	111.4	12.1	11.2	**37.7**	39.1
Mar-02	124.9	19.4	6.1	**33.6**	40.9
Apr-02	139.7	15.5	13.0	**30.1**	41.4
May-02	139.2	11.9	14.2	**30.2**	43.7

Jun-02	138.2	15.0	13.0	**30.4**	41.6
Jul-02	139.7	15.0	12.6	**30.1**	42.3
Aug-02	139.6	11.4	13.4	**30.0**	45.0
Sep-02	140.0	10.8	12.6	**30.0**	46.7
Oct-02	144.5	13.9	11.7	**29.1**	45.3
Nov-02	141.9	11.1	18.0	**29.6**	41.3
Dec-02	138.6	11.7	12.3	**30.3**	45.7
Jan-03	145.8	11.5	10.3	**28.8**	49.4
Feb-03	161.3	15.0	9.5	**26.0**	49.5
Mar-03	169.3	14.8	14.8	**24.8**	45.5
Apr-03	158.9	13.2	19.8	**26.4**	40.5
May-03	149.7	15.3	16.3	**28.1**	40.4
Jun-03	149.3	15.1	12.3	**28.1**	44.5
Jul-03	151.3	15.3	11.9	**27.8**	44.9
Aug-03	162.0	22.5	8.2	**25.9**	43.3
Sept-03	167.9	13.9	22.7	**25.0**	38.3
Oct-03	156.4	14.9	16.1	**26.9**	42.2
Nov-03	151.2	11.7	15.3	**27.8**	45.2
Dec-03	147.9	11.5	12.6	**28.4**	47.5
Jan-04	157.2	15.9	9.9	**26.7**	47.5
Feb-04	164.8	19.1	9.2	**25.5**	46.2
Mar-04	173.6	19.0	11.3	**24.2**	45.5
Apr-04	179.8	22.0	9.9	**23.4**	44.6
May-04	198.3	30.6	7.8	**21.2**	40.4
Jun-04	196.9	21.3	16.7	**21.3**	40.7
Jul-04	191.1	20.9	11.3	**21.9**	45.8
Aug-04	187.8	13.9	12.2	**22.4**	51.5
Sep-04	187.0	14.8	9.1	**22.5**	53.6
Oct-04	200.0	13.0	9.3	**21.0**	56.7
Nov-04	197.9	10.7	14.6	**21.2**	53.6
Dec-04	184.1	8.9	18.1	**23.9**	49.1
Jan-05	183.1	17.7	7.3	**24.0**	50.9
Feb-05	191.0	16.1	9.3	**23.0**	51.6
Mar-05	207.9	19.3	6.2	**21.2**	53.4
Apr-05	224.3	20.9	9.6	**19.6**	49.8
May-05	216.1	17.9	12.8	**20.4**	49.0

Jun-05	215.6	18.5	6.9	**20.4**	54.2
Jul-05	229.0	17.9	8.0	**19.2**	54.9
Aug-05	248.6	24.3	2.1	**17.7**	55.9
Sep-05	290.3	27.3	7.5	**15.2**	50.0
Oct-05	271.7	15.1	17.8	**16.2**	50.9
Nov-05	225.7	8.3	13.1	**19.5**	57.1
Dec-05	218.5	13.5	7.9	**20.1**	58.4
Jan-06	231.6	13.4	6.6	**19.8**	60.1
Feb-06	228.0	9.8	11.4	**20.1**	58.6
Mar-06	242.5	21.7	4.5	**18.9**	54.8
Apr-06	274.2	25.8	3.1	**16.7**	54.2
May-06	290.7	21.9	8.8	**15.8**	53.4
Jun-06	288.5	22.0	7.9	**15.9**	54.1
Jul-06	298.1	26.3	6.3	**15.4**	52.0
Aug-06	295.2	15.2	13.5	**15.9**	55.4
Sep-06	255.5	6.3	18.8	**18.3**	56.7
Oct-06	224.5	10.9	10.6	**20.8**	57.7
Nov-06	222.9	14.6	7.5	**20.4**	57.5
Dec-06	231.3	12.9	9.4	**19.7**	58.0
Jan-07	224.0	10.6	15.2	**20.3**	53.9
Feb-07	227.8	18.0	5.8	**20.0**	56.3
Mar-07	256.3	23.6	8.5	**15.5**	52.3
Apr-07	284.5	28.1	7.6	**14.0**	50.3
May-07	314.6	27.9	13.3	**12.7**	46.1
June-07	305.6	22.7	13.7	**13.0**	50.5
Jul-07	296.5	18.4	11.4	**13.4**	56.8
Aug-07	278.6	13.5	11.8	**14.3**	60.4
Sep-07	280.3	12.8	8.6	**14.2**	64.3
Oct-07	280.3	10.1	8.1	**14.2**	67.6
Nov-07	308.0	10.0	8.7	**13.0**	68.3
Dec-07	301.8	8.1	10.5	**13.2**	68.1
Jan-08	304.3	7.8	11.1	**13.1**	67.9

Appendix B

State	Gasoline (cents per gallon)		
State	Excise Tax	Other Tax	Total Tax
FEDERAL	**18.3**	**0.1**	**18.4**
Alabama	16.0	2.0	**18.0**
Alaska	8.0	0.0	**8.0**
Arizona	18.0	0.0	**18.0**
Arkansas	21.5	0.0	**21.5**
California	18.0	0.0	**18.0**
Colorado	22.0	0.0	**22.0**
Connecticut	25.0	0.0	**25.0**
Delaware	23.0	0.0	**23.0**
District of Columbia	20.0	0.0	**20.0**
Florida	4.0	11.3	**15.3**
Georgia	7.5	7.7	**15.2**
Hawaii	16.0	0.0	**16.0**
Idaho	25.0	0.0	**25.0**
Illinois	19.0	1.1	**20.1**
Indiana	18.0	0.0	**18.0**
Iowa	21.0	0.0	**21.0**
Kansas	24.0	0.0	**24.0**
Kentucky	18.3	1.4	**19.7**
Louisiana	20.0	0.0	**20.0**
Maine	26.8	0.0	**26.8**
Maryland	23.5	0.0	**23.5**
Massachusetts	21.0	0.0	**21.0**
Michigan	19.0	0.0	**19.0**
Minnesota	20.0	0.0	**20.0**

State	Gasoline (cents per gallon)		
State	Excise Tax	Other Tax	Total Tax
Mississippi	18.0	0.4	**18.4**
Missouri	17.0	0.55	**17.55**
Montana	27.0	0.0	**27.0**
Nebraska	27.1	0.9	**28.0**
Nevada	24.0	0.805	**24.805**
New Hampshire	18.0	1.625	**19.625**
New Jersey	10.5	4.0	**14.5**
New Mexico	17.0	1.9	**18.9**
New York	8.0	16.6	**24.6**
North Carolina	29.9	0.25	**30.15**
North Dakota	23.0	0.0	**23.0**
Ohio	28.0	0.0	**28.0**
Oklahoma	16.0	1.0	**17.0**
Oregon	24.0	0.0	**24.0**
Pennsylvania	12.0	19.2	**31.2**
Rhode Island	30.0	1.0	**31.0**
South Carolina	16.0	0.0	**16.0**
South Dakota	22.0	0.0	**22.0**
Tennessee	20.0	1.4	**21.4**
Texas	20.0	0.0	**20.0**
Utah	24.5	0.0	**24.5**
Vermont	19.0	1.0	**20.0**
Virginia	17.5	0.0	**17.5**
Washington	34.0	0.0	**34.0**
West Virginia	20.5	11.0	**31.5**
Wisconsin	29.9	3.0	**32.9**
Wyoming	13.0	1.0	**14.0**

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Curriculum Vita

With this thesis and its oral defense, Aaron Kraus will be graduating from the Johns Hopkins University with a Master of Arts degree in Government. During his graduate studies, Mr. Kraus's academic focus was on U.S. energy and environmental policy.

Born and raised in New York, Mr. Kraus attended the University of Maryland where he graduated in 2005 with a Bachelor of Arts degree in Government and Politics.

Mr. Kraus is an Energy Analyst in Washington, D.C. with Energetics Inc.'s Energy Systems Division. The focus of his work consists of researching, analyzing and communicating new technological, economic, and political trends in the energy and environmental fields. His primary clients include: the Department of Energy (DOE); the Maryland Energy Administration (MEA); and the National Rural Electric Cooperative's (NRECA) Cooperative Research Network (CRN)

Mr. Kraus has authored over 30 different published articles for CRN and a variety of policy papers for the MEA. Policy and best practices covered in these papers include: renewable energy and energy efficiency; end-use solutions; transmission reliability and security; generation fuels and environment; distribution operations; and informational and digital communication technology. He has collaborated on PHEV congressional reports, DOE's 20% by 2030 Wind Project, 2007 Superconductivity Peer Review, 2008 National Electricity Delivery Forum, and many other projects and policy papers.

Prior to his work at Energetics, Mr. Kraus served as the sole public information officer for the State of Maryland's Department of Natural Resources in Annapolis, MD. In this capacity, Mr. Kraus was responsible for all communication and media for this nearly 1,500 person agency. Prior to this work, he was a field director for Maryland's Montgomery County Executive Doug Duncan's campaign for Governor.