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# Ethanol: Law, Economics, and Politics

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## Executive Summary

Ethanol production in the United States has been steadily growing and is expected to continue growing. Many politicians see increased ethanol use as a way to promote environmental goals, such are reducing greenhouse gas emissions, and energy security goals. This paper analyzes the economic and political issues surrounding the ethanol industry. It provides a cost-benefit analysis of substantially increasing ethanol production, and finds that costs are likely to exceed benefits by about three billion dollars annually in 2012 if current policies continue. It also suggests that earlier attempts aimed at promoting ethanol would have likely failed a benefit-cost test.

The paper then identifies key issues that will affect future ethanol support and suggests how politics could affect the development of sensible energy and climate policies in general. Finally, the paper offers some suggestions for more cost-effective development of energy alternatives that would enhance energy security and environmental quality.

# ETHANOL: LAW, ECONOMICS, AND POLITICS

Robert W. Hahn

## I. INTRODUCTION

Ethanol is a fuel that has been touted by politicians and technologists for a variety of reasons related to both energy security and the environment. It figures prominently in President Bush's strategy to address climate change.[1]

Largely as a result of government policies, the production of ethanol in the United States is expected to grow dramatically during the next decade. As of December 2007, there are 134 ethanol plants in the United States with a total capacity of more than 7 billion gallons per year.[2] This capacity is expected to exceed 13 billion gallons per year after current construction and expansion projects are completed.[3]

Interest group support for ethanol has been a major factor behind the increase in production. Many politicians see increased ethanol use as a way to promote environmental goals and energy security goals while catering to key interest groups, such as corn farmers and environmentalists. This paper analyzes legal, economic, and political issues surrounding the ethanol industry, with particular focus on ethanol policy in the United States.

At first glance, ethanol appears to be a regional issue because production is concentrated in the Midwest. Most plants are close to farm land, with more than 40 plants in the state of Iowa alone. The majority of plants are owned by

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[1] *See* George W. Bush, *Twenty in Ten: Strengthening America's Energy Security*, *available at* http://www.whitehouse.gov/stateoftheunion/2007/initiatives/energy.html. A 15 percent reduction is to come through the increased use of renewable fuels such as ethanol and a five percent reduction is to come through new fuel economy standards.

[2] As of December 2007, sixty-six plants are under construction and ten are expanding. *See* Renewable Fuels Association (RFA), *U.S. Fuel Ethanol Industry Biorefineries and Production Capacity*, *available at* http://www.ethanolrfa.org/industry/locations/ [hereinafter RFA, *Biorefineries*].

[3] *Id.*

corporations, which account for about 72 percent of total production capacity.[4] More than 80 percent of the ethanol in the U.S. is produced exclusively from corn.

Ethanol has widespread support in the U.S. An April 2007 poll by CBS News/New York Times found that 70 percent of the public thought ethanol was a good idea, agreeing with the statement that ethanol made from corn is an American-made substitute for foreign oil that causes less air pollution.[5] Politicians are also jumping on the ethanol bandwagon, especially presidential hopefuls campaigning in Iowa, such as Hillary Clinton, Barack Obama, and Rudy Guiliani.[6] In January 2007, President Bush announced his plan to reduce U.S. gasoline consumption by 20 percent in ten years mostly through increased ethanol use.[7]

Most ethanol incentive programs are justified by concerns with improving energy security or air quality. Energy security is typically understood to mean reducing U.S. reliance on foreign oil or insecure sources of foreign oil. Because ethanol is currently made from corn and domestic corn production is limited by available land, ethanol is not expected to have a large impact on U.S. oil imports in the short term.

The environmental argument for ethanol relates to possible reductions in greenhouse gas emissions and improvements in local air quality. The evidence on environmental benefits is mixed. Although ethanol is likely to reduce carbon dioxide emissions, it may not decrease overall greenhouse gas emissions.[8] Ethanol use is also likely to reduce carbon monoxide emissions and some air toxics, such as benzene.[9] At the same time, ethanol use increases annual emissions of nitrogen oxides, and ethanol production and transportation may increase emissions of sulfur oxides, particulate matter, and volatile organic compounds.[10] There is also evidence that ethanol use may increase ground-level

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[4] About 38 percent of the plants are farmer-owned, but these plants only account for about 28 percent of total capacity. In addition, only a small percentage of plants under construction are farmer-owned, meaning that the share of farmer-owned capacity is expected to decrease substantially in the next few years. *See* Renewable Fuels Association (RFA), *Ethanol Industry Overview*, *available at* http://www.ethanolrfa.org/industry/statistics/#EIO [hereinafter RFA, *Industry Overview*].

[5] CBS News/New York Times Poll, *Americans' Views on the Environment*, April 20-24, (2007), *available at* http://www.cbsnews.com/htdocs/pdf/042607environment.pdf.

[6] *See* Martin C. Evans, *As Candidate's Look to Iowa, Ethanol Becomes Top Issue*, NEWSDAY, July 22 (2007).

[7] *See* Bush, *supra* note 1.

[8] *See* Paul J. Crutzen et al., N2O release from agro-biofuel production negates global warming reduction by replacing fossil fuels, 7 ATMOS. CHEM. PHYS. DISCUSS., 11191-11205 (2007), *available at* http://www.atmos-chem-phys-discuss.net/7/11191/2007/acpd-7-11191-2007.html. *See also* Jerry Taylor & Peter Van Doren, *The Ethanol Boondoggle*, 1 THE MILKEN INSTITUTE REV. 16, 16-27 (2007). Using data from the International Energy Agency and calculations by William Nordhaus, Taylor & Van Doren, *supra*, find that reducing greenhouse gas emissions through increased ethanol use costs about ten times more than through optimal carbon abatement.

[9] *See* U.S. Environmental Protection Agency (EPA), *Regulatory Impact Analysis: Renewable Fuel Standard Program*, EPA 420-R-07-004 (2007), *available at* http://www.epa.gov/otaq/renewablefuels/420r07004.pdf [hereinafter EPA, *RIA*].

[10] *Id.*

ozone and water contamination, especially in the Gulf of Mexico.[11]

Increasing the production of ethanol is likely to be costly relative to gasoline. On an energy basis, ethanol typically costs more than oil, and is also more costly to distribute in the U.S.[12] In addition, one needs to take into account the deadweight costs of government programs aimed at promoting ethanol, such as the tax credit. The production of ethanol is also resource-intensive, using large amounts of electricity, natural gas, and an average of 4.7 gallons of water per gallon of ethanol.[13] As corn prices increase, corn production will move to marginal lands that will require more fertilizer use to make it arable, causing more emissions.

This paper has three objectives: first, to provide a systematic overview of different aspects of the ethanol issue, including the various laws and regulations supporting ethanol in the U.S. and abroad; second, to provide a benefit-cost analysis of substantially increasing ethanol production; and third, to understand the politics behind ethanol support, and suggest how these politics could affect the development of sensible energy and climate policies.

I discuss laws and regulations related to ethanol in Section II. I explain ethanol's potential to address market failures in section III. I analyze the likely benefits and costs of the future of ethanol in section IV. Section V discusses the political support for ethanol, evaluates whether it is likely to continue, and discusses how politics is likely to affect the design of energy and climate policy. Section VI offers suggestions for better ethanol policy and concludes with suggestions.

In general, I find that policy rationales for ethanol do not justify its widespread support. Ethanol made from corn is not likely to boost energy security and its environmental benefits are uncertain. Costs of increased production are likely to exceed benefits by about three billion dollars annually in 2012 if current policies continue.[14] I also suggest that earlier attempts aimed at promoting ethanol would have likely failed a benefit-cost test. I believe that the growing opposition to ethanol from corn will contribute to decreased support for ethanol in the future. At the same time, I see little reason to believe that energy policy or climate policy will focus primarily on economic efficiency. Finally, I offer some suggestions for the more cost-effective development of energy alternatives that would rely less on prescriptive regulation that selects particular fuels or technologies.

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[11] *See* Robert K. Niven, *Ethanol in Gasoline: Environmental Impacts and Sustainability Review Article*, 9(6) RENEW. SUSTAIN. ENERGY REV. 535, 535-555 (2005); Don Scavia, *The Gulf of Mexico's Dead Zone: Mess, Problem, or Puzzle?*, Resources for the Future, Weekly Policy Commentary (2007).

[12] *See* EPA, *RIA*, *supra* note 9 at 44.

[13] Hosein Shapouri & Paul Gallagher, *USDA's 2002 Ethanol Cost-of-Production Survey*, U.S. Department of Agriculture, Agricultural Economic Report Number 841 (2005) [hereinafter Shapouri & Gallagher, *USDA's 2002*].

[14] Calculations were based on the benefits and costs that we could monetize. Most items that could not be monetized were environmental costs. This means that our conclusion that costs are likely to exceed benefits is unlikely to change.

## II. LAWS AND REGULATIONS

Ethanol production in the United States has been steadily growing and is expected to continue to grow. The growth in this industry is a direct result of subsidies and regulations at both the federal and state level aimed at promoting ethanol use, especially corn ethanol.[15] This section provides an overview of laws and regulations in the U.S. and the rest of the world aimed at promoting ethanol.

The major driver behind the development of the fuel ethanol industry in the United States is the Volumetric Ethanol Excise Tax Credit, the federal subsidy for ethanol that is used in gasoline.[16] In 2006, about $2.5 billion dollars was distributed to gasoline blenders through the tax credit, which provides a 51 cent credit against gasoline taxes for every gallon of ethanol blended with gasoline.[17] The federal tax credit was created in 1978 by the Energy Tax Act, which provided blenders with 40 cents for every gallon of ethanol that they blended with gasoline.[18] Although only ethanol blenders could claim this credit, the subsidy indirectly benefits other groups, such as ethanol producers and owners of land where corn can be produced.[19] Congress has increased and decreased the federal tax credit for ethanol blending over the years, but it has always been extended.[20] Although recently lowered to 51 cents, the total amount of the sub-

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[15] Corn ethanol refers to ethanol made from corn.

[16] We will refer to the Volumetric Ethanol Excise Tax Credit simply as the federal tax credit throughout the text.

[17] This amount was calculated using information from the Energy Information Administration (EIA), *Annual Energy Outlook 2007: Legislation and Regulations*, *available at* http://www.eia.doe.gov/oiaf/aeo/pdf/leg_reg.pdf (2006) [hereinafter EIA, *Annual Outlook 2007*]; *see also* Energy Information Administration (EIA), *Ethanol Milestones*, *available at* http://www.eia.doe.gov/cneaf/solar.renewables/renewable.energy.annual/backgrnd/chap8d.htm [hereinafter EIA, *Milestones*]. *See* Figure 1.

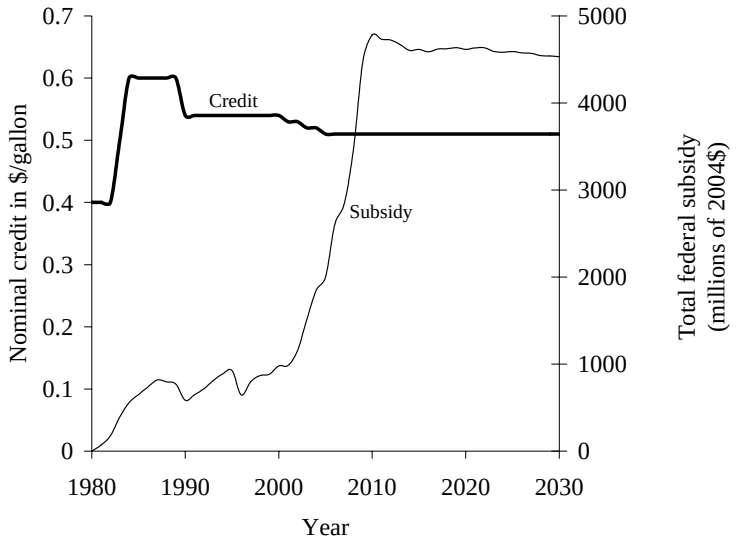
[18] *See* Doug Koplow, *Biofuels – At What Cost? Government Support for Ethanol and Biodiesel in the United States*, Prepared for The Global Subsidies Initiative of the International Institute for Sustainable Development, at 11 (2006), *available at* http://www.globalsubsidies.org/IMG/pdf/biofuels_subsidies_us.pdf.

[19] *See* Bruce Gardner, *Fuel Ethanol Subsidies and Farm Price Support: Boon or Boondoggle?*, Department of Agricultural and Resource Economics, University of Maryland, Working Paper 03-11 (2003), *available at* http://www.arec.umd.edu/publications/papers/Working-Papers-PDF-files/03-11.pdf [hereinafter Gardner, *Fuel Ethanol Subsidies*]. *See also* Godwin M. Agbara, U.S. Government Accountability Office, *Federal Energy Tax Incentives and Subsidies and the Current State of Biomass Fuels: A View from Congressional Oversight*, Prepared for the Baker Institute for Public Policy (2006), *available at* http://www.rice.edu/energy/publications/eventpres/Biofuels_Agbara_092606.pdf; Government Accountability Office (GAO), *Tax Policy: Effects of the Alcohol Fuels Tax Incentives*, GAO/GGD-97-41 (1997), *available at* http://www.gao.gov/archive/1997/gg97041.pdf [hereinafter GAO, *Tax Policy*].

[20] *See* EIA, *Annual Outlook 2007*, *supra* note 17. *See also* U.S. Department of Energy (DOE), *Alternative Fuels Data Center: State and Federal Incentives and Laws*, *available at* http://www.eere.energy.gov/afdc/laws/incen_laws.html (2006) [hereinafter DOE, *Incentives and Laws*]. For example, the current law, the tax credit has been extended until 2010. There is also a tax credit for biodiesel production of 50 cents per gallon of biodiesel made from recycled oils and $1 per gallon of biodiesel made from virgin vegetable oils and animal fats. This direct production incentive for biodiesel is recent, only enacted in 2004 through the American Jobs Creation Act.

sidy is actually rising rapidly due to the increased production of ethanol. For example, the Energy Information Administration predicts that annual production of ethanol will exceed 11 billion gallons in 2010.[21] If the entire amount is blended into gasoline, the federal government could incur almost $5 billion annually in direct costs through the tax credit alone. Figure 1 shows the level of this tax credit subsidy over the years. The thick line is the nominal subsidy amount per gallon of ethanol determined by laws, which is measured on the left axis.[22] The thin line is the amount of federal subsidy distributed by the government measured in constant year 2004 dollars on the right axis.

Figure 1: Federal Subsidy for Fuel Ethanol, 1980-2030




Source: Energy Information Administration

Notes: Subsidy amount beyond 2006 is estimated using information from the Energy Information Administration.

The federal tax credit is not the only incentive program for ethanol production.[23] Other incentive programs include the tariff on imported ethanol, grants and loans, the renewable fuels standards, and corn subsidies. There are currently so many programs in place at different levels of government that it has become very difficult to keep track of all of them. One thing is certain: the effective annual subsidy totals are in the billions. In research sponsored by the International Institute for Sustainable Development, Koplow finds that ethanol

[21] *See* EIA, *Annual Outlook 2007*, *supra* note 17 at Table A17, converted from quadrillion Btus. The EIA's early release 2008 report predicts even higher amounts of ethanol used in gasoline blending.

[22] The laws and regulations that are summarized in the figure are listed in the Appendix, Table A1.

[23] The Appendix, Table A2, includes a list of current federal laws and regulations that relate to ethanol.

received between $5 and $7 billion dollars in subsidies in 2006 from federal and state governments.[24] In absolute size, these subsidies are lower than the subsidies given to energy sources such as fossil fuels and nuclear fission, but the subsidies exceed all other government subsidies to energy in per unit energy terms.[25] Many of these programs have been in place for decades. Below I describe the various other tax, tariff, grant and loan incentive programs that support ethanol in addition to the federal tax credit.

The predominant method of supporting ethanol is through tax incentive programs. The U.S. Government Accountability Office estimates that more than $10 billion in support was given to the ethanol industry between 1979 and 2000 in the form of tax incentives.[26] In addition to the federal tax credit, the Small Ethanol Producer Tax Credit is a tax incentive program that provides a tax credit for small ethanol producers, defined as those with a production capacity of up to 60 million gallons.[27] The program allows a 10 cent tax credit on up to 15 million gallons of annual ethanol production, capped at $1.5 million per year per producer.[28] Originally enacted in 1990 under the Clean Air Act Amendments, the credit only applied to producers of up to 30 million gallons of ethanol. The definition of a small ethanol producer was revised in 2004 and the credit was extended.[29]

One of the most controversial incentive programs is the Omnibus Reconciliation Tax Act enacted in 1980, which established the tariff on imported ethanol. This tariff provides market price support for ethanol producers because the imported ethanol would otherwise drive down the price of domestic ethanol.[30] Because all ethanol was eligible for the blending tax credit, Congress feared the benefits of the credit would go to countries such as Brazil, where sugarcane ethanol is cheaper to produce.[31] Hence, Congress subjected all fuel ethanol to a most-favored-nation added duty, which is currently set at 54

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[24] *See* Koplow, *supra* note 18 at Table 5.1. Subsidies for biodiesel were lower, around $2 billion. Also, the U.S. Government Accountability Office estimates about $10 billion of budget authority for energy-related programs. See Agbara, *supra* note 19.

[25] *See* Government Accounting Office (GAO), Tax Incentives for Petroleum and Ethanol Fuels, GAO/RCED-00-301R (2000), available at http://www.gao.gov/new.items/rc00301r.pdf.

[26] *Id.*

[27] *See* Energy Information Administration (EIA), Alternative Fuels Data Center, *United States (Federal) Incentives and Laws*, *available at* http://www.eere.energy.gov/afdc/progs/view_ind_fed.php/afdc/352/0 [hereinafter EIA, *Federal Incentives*].

[28] *See* Renewable Fuels Association (RFA), *Federal Regulations: Small Ethanol Producer Tax Credit*, *available at* http://www.ethanolrfa.org/policy/regulations/federal/septc/. In 2005, the Energy Policy Act expanded the definition of a "small ethanol producer" from a plant that produces less than 30 million gallons of ethanol per year to one that produces less than 60 million gallons per year. The Act also created a similar tax credit for small producers of biodiesel.

[29] *See* EIA, *Federal Incentives*, *supra* note 27.

[30] *See* Koplow, *supra* note 18 at 19.

[31] *See* California Energy Commission, *Ethanol Fuel Incentives Applied in the U.S. Reviewed from California's Perspective*, Staff Report P600-04-001 (2004), at 7.

cents.[32] This tariff remains controversial because it goes against professed efforts to increase ethanol consumption by discriminating against foreign producers.[33]

The federal government also offers grants and guaranteed loans. In 1980, the Energy Security Act granted insured loans for small ethanol producers that covered up to 90 percent of construction costs on ethanol plants as well as other incentives for biomass projects.[34] The act also allocated $600 million to the Department of Energy and the Department of Agriculture for biomass research. Some of this research money, however, was retracted by the Consolidated Farm and Rural Development Federal Act, which offered more money for ethanol loan guarantees. There are currently about 12 federal programs that offer grants or loans for energy efficiency and renewable energy projects in the United States.[35] Most of these programs were enacted to address air quality concerns.

The 1990 Clean Air Act Amendments boosted the demand for ethanol by mandating the use of oxygenated fuels in areas that did not meet the air quality standards for carbon monoxide levels.[36] Ethanol adds oxygen to gasoline and helps the engine run more smoothly, reducing carbon monoxide.[37] Although methyl tertiary butyl ether (MTBE) was previously the most commonly used oxygenate, ethanol became more popular after many states banned MTBE because of its role in groundwater contamination.[38]

The renewable fuels standard provision of the Energy Policy Act of 2005 ensured demand for ethanol into the future, requiring at least 7.5 billion gallons to be purchased in 2012.[39] Interestingly, assuming that the ethanol tax credits are extended, the Energy Information Administration already predicts that the 7.5 billion gallon mandate will be reached long before 2012 due to production incentives.[40] I provide more analysis of the renewable fuels standard and the Energy Information Administration scenario in section IV.

Because almost all of the current ethanol produced for fuel in the U.S. is made from corn, ethanol producers also benefit from the federal subsidies given to corn.[41] The International Institute for Sustainable Development (IISD) esti-

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[32] Notably, it is above the current tax credit of 51 cents.

[33] In addition, some scholars note that the tariff is actually punitive because it more than offsets the tax credit when it is applied. *See* Koplow, *supra* note 18 at 12.

[34] *See* EIA, *Milestones*, *supra* note 17.

[35] *See* EIA, *Federal Incentives*, *supra* note 27. The Appendix, Table A2, includes a list of these programs.

[36] The EPA's Renewable Oxygenate Rule was overturned in court. *See* Koplow, *supra* note 18, at 13.

[37] *See* John Miranowski, *Biofuel Incentives and the Energy Title of the 2007 Farm Bill*, Prepared for the American Enterprise Institute, Agricultural Policy for the 2007 Farm Bill and Beyond Project, *available at* http://www.aei.org/research/farmbill/publications/pageID.1476,projectID.28/default.asp.

[38] *See* Environmental Protection Agency (EPA), *States Banning MTBE (Statewide), available at* http://www.epa.gov/mtbe/420b04009.pdf.

[39] *See* Environmental Protection Agency (EPA), *Renewable Fuel Standard Program*, *available at* http://www.epa.gov/otaq/renewablefuels/.

[40] *See* EIA, *Annual Outlook 2007*, *supra* note 17 at Table A17.

[41] According to the Renewable Fuels Association, ethanol producers create 96 percent of to-

mates that about 15 percent of the total subsidy to ethanol comes from ethanol's share of corn producers' subsidies, which is about $1 billion annually.[42] The IISD calculates this amount by taking the share of corn crops that are diverted to ethanol production and multiplying that by the average federal subsidy to corn producers. The actual amount may be lower since some of the subsidies given to corn fall as the price of corn increases.[43]

In addition to these federal incentive programs, many states have their own incentive programs for ethanol. A search of the Department of Energy's online database devoted to state and federal incentive programs displays 39 states with at least one grant, tax incentive, or loan program for ethanol.[44] Often, these state laws take the form of tax incentive programs. For example, Iowa has an ethanol tax credit available to fuel stations that sell mostly gasoline blended with ethanol. Once owners pass a 60 percent sale threshold, they are eligible for a tax credit of 2.5 cents for every additional gallon of gasoline blended with ethanol and sold during the year. Indiana has an ethanol production tax credit of 12.5 cents per gallon of ethanol produced with specific caps. Some states have programs in the forms of grants and loans. Maine, for example, has a fund that provides direct loans and subsidies to businesses for designing and building facilities to produce biofuels, the generic name for fuels produced from biomass sources, such as corn ethanol. And still other states have their own renewable fuels mandates. Missouri, for example, requires that all gasoline sold within the state must contain 10 percent ethanol after 2008. Many of these state laws have been in place for decades. The Congressional Research Service identified incentives in place in 29 states by 1985, with the state tax credits alone costing state treasuries over $400 million in foregone tax receipts.[45] Today, the International Institute for Sustainable Development estimates that state incentive programs contribute about $300 million dollars to total ethanol and biodiesel production subsidies.[46]

The U.S. is not alone in its support for ethanol.[47] Brazil, the world leader in

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tal ethanol exclusively from corn. *See* www.ethanolrfa.org.

[42] *See* Koplow, *supra* note 18.

[43] This amount may still rise as ethanol production uses a larger share of U.S. corn supplies. The U.S. Department of Agriculture predicts the share of corn devoted to ethanol will rise from about 14 percent in 2005 to about 30 percent in 2009. *See* Paul C. Westcott, *Ethanol Expansion in the United States: How Will the Agricultural Sector Adjust?*, U.S. Department of Agriculture, Report from the Economic Research Service, FDS-07D-01, at 4 (2007), *available at http://www.ers.usda.gov/Publications/FDS/2007/05May/FDS07D01/fds07D01.pdf*.

[44] *See* DOE, *Incentives and Laws*, *supra* note 20. Results were found using the comprehensive search function. The International Institute for Sustainable Development estimates that 38 states today have at least one incentive in place for ethanol or biodiesel. *See* Koplow, *supra* note 18 at 28 for a summary table of state incentive programs identified. The Renewable Fuels Association also has a table of the state laws that affect ethanol production, *available at* http://www.ethanolrfa.org/policy/actions/state/.

[45] *See* Congressional Research Service, *Alcohol Fuels and Lead Phasedown*, Report prepared for the Subcommittee on Fossil and Synthetic Fuels of the Committee on Energy and Commerce, U.S. House of Representatives (1986), as cited by Koplow, *supra* note 18 at 12.

[46] *See* Koplow, *supra* note 18.

[47] Foreign country information is from the Renewable Fuels Association (RFA), *Ethanol*

ethanol production, started to develop its industry in the mid-1970s by initiating a government program that guaranteed demand, offered low-interest loans for ethanol plants, and fixed the price of ethanol as compared to gasoline at the pump.[48] During the 1990s, the government eliminated many of the ethanol support programs.[49] Nevertheless, Brazil still requires 20 to 25 percent ethanol blends and gives preferential treatment to ethanol producers.[50] The European Union also has legislation and other mechanisms in place to encourage biofuel production, which includes any fuel made from biomass sources, such as ethanol.[51] For example, the EU has set a 5.75 percent biofuels target for transport fuels by 2010. Though meeting the target is voluntary, member states are expected to report the steps they are taking toward the target each year and the biofuel's share of total transport fuel use.[52]

There is also support outside of the U.S., EU and Brazil. The Renewable Fuels Association lists ethanol support programs around the world.[53] For example, all gas sold in Bangkok must be blended with at least 10 percent ethanol. India and Argentina require at least 5 percent ethanol in all gas. Finally, Canada offers preferential tax treatment for ethanol producers. These countries also have high ethanol import tariffs in place.

These incentive programs have large impacts. It is difficult, however, to estimate how much of current ethanol production is driven by these programs. The case of biodiesel, a fuel made from natural oils and fats, provides an example of how production can vary in the presence or absence of these programs. A tax credit for biodiesel production was enacted in 2004 under the federal tax credit and has already been extended once. It is currently set to expire in 2008. The credit offers 50 cents per gallon of biodiesel made from recycled oils and $1 per gallon of biodiesel made from virgin vegetable oils and animal fats. The Energy Information Administration predicts production of biodiesel will surge to just over a billion gallons in 2007 and 2008 due to this subsidy. Since the Energy Information Administration assumes that the subsidy will not be extended, it predicts that biodiesel production will fall to about 450 million gallons in 2009 and stay near that level for many years.[54] Hence, over half of the

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*Facts: Trade*, *available at* http://www.ethanolrfa.org/resource/facts/trade [hereinafter RFA, *Ethanol Facts*].

[48] *See* AMORY B. LOVINS ET AL., WINNING THE OIL ENDGAME: INNOVATION FOR PROFITS, JOBS, AND SECURITY 105-06 (Rocky Mountain Institute 2004).

[49] *See* Constanza Valdes, *Brazil's Booming Agriculture Faces Obstacles*, U.S. Department of Agriculture, Economic Research Service (2006), *available at* www.ers.usda.gov/AmberWaves/November06/Features/Brazil.htm. *See also* Marcelo E. Dias de Oliveira et al., *Ethanol as Fuel: Energy, Carbon Dioxide Balances, Ecological Footprint*, 55 BIOSCIENCE 7 (2005).

[50] *See* RFA, *Ethanol Facts*, *supra* note 47. *See also* Dias de Oliveira et al., *supra* note 49.

[51] *See* Randy Schnepf, *European Union Biofuels Policy and Agriculture: An Overview*, Congressional Research Service Report to Congress (2006), *available at* http://italy.usembassy.gov/pdf/other/RS22404.pdf.

[52] *Id.*

[53] *See* RFA, *Ethanol Facts*, *supra* note 47.

[54] It is actually the policy of the EIA not to assume that laws will not be extended and to make no predictions about laws that may be introduced in the future. In a departure from typical procedure, the EIA assumed that the ethanol tax credit will be extended because of its

biodiesel production in the next two years is estimated to be a direct result of the federal biodiesel tax credit. In line with this prediction, the U.S. Government Accountability Office estimated in 1995 that ethanol use would drop by at least 50 percent if the ethanol tax credit were eliminated.[55]

Despite the support for corn ethanol production, administrative officials realize that corn ethanol cannot achieve their energy security and other goals.[56] Today, many ambitious policies depend on the availability of ethanol from biomass sources such as cellulosic ethanol.[57] For example, cost-effective cellulosic ethanol production is an important part of President Bush's plan to reduce America's gasoline consumption by 20 percent in ten years.[58] Cellulosic ethanol is produced from the structural material of plants, which can be found in agricultural and forestry waste and fast-growing crops such as switchgrass.[59] It uses less energy in its production than does ethanol made from corn, resulting in lower greenhouse gas emissions.[60] Unfortunately, it is much more difficult to break down cellulose into the simple sugars necessary to make ethanol than it is to break down corn.[61]

New ethanol programs are marked by a focus on research and development into cellulosic ethanol technologies, although the earlier subsidy programs are frequently extended. The Energy Policy Act of 2005 created future demand for cellulosic ethanol by requiring 250 million gallons to be produced by 2013. In his 2006 State of the Union Address, President Bush outlined his Advanced Energy Initiative, which included programs such as the Biorefinery Initiative. This initiative grants about $150 million to help develop cellulosic technologies.[62] In 2007, the Department of Energy distributed up to $385 million in federal funding to six cellulosic ethanol plants.[63] Previously, federal spending on biofuels research and development was between $50 and $100 million a year

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history of being extended. *See* EIA, *Annual Outlook 2007*, *supra* note 17.

[55] Government Accountability Office (GAO), *Ethanol Tax Exemption*, GAO/RCED-95-273R (1995).

[56] *See, e.g.*, Timothy Gardner, *Corn is Not the Future of U.S. Ethanol: DOE*, REUTERS, Mar. 28, (2007), *available at* http://www.reuters.com/article/scienceNews/idUSN2830990020070328.

[57] Clay Sell, Deputy Energy Secretary of the Department of Energy, made headlines in March 2007 when he said in an interview that "…the future of biofuels is not based on corn." *Id.*

[58] *See* Bush, *supra* note 1. *See also* Press Release, Department of Energy, *DOE Selects Six Cellulosic Ethanol Plants for Up to $385 Million in Federal Funding*, February 28 (2007), *available at* http://www.energy.gov/news/4827.htm [hereinafter DOE, *DOE Selects*].

[59] *See* Department of Energy, Energy Information Administration, *Biofuels in the U.S. Transportation Sector* (2007), *available at* http://www.eia.doe.gov/oiaf/analysispaper/biomass.html.

[60] *See* Alexander E. Farrell et al., *Ethanol Can Contribute to Energy and Environmental Goals*, 311 SCIENCE 506, 506-08 (2006).

[61] Roel Hammerschlag, *Ethanol's Energy Return on Investment: A Survey of the Literature 1990-Present*, 40 ENVTL. SCI. & TECH. 1744 (2006).

[62] Press Release, Office of the Press Secretary, *State of the Union: The Advanced Energy Initiative*, Jan. 31 (2006), *available at* http://www.whitehouse.gov/news/releases/2006/01/20060131-6.html.

[63] *See* DOE, *DOE Selects*, *supra* note 58.

between 1978-1998, with only about $15 million a year allocated within the Department of Energy for the years 1978-1980.[64]

Ethanol incentive programs in the U.S. have different, and in some cases, conflicting goals. In fact, the ultimate goals of individual laws are rarely made clear, making the policies seem uncoordinated.[65] On one hand, most government biofuel expenditures subsidize corn ethanol. On the other hand, lawmakers are aware that corn ethanol by itself cannot meet U.S.'s energy and environment goals, though it could conceivably help. Not surprisingly, a large portion of the money goes towards research and development programs for cellulosic ethanol, but this amount is smaller than the sums paid to corn ethanol producers. Finally, the permanence of the ethanol tariff seems to imply that the goals of benefiting the U.S. ethanol industry in general outweigh the expressed environmental and energy security goals.[66] For such a high-cost issue, benefits should be clearly defined and a comprehensible national agenda established. The next section will evaluate some of these professed benefits in detail.

## III. ARGUMENTS IN FAVOR OF INTERVENING IN ETHANOL MARKETS

Economists generally believe that intervention in markets is not typically justified unless there is a well-defined market failure. A common example of a market failure is an externality, such as when one party's actions impose a cost on another party and market signals do not fully capture this cost.[67] Pollution is a case in point. A factory emitting smoke will not generally take into full account how its emissions affect people downwind of its plant, unless there is some type of government regulation.[68] Other market failures can result from market structure, such as monopoly, or difficulties in obtaining information. There are two main arguments advanced in favor of fuel ethanol production.[69]

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[64] *See* Koplow, *supra* note 18, at 13.

[65] *See* Koplow, *supra* note 18.

[66] Some politicians, however, believe that removing the tariff would hurt U.S. energy security by moving the U.S. from a dependence on foreign oil to a dependence on foreign ethanol. *See* Chuck Grassley, *Floor Statement of Sen. Chuck Grassley Chairman, Committee on Finance* ((May 5, 2006), *available at* http://www.senate.gov/~finance/press/Gpress/2005/prg050506.pdf. Most scholars agree that lower consumption and diversification of energy sources is the key to energy security, not necessarily domestic production of all energy. *See* Michael A. Toman, *International Oil Security: Problems and Policies*, Resources for the Future Issue Brief No. 02-04 (2002);6-8 (2002), *available at* http://www.rff.org/rff/Documents/RFF-IB-02-04.pdf; Heather Ross, *Producing Oil or Reducing Oil: Which is Better for U.S. Energy Security?*, 148 RESOURCES 16 (2002).

[67] *See* Office of Management and Budget, *Economic Analysis of Federal Regulations under Executive Order 12866*, Jan. 11 (1996), *available at* http://www.whitehouse.gov/omb/inforeg/riaguide.html.

[68] *See* Ronald H. Coase, *The Problem of Social Cost*, 3 J. L. & ECON. 1 (1960). Coase argued that regulation is needed to establish property rights in the case of large transactions costs, where the initial property rights allocation matters.

[69] Other arguments include offsetting gasoline subsidization, developing rural America, and supporting an infant industry. These arguments do not have much merit. A better way to ensure that gasoline does not have an advantage is to eliminate support to gasoline. Ethanol plants only modestly add to rural development because they do not require many employees

One suggests that ethanol is better than fossil fuel use on environmental grounds; the other suggests that ethanol production is better than the use of imported oil on energy security grounds. I discuss the merits of these two arguments below.

### A. ENVIRONMENTAL ARGUMENT

Ethanol has been associated with reductions in greenhouse gases relative to gasoline.[70] The regulatory impact analysis for the Environmental Protection Agency's Renewable Fuels Standard estimates that increasing ethanol use to the 6.7 billion gallon minimum would result in an 11 percent decrease in greenhouse gas emissions, a result similar to that calculated by other studies.[71]

There are reasons to believe that the estimated greenhouse gas reductions might be greatly overstated. For example, the estimates assume that one energy unit of ethanol displaces one energy unit of oil.[72] This one-for-one assumption is not likely to hold in a global economy because as ethanol production increases, the price of oil can be expected to decline due to lower U.S. oil imports. The lower price of oil could lead to more use of oil worldwide. Thus, some factor less than one-for-one is appropriate.[73]

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and benefit mostly farmland owners. *See* Shapouri & Gallagher, *USDA's 2002*, *supra* note 13; Miranowski, *supra* note 37. Finally, the ethanol industry, first subsidized in the 1970s, is a mature industry.

[70] *See* Jason Hill et al., *Environmental, Economic, and Energetic Costs and Benefits of Biodiesel and Ethanol Biofuels*, 103(30) PROCEEDINGS OF THE NAT'L ACAD. OF SCI. OF THE U.S. 11206 (2006);, 11206-07 (2006); Michael Wang et al., *Fuel-Cycle Fossil Energy Use and Greenhouse Gas Emissions of Fuel Ethanol Produced from U.S. Midwest Corn*, Argonne Laboratory's Center for Transportation Research, 21-38 (1997); EPA, *RIA*, *supra* note 10 at 25255-56. Ethanol use, however, is likely to result in increases in methane and nitrous oxide emissions, two other greenhouse gases. *Id.*

[71] EPA, *RIA*, *supra* note 9 at 67, 255-56. The Renewable Fuels Standard will lower emissions of carbon dioxide by 17 percent. *Id.*

[72] EPA, *RIA*, *supra* note 9 at 242.

[73] In addition, the decreased price of oil may encourage rapid development in underdeveloped nations and may actually raise world emissions. An example of the importance of unintended international effects regards the European Union (EU) targets for biodiesel. *See* Press Release, European Commission, Transport: Commission Proposes to Encourage Alternative Fuels, Starting with Biofuels, (Nov. 7, 2001), *available at* http://europa.eu/rapid/pressReleasesAction.do?reference=IP/01/1543&format=HTML&aged=0&language=EN&guiLanguage=fr. The EU targets increased EU biodiesel demand, which left many hypothesizing that the EU may unintentionally be subsidizing the destruction of tropical rainforests in South East Asia. *See* Fred Pearce, *Forests Paying the Price for Biofuels*, NEW SCIENTISTSCIENTIST, Nov. 22, 2005, at 19, *available at* http://environment.newscientist.com/channel/earth/mg18825265.400-forests-paying-the-price-for-biofuels.html. A cheap source of biodiesel is palm oil, which is frequently made by converting tropical rainforests to plantations for palm oil. Peet, a young form of coal, is found on rainforest floor and burns when the rainforests are destroyed, resulting in enormous greenhouse gas emissions. The EU is now aware of this potential side-effect and considers it in designing new legislation. *See, e.g.*, European Commission, *An EU Strategy for Biofuels Impact Assessment*, COM (2006) 34 final, 10 (Jan. 10, 2006), *available at* http://ec.europa.eu/agriculture/biomass/biofuel/sec2006_142_en.pdf. The EU attests, however, that "insignificant" amounts of palm oil have been used in biodiesel production. *See* European Commission, *Report on the Progress Made in the Use of Biofuels and Other Re-*

Another problem is that many studies do not adequately take into account the impact that lower U.S. corn exports could have on corn production elsewhere. The decrease in corn exports may cause other countries to convert previously unused, marginal lands, for example, into farm lands, which will also increase global emissions of greenhouse gases. Some scholars, such as Hill et al., acknowledge that the small reduction in greenhouse gas emissions associated with ethanol use may not be robust to alternate assumptions.[74]

One of the greatest challenges to the greenhouse gas reductions attributed to ethanol is from a recent study led by Nobel Prize winner Paul Crutzen. The study finds that the amount of nitrous oxide, a greenhouse gas, emitted through agriculture was previously underestimated. Accounting for the increase in nitrous oxide emissions actually results in net *increases* in greenhouse gases from the production and use of biofuels such as ethanol. If correct, this study could drastically alter the perception of the greenhouse gas benefits of ethanol.[75]

In general, many studies focus on the greenhouse gas emissions associated with ethanol use, but ignore some of the other environmental impacts including resource depletion, ozone depletion, acidification, human and ecological health, and smog formation.[76] Aside from greenhouse gas emissions, several scholars believe that the overall environmental effects of ethanol are no better than gasoline, and in some cases, may actually be worse.[77] Hill et al. find potentially greater human health impacts due to ethanol use because of increased numbers of other air pollutants, such as nitrogen oxides, in line with other studies.[78] Niven finds that ethanol may increase smog formation.[79] A recent study by Jacobson concludes that a fleet of vehicles running on E85 (85% ethanol blend) is not likely to improve air quality and may cause more health risks than a fleet of

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*newable Fuels in the Member States of the European Union*, SEC (2007) at 9 (Jan. 10 2007), *available at* http://ec.europa.eu/energy/energy_policy/doc/07_biofuels_progress_report_en.pdf.

[74] *See* Hill et al., *supra* note 70 at 11207. Importantly, their study only considers pollution from land already in corn production. In reality, increased demand for ethanol will increase the amount of land devoted to growing corn; they acknowledge that converting intact ecosystems to production would reduce the emissions savings or even result in net gains in emissions.

[75] *See* Crutzen et al., *supra* note 8.

[76] *See* Harro von Blottnitz & Mary Ann Curran, *A Review of Assessments Conducted on Bio-ethanol as a Transportation Fuel from a Net Energy, Greenhouse Gas, and Environmental Life Cycle Perspective*, 15(7) J. OF CLEANER PRODUCTION 607-619, (2007). [RCC: waiting for ILL]

[77] *See, e.g.*, Farrell et al., *supra* note 60; Ben Hancock, *EMFAC Modeling Change Technical Memo: Correction Factor for Increased Evaporative Emissions Due to Ethanol Replacement in Oxygenated Gasoline*, Cal. Air Resources Board, 1-4 (2004), *available at* www.arb.ca.gov/fuels/gasoline/meeting/2005/030105etohapp.pdf; Dias de Oliveira et al., *supra* note. 49, at 599-601.

[78] Hill et al, *supra* note 70, at 11207; *See also* von Blottnitz & Curran, *supra* note 76; Cal Hodge, *Ethanol Use in US Gasoline Should Be Banned, not Expanded*, 100(37) OIL & GAS J. ((Sept. 9, 2002); Jeffrey S. Gaffney et al., *Potential Air Quality Effects of Using Ethanol-Gasoline Fuel Blends: A Field Study in Albuquerque, New Mexico*, 31(11) ENVTL. SCI. & TECH. 3053, 3053-613055-60 (1997).

[79] Niven, *supra* note 11, at 535-55.

gasoline vehicles.[80]

In addition, the production of ethanol from corn is likely to cause environmental degradation through soil erosion and the use of pesticides and fertilizers, contributing to water and air pollution.[81] Environmental concerns also exist regarding the impacts on wildlife and biodiversity, especially if land that has been set aside for conservation purposes is used in corn production.[82] Some analysts also worry about the high amount of water that ethanol plants require, limiting their expansion in cities such as Tampa Bay, FL, Pipestone, MN, and Chesapeake, VA that could not guarantee water availability.[83] According to the U.S. Department of Agriculture, water use for ethanol plants ranged between 1 gallon to 11 gallons per gallon of ethanol, with an average of 4.7 gallons of water per gallon of ethanol.[84] Some see potential water shortages as the biggest setback to corn ethanol as a viable renewable resource, dubbing it as the "Achilles heal."[85]

At best, ethanol made from corn has slightly lower greenhouse gas emissions than gasoline. The entire environmental picture appears muddier, with ethanol potentially having worse overall environmental outcomes than gaso-

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[80] Although he finds the two to have comparable cancer risks, he finds E85 to have greater ozone health risks. *See* Mark Z. Jacobson, *Effects of Ethanol (E85) versus Gasoline Vehicles on Cancer and Mortality in the United States*, 41(11) ENVTL. SCI. & TECH. 4150, 4154-56 (2007). *See also* Niven, *supra* note 11, who finds that low level of ethanol emit less pollution, but high levels emit more pollution than gasoline.

[81] *See* David Pimentel, *Ethanol Fuels: Energy Balance, Economics, and Environmental Impacts Are Negative*, 12(2) NAT. RESOURCES RES.127, 130-31 (2003). In fact, Pimental, at 130, believes that corn causes more environmental degradation through soil erosion and the use of pesticides and fertilizers than any other U.S. crop.

[82] *See* Dennis Avery, *Biofuels, Food, or Wildlife? The Massive Land Costs of U.S. Ethanol*, Competitive Enterprise Institute Issue Analysis No. 5 (2006); Don Scavia, *The Gulf of Mexico's Dead Zone: Mess, Problem, or Puzzle?*, Resources for the Future Weekly Policy Commentary ((Oct. 1, 2007); NATIONAL RESEARCH COUNCIL, WATER IMPLICATIONS OF BIOFUELS PRODUCTION IN THE UNITED STATES (2007). For a general discussion of the tradeoffs involved in land use, see Jonathan A. Foley et al., *Global Consequences of Land Use*, 309 SCIENCE 570(2005).

[83] *See* Government Accountability Office (GAO), *DOE Lacks a Strategic Approach to Coordinate Increasing Production with Infrastructure Development and Vehicle Needs*, GAO-07-713, at 5, 17 (2007), *available at* http://www.gao.gov/new.items/d07713.pdf [hereinafter GAO, *DOE Lacks a Strategic Approach*]. *See, e.g.*, Perry Beeman, *Water Use: Biofuel Plants' Thirst Creates Water Worries*, DES MOINES REG., June 3, 2007, *available at* http://www.desmoinesregister.com/apps/pbcs.dll/article?AID=/20070603/BUSINESS01/706030323/1001/NEWS; David Adams & Janet Zink, *Ethanol Faces Big Hurdle: Water Use*, ST. PETERSBURG TIMES, May 28, 2007, *available at* http://www.sptimes.com/2007/05/28/Hillsborough/Ethanol_faces_big_hur.shtml; Mike Saewitz, *Proposed Ethanol Plant Would Need Water from City—Lots of It*, VIRGINIAN-PILOT (Chesapeake, Va.), June 10, 2007, *available at* http://content.hamptonroads.com/story.cfm?story=126388&ran=12735.

[84] Shapouri & Gallagher, *USDA's 2002*, *supra* note 13, at 14.

[85] *See also*, Dennis Keeney & Mark Muller, Water Use by Ethanol Plants: Potential Challenges, Institute for Agriculture & Trade Policy 4 (2006), *available at* http://www.agobservatory.org/library.cfm?refid=89449estimate (estimating 3.5 to 6 gallons of water per gallon of ethanol). According to the Institute for Agriculture and Trade, the Renewable Fuels Association estimates water consumption at three gallons per gallon of ethanol produced.

line. In summary, the environmental argument for ethanol is weak.[86]

## B. ENERGY SECURITY ARGUMENT

The other argument for ethanol production and use is that it promotes U.S. energy security. Energy security relates to the idea that problems resulting from abrupt changes in energy supply and price disruptions can be reduced.[87] Energy security has been used as a justification for various types of energy policy, such as import quotas, tariffs, and subsidies for domestic producers.[88] I focus on energy security specifically as it relates to the U.S. dependence on foreign oil.[89]

U.S. dependence on imported crude oil and petroleum products has been increasing. According to the Energy Information Administration (EIA), the U.S. imported 66% of the oil supplied in 2005, as compared to 37% in 1981. Almost 30% of the oil supplied in 2005 came from the Organization of Petroleum Exporting Countries (OPEC), which includes many Middle Eastern countries seen to be unstable. The EIA projects that the U.S. will import over 70% of oil by the year 2030.[90]

Figure 2: U.S. Crude Oil and Petroleum Products Consumed and Imported, 1981-2005

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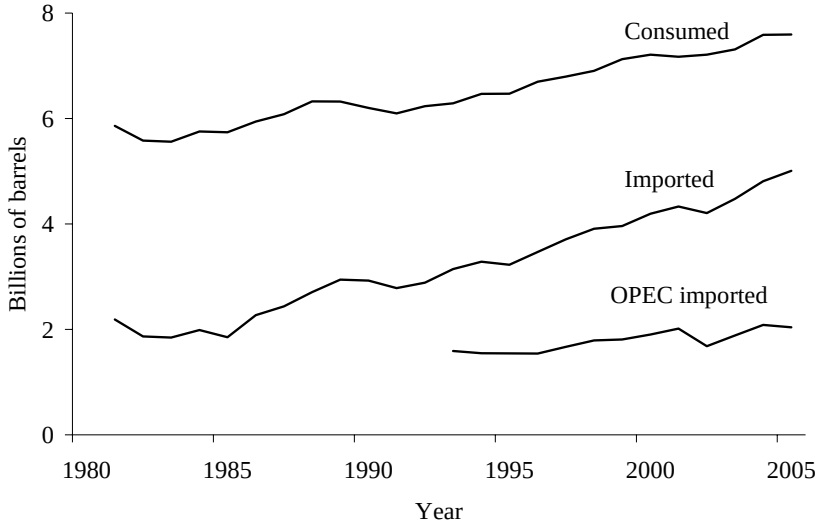
[86] In fact, some scholars worry that the increased attention to ethanol takes focus away from real solutions such as wind, solar, and hydrogen fuel cell technology. *See* Tad W. Patzek, *Thermodynamics of the Corn-Ethanol Biofuel Cycle*, 23 CRITICAL REVIEWS IN PLANT SCIENCES 519, 559-60 (2004). Cellulosic ethanol may be more promising because it requires less inputs and could be produced on land with little agricultural value, but current technology make it costs ineffective. *See* Hill et al., *supra* note 70, at 11208. 11208-09.

[87] *See* DOUGLAS R. BOHI & MICHAEL A. TOMAN, THE ECONOMICS OF ENERGY SECURITY (1995). *See also* Shimon Awerbuch, *Portfolio-Based Electricity Generation Planning: Policy Implications for Renewables and Energy Security*, 11 MITIGATION AND ADAPTATION STRATEGIES FOR GLOBAL CHANGE 693 (2006); David L. Greene & Paul N. Leiby, *The Oil Security Metrics Model: A Tool for Evaluating the Prospective Oil Security Benefits of DOE's Energy Efficiency and Renewable Energy R&D Programs*, U.S. Department of Energy (DOE) ORNL/TM-2006/505 (2006) *available at* http://www-cta.ornl.gov/cta/Publications/Reports/ORNL_TM_2006_505.pdf. This idea is sometimes called energy independence because it strives to make the U.S. independent of foreign energy.

[88] *See* BOHI & TOMAN, *supra* note 87, at 1-3.

[89] Some scholars, however, are concerned with ethanol's contribution to overall energy security. There is debate about whether more energy is consumed in ethanol production than can be derived from ethanol itself. See Hammerschlag, *supra* note 61 and Farrell et al., *supra* note 60, for a survey of the literature. Even the most optimistic estimates show small gains in net energy through ethanol (about 30 percent). *See* Hosein Shapouri et al.,*The Energy Balance of Corn Ethanol: An Update*, U.S. Department of Agriculture (USDA) AER814 10-11 (2002) *available at* .http://www.usda.gov/oce/reports/energy/aer-814.pdf.

[90] *See* Energy Information Administration (EIA), *Forecasts & Analyses: U. S. Data Projections* (2007) at Table 11, *available at* http://www.eia.doe.gov/oiaf/forecasting.html. Energy security is also often used as a defense for the tariff on Brazilian ethanol. See Grassley, *supra* note 66, who believes that not developing our domestic ethanol production could just shift us from one kind of dependence, i.e. dependence on foreign oil, to another, i.e. dependence on foreign ethanol. In 2006, the U.S. imported 653.3 million gallons of ethanol, 66 percent of which was from Brazil.




Source: U.S. Energy Information Administration

The value of decreased oil imports, called the oil premium, is based on the benefit associated with U.S. buying power in the oil market, and the avoided costs of economic shocks. I explain these potential benefits below.

The first potential benefit that I consider is associated with U.S. buying power in the oil market.[91] Because the U.S. is a large importer of oil, a reduction in U.S. oil imports could lead to a reduction in the world price of oil. If so, the U.S. would then pay less for the oil it still imports. This benefit is some-

[91] I do not include a value for reductions in the direct cost of protecting oil in the Middle East because these costs are difficult to estimate. The U.S. involvement in the Middle East is not just related to oil. *See* BOHI & TOMAN, *supra* note 87, at 25-26; Ian W.H. Parry & Joel Darmstadter, *The Costs of U.S. Oil Dependency* (Resources for the Future, Discussion Paper No. 03-59, 2003). 19-20. I also do not include a value for reduced military expenditures. Delucchi and Murphy suggest an average value between 2 and 18 cents per gallon of all gasoline and diesel motor fuel in 2004. *See* Mark A. Delucchi & James Murphy, *U.S. Military Expenditures to Protect the Use of Persian-Gulf Oil for Motor Vehicle*, Report #15 in the series: *The Annualized Social Cost of Motor-Vehicle Use in the United States*, based on 1990-1991 Data, UCD-ITS-RR-96-3 (15)2 (2004). The Renewable Fuels Association estimates that the U.S. spends about $50 billion each year for military protection of Middle East oil supplies, but it does not specify how it arrives at this estimate. *See* Renewable Fuels Association, Ethanol Facts: Energy Security http://www.ethanolrfa.org/resource/facts/energy/. Even if the percentage of total military expenses devoted to oil protection were known, it would be almost impossible to know the *incremental* cost associated with each additional unit of oil the U.S. imports from the area. We do not include a value for reduced military expenditures because we believe that this value is likely to be small or negligible at the margin. *See* Taylor & Van Doren, supra note 8 (who also do not include reduced military spending when calculating the benefits of reducing our demand for foreign oil). Another possible benefit of reducing the U.S. oil purchases is less funding for terrorist activities that could adversely impact the U.S. We do not include this potential benefit because we are not aware of any scholarly effort to monetize it on a per barrel basis.

times referred to as the monopsony benefit.[92]

In addition, energy dependence can impose costs through the economic shocks of sudden oil price increases.[93] In the 1970s, there were two major oil crises. In both cases, instability and war in the Middle East led to high gasoline prices, which were followed by unemployment and inflation in the U.S.[94] Although there may be an empirical link between oil price increases and economic slumps, the exact mechanism is unclear.[95] Some scholars, such as Bohi, believe that factors other than energy price shocks contributed greatly to the extensive declines in output and employment.[96] Kilian, as well as Blanchard and Gali, suggest that today's economy may be more resilient to shocks than the economy of the 1970s.[97]

Even if oil price shocks have a significant adverse impact on the U.S. economy, importing less oil is only a partial solution. The influence of oil shocks depends on petroleum consumption in the U.S. and not on U.S. oil imports.[98] The U.S. economy could still react negatively to abruptly changing world oil prices if all U.S. oil imports were eliminated, especially if consumption were not lowered.[99] Moreover, relying solely on domestic production is not feasible in the near future. The costs of increasing domestic energy supplies or increasing the efficiency of energy consumption are prohibitive.[100]

According to Toman, a good way to promote energy security is to decrease U.S. dependence on gasoline in general by increasing the use of other fuels and energy systems in transportation.[101] One strategy is to subsidize either the production or development of "alternative" fuels, such as ethanol.

People frequently point to Brazil as an example of a country that is promoting energy security through ethanol. By law, Brazilian gasoline must have 20 to 25 percent ethanol in it.[102]

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[92] Harry G. Broadman, *The Social Cost of Imported Oil. Energy Policy.* 14(3) ENERGY POLICY 242 (1986).

[93] B.G. HICKMAN ET AL, MACROECONOMIC IMPACTS OF ENERGY SHOCKS (1987). *See also* Greene & Leiby, *supra* note 82, at 3-10.

[94] *See* Robert B. Barsky & Lutz Kilian, *Oil and the Macroeconomy since the 1970s*, 18(4) J. OF ECON. PERSP. 115, 115-134115-118 (2004).

[95] Toman, *supra* note 66; Barsky & Kilian, *supra* note 94, at 118-125.

[96] Douglas.R. Bohi, *Energy Price Shocks and Macroeconomic Performance*, Resources for the Future (1990); Olivier J. Blanchard & Jordi Gali, *The Macroeconomic Effects of Oil Shocks: Why are the 2000s So Different from the 1970s?*, NBER Working Paper No. 13368 (2007). *See also* Barsky & Kilian, *supra* note 94, at 132-33, who arrive at a similar conclusion.

[97] Lutz Kilian, *Exogenous Oil Supply Shocks: How Big Are They and How Much Do They Matter for the U.S. Economy?*, University of Michigan, CEPR, Working Paper (2006), *available at* http://www-personal.umich.edu/~lkilian/ms10853r1.pdf; Blanchard & Gali, *supra* note 96.

[98] Toman, *supra* note 66.

[99] *Id.*

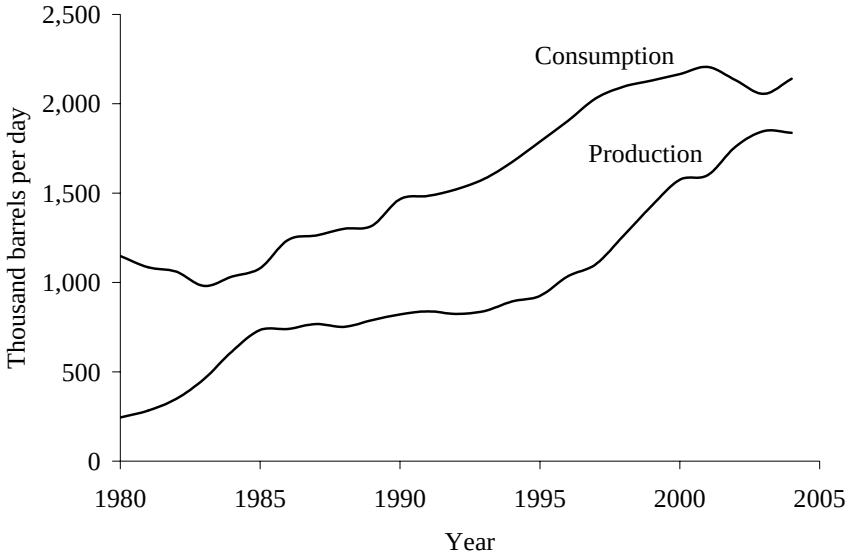
[100] *Id.*

[101] Toman at 66; *see also* Shimon Awerbuch, *Portfolio-Based Electricity Generation Planning: Policy Implications for Renewables and Energy Security*, 11(3) MITIGATION AND ADAPTATION STRATEGIES FOR GLOBAL CHANGE 693, 693-710 (2006).

[102] *See* RFA, *Ethanol Facts*, *supra* note 47.

The Brazilian experience is not easily transferred to other countries. Even if it could be transferred, it is not without its problems. For example, Brazilian ethanol is much cheaper to produce than U.S. ethanol because it is made primarily from sugarcane and not from corn, which is cheap to grow in Brazil and produces more gallons of ethanol per acre.[103] Second, Brazilian ethanol releases less carbon dioxide, a subset of greenhouse gases, because less energy is used to convert sugarcane into ethanol than is used to convert corn into ethanol.[104] Finally, as Figure 3 suggests, Brazil has been increasing its domestic production of oil, which has been a major factor in its reduced dependence on foreign sources.

Figure 3: Brazil Oil Consumption and Production, 1980-2004




Source: Energy Information Administration, International Energy Annual 2004, World Petroleum Data, Table 1.2 and G.2.

Since almost all future production of ethanol is currently based on corn, it is unlikely that ethanol can make the U.S. energy independent. President Bush's plan to reduce gasoline consumption by 20% in ten years is simply not feasible through corn ethanol.[105] The current ethanol program uses about 15% of U.S. corn supplies and makes up about 3% of gasoline consumption.[106] Ac-

[103] Dias de Oliveira et al., *supra* note 49.

[104] Even including the greater carbon dioxide reductions from sugarcane ethanol, some scholars have found that it would be more environmentally beneficial to decrease the rate of deforestation in Brazil than to plant sugarcane. *See* Dias de Oliveira et al, *supra* note 49, at 598-601. They conclude simply saying that no ethanol can alleviate dependence on petroleum. *Id*,. at 601. This is in line with conclusions by Pimentel, *supra* note 81, and Patzek, *supra* note 86.

[105] Hill et al., *supra* note 70.

[106] GAO, *DOE Lacks a Strategic Approach*, *supra* note 83, at 14. On an energy equivalent

cording to a study by the Government Accountability Office, this small percentage of gasoline displacement has not significantly enhanced U.S. energy security.[107]

Ethanol from corn does not currently contribute much to energy security and is not likely to do so in the future. According to Hill et al., using all the corn produced in the U.S. in 2005 for ethanol production would only offset 12% of gasoline and diesel demand.[108] Dias de Oliveira et al. calculate that all available cropland in the U.S. would have to be used for corn production if all vehicles are to run on E85. By 2048, the entire country would need to be filled with corn plantations.[109] The maximum amount of ethanol that can be produced from corn supplies is about 15 to 16 billion gallons, which is equivalent to approximately nine percent of conventional motor gasoline supplied in 2005.[110] Due to projected increases in the demand for gasoline, the Energy Information Administration estimates that ethanol will actually likely account for only 7.6% of total gasoline use in 2030.[111] Neither the President's plan, nor any other large scale plan to introduce corn ethanol, is likely to have a dramatic impact on the type of fuel used by most domestic vehicles. Expanded ethanol use could, however, be part of a larger strategy aimed at reducing dependence on oil.

### C. CELLULOSIC ETHANOL

One way that ethanol could contribute more to energy security is if it were made from something other than corn. In fact, some environmentalists support current corn ethanol production because they see it as a stepping stone to cellulosic ethanol. The Bush administration specifically mentions the importance of cellulosic ethanol in their plan's feasibility.[112]

Cellulosic ethanol is believed to be better for the environment and may ac-

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basis, it made up only about 2% of gasoline used in 2006. *See also* GAO, *Tax Policy*, *supra* note 19, at 7.

[107] GAO, *Tax Policy*, *supra* note 19, at 6. Some studies, however, value per barrel oil reductions highly and would perceive this small reduction as valuable due to decreased oil prices. *See* Paul N. Leiby, *Estimating the Energy Security Benefits of Reduced U.S. Oil Imports*, U.S. Department of Energy (DOE) ORNL/TM-2007/028 (2007).

[108] Hill et al., *supra* note 70. This is equivalent to 2.5 percent of gasoline and diesel consumption because of the fossil energy required to produce ethanol and biodiesel. Importantly, the 12 percent is likely to be an upper bound because some corn would be needed for human and animal consumption.

[109] Dias de Oliveira et al., *supra* note 49, at 600-01.

[110] *See* GAO, *DOE Lacks a Strategic Approach*, *supra* note 83. In the short run, however, the maximum amount of ethanol demanded in fuel might be even lower. Keith Collins, the Chief Economist of the U.S. Department of Agriculture, estimates the practical limit of ethanol demand to be less than 14 billion gallons, based on calculations of how much ethanol would be required if every vehicle ran on 10 percent ethanol. *See Agriculture and Rural America's Role in Enhancing National Energy Security: Hearing Before the S. Comm. on Agriculture, Nutrition & Forestry*, 110th Cong. (2007) (statement of Keith Collins, Chief Economist, U.S. Department of Agriculture).

[111] As cited in GAO, *DOE Lacks a Strategic Approach*, *supra* note 83, at 14

[112] Bush, *supra* note 1.

tually achieve some energy security for the U.S. In fact, a Department of Energy study cited by the Government Accountability Office estimates that there is sufficient biomass in wood chips and corn stalks to potentially produce about 60 billion gallons of ethanol per year by 2030, which would be about 30 percent of the amount of gasoline consumption projected by the Energy Information Administration for 2030.[113]

Although money for research and development for cellulosic ethanol has increased in recent years, cellulosic has not received nearly the support in the form of tax credits and other incentives that has been given to current corn ethanol production.

This section has reviewed general arguments in favor of intervening in markets to support the production of ethanol. The next section takes a closer look at the benefits and costs of supporting ethanol production from an economic point of view.

## IV. BENEFITS AND COSTS OF THE U.S. ETHANOL PROGRAM

The potential benefits of supporting ethanol include energy security and environmental benefits. The potential costs include the increased cost of producing the fuel relative to producing or purchasing petroleum. In addition, there are likely to be some environmental costs as well. I consider these in turn. My primary interest here is in quantifying those costs and benefits that can be measured with some degree of certainty. I also identify some potential costs and benefits that are not easily quantified.

The costs to date, in terms of plant infrastructure and increased corn plantings, have been high.[114] The benefits appear to be low, based on the relatively small amount of gasoline displacement and the uncertain air quality benefits. While a complete benefit-cost test of the ethanol program to date has not been done, I believe that the high costs of the program were likely to have exceeded any benefits.[115] Though unlikely to have resulted in net benefits in the past, some scholars believe that advances in technology will make corn ethanol pro-

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[113] As cited by GAO, *DOE Lacks a Strategic Approach supra* note 83, at 18. Using this ethanol would require investment in flex-fuel vehicles. *See* Collins, *supra* note 110.

[114] I do not take into account government subsidies here. A 1986 study by the U.S. Department of Agriculture is worth noting because it was one of the first negative assessments of the ethanol program released by the government. Earle E. Gavett et al., *Fuel Ethanol and Agriculture: An Economic Assessment*, U.S. Department of Agriculture (USDA) AER0562 (1986). The study concluded that the ethanol industry is likely to cost the government, taxpayers, and consumers billions of dollars in the future if it is allowed to continue. In fact, decreasing ethanol production to zero would save consumers $7 to $9 billion dollars. According to the study, if the goal of subsidizing ethanol is to raise farm income, it would be more economical for the government to just directly pay farmers the amount they would get from the ethanol subsidy. *Id.* at iv-v.

[115] This is my judgment since I believe that costs, if anything, were higher in the past than they are now and benefits were likely to be on the same order as now. Some scholars may disagree. Miranowski, for example, does not believe that ethanol offers net benefits going forward but might have been net beneficial in the past. *See* Miranowski, *supra* note 37. Miranowski does not monetize any impacts.

duction more cost-effective. They point to the experience of Brazil, whose sugarcane ethanol industry may have experienced cost savings over time. I focus my analysis on the likely benefits and costs of existing policies.[116] I present a detailed analysis of the ethanol industry in 2012, taking many of the Environmental Protection Agency's optimistic assumptions as given.[117] I find that costs are much more likely to exceed benefits even when I account for various uncertainties about the cost-benefit numbers. Below I provide some details about the monetized costs and benefits, including our reservations about some of the estimates.

## A. BENEFITS

The quantifiable benefits of increased ethanol use include those related to energy security and the environment.[118] The Environmental Protection Agency models both the oil displacement and greenhouse gas (GHG) reductions in its regulatory impact analysis.[119] I monetize these impacts using estimates obtained from the literature.[120] The impacts are defined as the changes resulting from increasing ethanol production from the baseline of four billion gallons per year to the renewable fuels standard (RFS) of almost seven billion gallons per year. The Environmental Protection agency also considers a second scenario where ethanol production reaches almost ten billion gallons per year, called the Energy Information Agency (EIA) scenario. That is the level of production that the Energy Information Agency predicts ethanol will reach by 2012 if current subsidies remain in place.[121]

Figure 4 below shows the increasing benefits, ranging from about $300 million for the RFS scenario and more than $600 million for the EIA sce-

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[116] There have been other attempts to monetize some of the impacts of ethanol, but some do not monetize impacts or focus on a part of the program. *See, e.g.*, Matthew McCormick et al. *A Federal Ethanol Mandate: Is it Worth it? If Not, Why is it so Popular?*, Reason Pub. Pol'y Inst. Policy Study No. 315 (2003) *available at* http://72.10.40.168/ps315.pdf; *see also* Miranowski *supra* note 37.

[117] The assumptions are described in more detail in Hahn and Cecot. *See* Robert W. Hahn & Caroline Cecot, *The Benefits and Costs of Ethanol*, AEI-Brookings Joint Center Working Paper 07-17 (2007).

[118] We value the greenhouse gas emissions at values accepted for carbon dioxide emission reductions, since the greenhouse gas estimates were presented as carbon dioxide equivalent tons. The third benefit category not shown separately is the decreased emissions of hydrocarbons such as benzene. These benefits are included in the total benefits, but were not shown separately because they were very small relative to the other benefit categories.

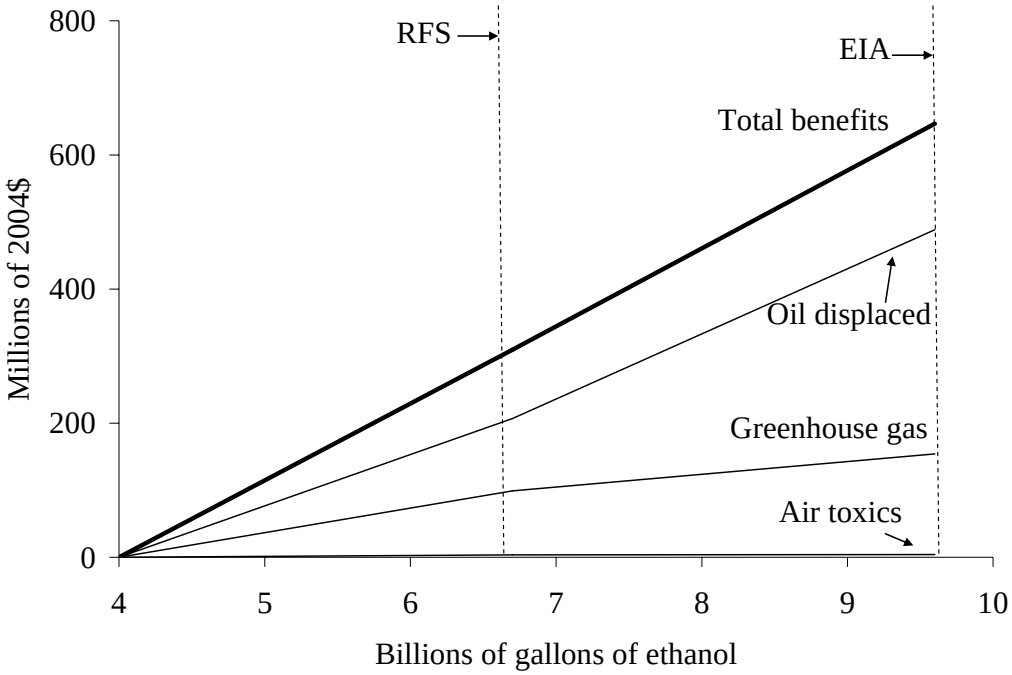
[119] *See* EPA, *RIA*, *supra* note 9.

[120] To monetize energy security, we multiply the projected displacement of oil by the average value per dollar according to the literature. The estimate is driven up by the high estimates of Leiby, *supra* note 107, which take into account the resulting falling price of gasoline. The Environmental Protection Agency's estimate of gasoline displacement assumes that the price of gasoline remains constant; hence, the Leiby estimates may overstate the benefits. The emission and greenhouse gas data was valued at accepted values from the literature. See longer version of paper for details.

[121] The Energy Information Administration predicts even higher production of ethanol in its 2007 energy outlook. *See* EIA, *Annual Outlook 2007*, *supra* note 17 at Table A17, converted from quadrillion Btus

nario.[122] I linearly extrapolate benefits between the three points, the origin, the RFS scenario, and the EIA scenario to estimate trends. The graph also shows the relative contributions of oil displacement, greenhouse gas reductions, and air toxic emission reductions.[123]

Figure 4: Benefits of Increased Ethanol Production




Source: Environmental Protection Agency and author's calculations.
Notes: Benefits relative to a baseline of four billion gallons of ethanol. Total benefits are the sum of the oil, greenhouse gas, and air toxic reduction benefits..

## B. COSTS

Figure 5 provides estimates the future costs of increased ethanol production. Unlike in many benefit-cost analyses, the costs in the case of ethanol include more than just monetary costs. The costs also include the values of the negative air quality impacts associated with increased ethanol. As before, I use the Environmental Protection Agency's best estimates for the production cost and the increased emissions from ethanol production and use.[124]

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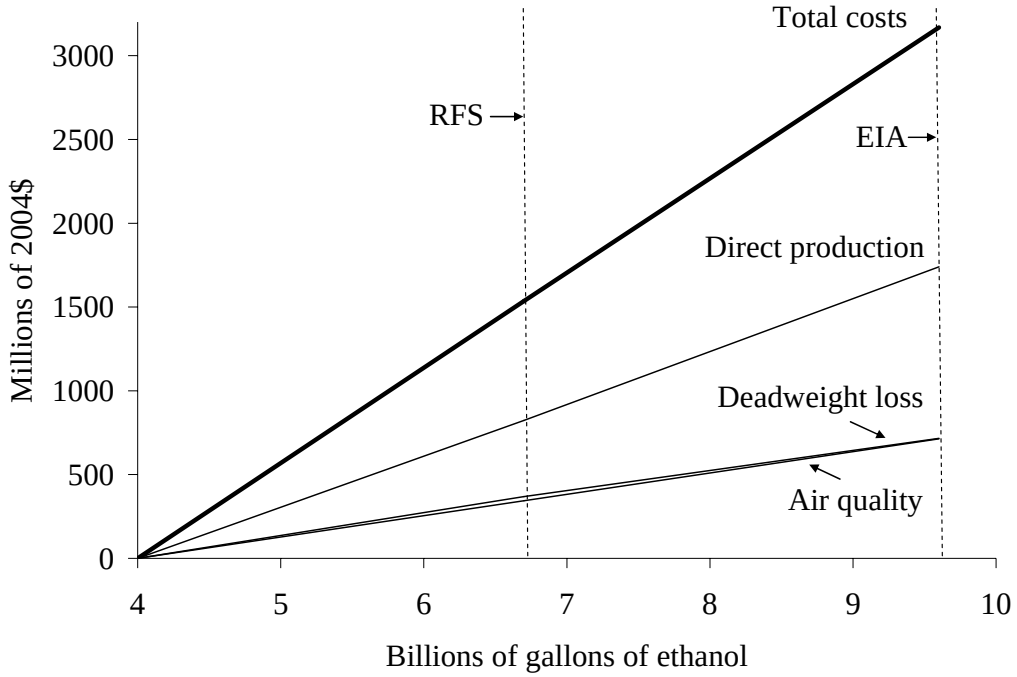
[122] These estimates are likely to be over-estimates. See Hahn & Cecot, *supra* note 117, for a fuller discussion about the likely range of the results.
[123] Air toxics benefits make us less than 1% of total benefits.
[124] Significantly, the average value used to monetize increased nitrogen oxides emissions (around $3,000 per ton) is much lower than the value the Environmental Protection Agency suggests in the regulatory impact analysis ($8,000 per ton) because we use the average value from many published studies. Other increased air toxics include volatile organic compounds,

Figure 5 summarizes the total costs.[125] The total costs are significantly higher than the total benefits, ranging from about $1.5 billion for the RFS scenario to about $3 billion for the EIA scenario. The main costs are the direct production costs associated with the fuel changes resulting from expanded use of ethanol over oil, the excess burden associated with the government subsidies, and the negative air quality impacts, most importantly the increased nitrogen oxides emissions from ethanol use that contribute to fine particulate matter formation, which can have negative human health effects.[126]

Figure 5: Costs of Increased Ethanol Production




Source: Environmental Protection Agency and author's calculations.
Notes: Costs relative to a baseline of four billion gallons of ethanol. Total costs are the sum of the production cost, the deadweight loss, and the air quality cost.

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particulate matter-10, and sulfur oxides, which are valued at about $1,400, $500, and $6,500 per ton, respectively. Increases in acetaldehyde are worrisome for some scholars, but we could not find a value for them. The excess burden was valued at 25 percent of the value of the subsidies, following OMB Circular A-94, *available at* .http://www.whitehouse.gov/omb/circulars/a094/a094.html.

[125] I assume here that farmers get no support in the status quo. If deficiency payments were the alternative, I would have to compare the decrease in the payments going to farmers with the ethanol subsidy and without. *See* Gardner, *Fuel Ethanol Subsidies*, *supra* note 19 (discussing the relative merits of each as a farm price support).

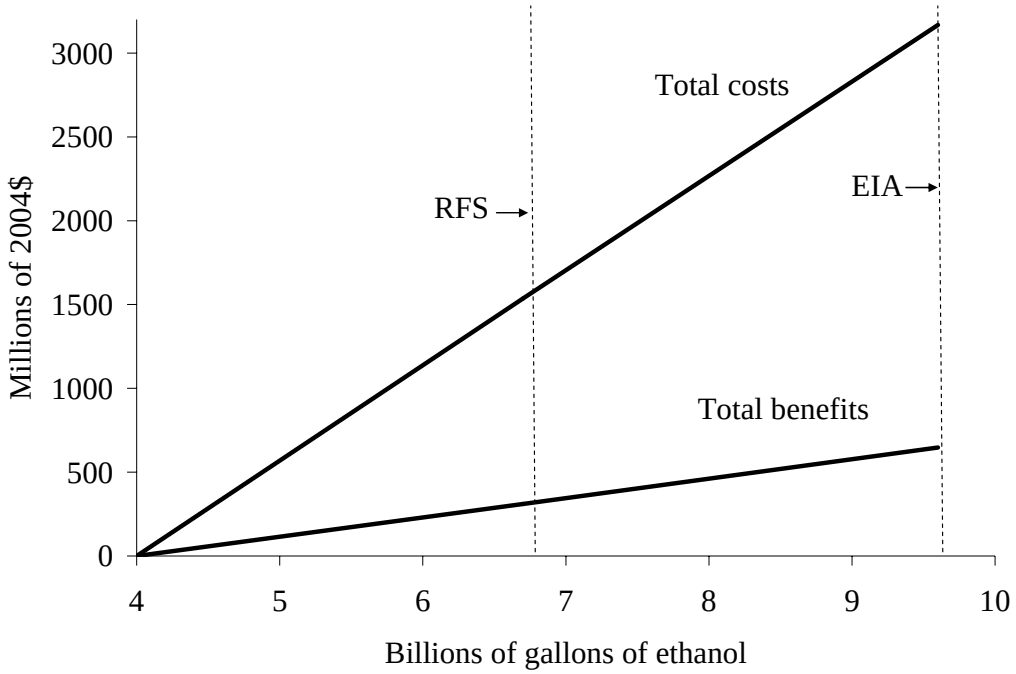
[126] *See* EPA, *RIA*, *supra* note 9, at 322. These health effects include changes in mortality risk, chronic bronchitis, nonfatal heart attacks, respiratory hospital admissions, and asthma attacks.

Air quality costs and deadweight loss costs are distinct, although they happen to coincide.

## C. Benefits and Costs

Figure 6 shows the relative levels of total costs and total benefits under the two scenarios.

Figure 6: Benefits and Costs of Increased Ethanol Production




Source: Environmental Protection Agency and author's calculations.
Notes: Benefits and costs relative to a baseline of four billion gallons of ethanol. RFS and EIA scenarios are discussed in text.

The results suggest that production of ethanol over four billion gallons will cost society much more than it will benefit society. Unlike in many benefit-cost analyses, the costs in the case of ethanol include more than just monetary costs; the costs also include the values of the negative air quality impacts associated with increased ethanol.

I believe the actual net benefits would be lower than those estimated here for a number of reasons related to the Environmental Protection Agency's methodology. For example, I noted previously that the agency estimates that one energy unit of ethanol displaces one energy unit of gasoline, assuming that the price of oil will remain constant. If the price of oil decreases, oil use might

increase more than expected, resulting in a displacement that is less than one to one. This is further complicated by my use of a high average value for oil displacement.[127] Thus, my estimate of energy security benefits is likely to be overstated.

The Environmental Protection Agency also estimates the carbon dioxide and other greenhouse gas benefits without taking into account more marginal corn land use and international effects of increased ethanol use in the U.S. As the value of corn increases, more corn will be planted.[128] Some of this land will come from decreased plantings of soybean and cotton.[129] Other land will come from land that was previously set aside for biodiversity or other purposes under conservation reserve contracts.[130] This land may be overworked or less suitable for farming, meaning that the marginal costs and energy used to produce more gallons of ethanol are likely to increase. This also means that the carbon dioxide released during production is likely to increase. International effects are also important because, as the price of oil decreases due to lower U.S. imports, consumption around the world might increase, especially in underdeveloped countries. Greenhouse gas emissions are ultimately a global problem and the international impacts may offset, or even exceed, some of the gains in carbon dioxide reductions in the U.S. Finally, the agency might not have adequately accounted for increased nitrous oxide emissions, which may outweigh the carbon dioxide reductions and lead to net increases in greenhouse gas emissions.[131]

In addition to these main concerns, many negative impacts were not monetized in the above analysis due to difficulties in estimating their value. These include land use change, biodiversity loss, groundwater contamination (especially its role in increasing the "dead zone" in the Gulf of Mexico), soil erosion, heavy water use, acidification, and international effects in general. Also, the focus on ethanol as a way to reduce greenhouse gases may make it difficult for policy makers to select better climate policy options later. For example, once an ethanol plant is built, it will be hard for a politician to close it down by withdrawing the subsidy. The bottom line is that the net costs of ethanol could be substantially larger than I have estimated here.

Even when I take into account large uncertainties in some of the estimates using, both the EIA scenario and the RFS scenario still produce costs in excess of benefits more than 99%of the time. I demonstrate this by running a Monte Carlo simulation of 2,500 trials for both the RFS and the EIA scenarios.[132] The simulation selects probability distributions for key parameters and then esti-

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[127] My estimate is an average of the estimates in the literature. I include the Leiby estimate, which is much higher than the other estimates and drives up my average. *See* Leiby, *supra* note 107.

[128] *See* Westcott, *supra* note 43.

[129] *Id.*

[130] *Id.*

[131] *See* Crutzen et al., *supra* note 8.

[132] We used @Risk to run the analysis. The data had converged after 2,500 trials. The details of this simulation are described in a more technical paper. *See* Hahn & Cecot, *supra* note 117.

mates the benefits and costs based on those distributions.[133]

For the RFS scenario, the uncertainty analysis yielded a mean net benefit of negative $1.5 billion with a standard deviation of about $700 million. The net benefits were negative in more than 99%of the trials.

For the EIA scenario, the uncertainty analysis yielded a mean net benefit of negative $3 billion with a standard deviation of about $1.5 billion. The net benefit was negative in more than 97%of the trials. Our analysis strongly suggests that it is very unlikely that increasing ethanol production to the level fostered by current subsidies will result in net benefits for society. Most likely, society will incur costs that are hundreds of millions of dollars greater than the benefits.

## V. THE POLITICS OF ETHANOL SUPPORT

### *A. The Interest Group Framework*

Given the questionable environmental and energy security benefits of ethanol, the high level of political and public support may seem puzzling. In fact, much of the political support for ethanol can be explained using public choice theory.[134] This theory examines the motivations of individuals, interest groups and politicians to help explain policy outcomes. In this framework, ongoing farm policy is the logical result of political pressures from agricultural interest groups that have a strong interest in enacting and maintaining support through subsidies and other means.[135] In some cases, these groups are able to exert influence because the benefits of such policies are concentrated but the costs are diffuse.[136]

The corn lobby appears to be very strong. For example, the National Corn

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[133] These distributions depend on the literature. For example, if the literature presents a best estimate and high and low values for an input, we use a triangular probability distribution.

[134] For a general theory of interest group politics, see Gary S. Becker, *A Theory of Competition Among Pressure Groups for Political Influence*, 98(3) Q. J. OF ECON. 371, 371-400 (1983). Other theories include the ethnocentric theory and the social contract theory. *See* BRUCE GARDNER, PLOWING GROUND IN WASHINGTON: THE POLITICAL ECONOMY OF US AGRICULTURE (Pacific Research Institute 1995); Robert Paarlberg, *The Political Economy of American Agricultural Policy: Three Approaches*, 71(5) AM. J. OF AGRIC. ECON. 1157, 1157--64 (1989). The ethnocentric theory argues that agricultural protection is something uniquely American, stemming from America's history or philosophy. Since many Americans can trace their roots back to farmers, they have a romanticized view of farming and support the government transfer systems. This theory has been largely discredited since it does not explain the pervasiveness of agricultural subsidies around the world, especially in countries without the history of farming that exists in the U.S. Another theory, the social contract theory, describes farm programs as agreements made by the public and farmers for mutual benefit. Robert Paarlberg, *supra*, at 1162, notes that the social contract theory helps explain the uniquely American practice of paying farmers to keep land idle for environmental reasons. Though the social contract theory is useful, it is not clear why it would be in the interest of the average consumer to subsidize farmers in general.

[135] See Gardner, *Fuel Ethanol Subsidies*, *supra* note 19, at 13-14.

[136] MANCUR OLSON, JR., THE LOGIC OF COLLECTIVE ACTION: PUBLIC GOODS AND THE THEORY OF GROUPS, (Harvard University Press 1965).

Growers Association and the Corn Refiners Association have spent about $9 million in lobbying expenditures between 1998 and 2007.[137] Corn-related political action committees regularly donate to political parties and election campaigns.[138] These groups support ethanol because ethanol raises the demand for corn, leading to higher corn prices and higher revenues for farm growers.[139] In addition, those farmers that own land benefit from increased land prices due to the increased value of corn production.[140]

The reason these powerful interest groups support ethanol instead of direct payments to corn farmers may be political. Gardner finds that in most cases, direct deficiency payments are more beneficial to farmers than an ethanol subsidy.[141] He hypothesizes that farmers may focus on supporting ethanol in order to get additional lobbying assistance from ethanol producers. Over the last ten years, large organizations supporting ethanol, such as the Renewable Fuels Association, the National Ethanol Vehicle Coalition, the Clean Fuels Development Coalition, and the American Coalition for Ethanol have spent over $3 million in lobbying expenditures.[142] Ethanol producers represent a strong interest group. So far in 2007, just four ethanol producers spent almost one million dollars on lobbying.[143]

By far the most powerful ethanol producer is Archer Daniels Midland.[144] In 1996, Dwayne Andreas, the chairman of Archer Daniels Midland, asserted: "We do not lobby. We have no lobbyist. We never lobby. Archer Daniels Midland has never lobbied in the 25 years since I've been here."[145] This has since changed. Already in 2007, Archer Daniels Midland has spent almost half a million dollars in lobbying expenditures. Furthermore, Archer Daniels Midland has given generously to organizations that lobby in favor of ethanol subsidies for many years. Over the last nine election cycles, Archer Daniels Midland has donated almost $8 million, mostly through soft money contributions when those were allowed, and more recently through political action committees and individuals.[146]

One example of Archer Daniels Midland's influence occurred in 1986, when the price of corn had risen and the price of gasoline had fallen, leading to

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[137] *See* Center for Responsive Politics, *available at* http://www.opensecrets.org/.

[138] *Id.* Political action committees are committees seeking to elect and defeat candidates.

[139] See Westcott, *supra* note 43.

[140] *Id.* Also, sugar farmers now want to come into the game as well. They would want specific support for sugar ethanol. This would also serve to increase ethanol supply in general.

[141] Gardner, *Fuel Ethanol Subsidies*, *supra* note 19, at 4.

[142] *See* Center for Responsive Politics, *supra* note 137.

[143] *Id.* The four producers are Abengoa Bioenergy Corp, Archer Daniels Midland, E3 Biofuels, and First United Ethanol, LLC.

[144] *See* James Bovard, *Archer Daniels Midland: A Case Study in Corporate Welfare*, Cato Inst. Policy Analysis No. 241 (1995) *available at* http://www.cato.org/pubs/pas/pa-241.html.

[145] Nancy Watzman et al., *Cashing In: A Guide to Money, Votes, and Public Policy in the 104th Congress*, Center for Responsive Politics (1997). See *Archer-Daniels-Midland: Ethanol & Sugar Subsidies*, *available at* http://www.opensecrets.org/pubs/cashingin_104th/18adm.html [hereinafter *ADM: Ethanol*].

[146] *See* Center for Responsive Politics, *supra* note 137.

difficult conditions for ethanol producers.[147] After meeting with Andreas, then U.S. Department of Agriculture secretary Richard Lyng announced a program under which ethanol producers would receive free corn, with Archer Daniels Midland receiving almost $30 million dollars worth of it. The influence of Archer Daniels Midland became apparent again in 1995, when the House Ways and Means Committee voted to end the ethanol tax credit. According to the Center for Responsive Politics, lobbying by the ethanol industry forced the House Committee chairman to yield and, in 1996, Congress voted to extend the tax credit.[148]

Working together, farm growers and ethanol producers form a formidable group. The Center for Responsive Politics gives the example of an amendment sponsored by Senators Schumer and Feinstein in 2001 that would have eliminated a provision that gave preference for ethanol as a fuel additive.[149] The original provision was strongly supported by interest groups such as the National Corn Growers Association and Archer Daniels Midland. Together, the two groups spent almost a million dollars in contributions and lobbying expenditures. The amendment failed. Though stories like these do not prove a relationship, they do suggest that pro-ethanol interest groups wield a considerable amount of power.

There is another important reason policies to promote ethanol may receive widespread political support. It is not only supported by interest groups who directly profit from such government intervention, but also by some interest groups concerned with energy security and the environment that primarily support cellulosic ethanol in particular.[150] Johnson and Libecap describe how politicians, who have an incentive to obtain strong interest group support, sustain subsidies by presenting them as broadly beneficial.[151] Yandle, in his 1983 theory of "bootleggers and Baptists," argues that social regulations last when they are demanded by Baptists, or those in favor of public benefits from it, and bootleggers, or those who stand to profit from it.[152] Ethanol lends itself to support from both kinds of interest groups because of its profit potential for specific groups as well as its perceived contributions to energy security and to global warming abatement. Other scholars have noticed this tendency in the political advertisement of programs such as the space shuttle program, which emphasized technology spinoffs, and the oil import quota of the 1960s, which empha-

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[147] See Bovard, *supra* note 144.

[148] See *ADM: Ethanol*, *supra* note 145.

[149] *Energy: Key Senate Votes During the Debate of the Bush Energy Plan*, *available at* http://www.opensecrets.org/payback/amendments.asp?issueid=EN1&congno=107&billnum=S.+517.

[150] Jim Snyder, *Biofuels 'juggernaut' makes some nervous*, The Hill, June 29 (2007).

[151] Ronald N. Johnson & Gary D. Libecap, *Information Distortion and Competitive Remedies in Government Transfer Programs: The Case of Ethanol*, 2(2) ECON. OF GOVERNANCE, 101-134 (2001). One study finds little relationship between money and votes in Congress. See Stephen Ansolabehere et al., *Why is there so Little Money in U.S. Politics?*, 17(1) J. OF ECON. PERSP., 105-130 (2003).

[152] Bruce Yandle, *Bootleggers and Baptists: The Education of a Regulatory Economist*, 7(3) REG. 12 (1983).

sized energy security.[153] Unbiased information, according to Johnson and Libecap, may emerge if another group mobilizes opposition and sponsors research.[154] Johnson and Libecap cite ethanol as a case in point for their theories. They present evidence that negative research about ethanol was suppressed, such as a 1986 study by the U.S. Department of Agriculture explaining the high costs of ethanol to taxpayers, because there was not much opposition to the ethanol lobby.[155]

Perhaps the most convincing evidence of the effect of interest group competition is Johnson and Libecap's account of the circumstances surrounding the use of ethanol over MTBE as a fuel oxygenate.[156] The Clean Air Act originally had a requirement that gave preference to ethanol as a fuel oxygenate, but this requirement was not enacted. The promotion of ethanol at the expense of MTBE brought powerful interest groups into the ethanol debate, specifically MTBE producers and natural gas producers. This led to a series of hearings in the House of Representatives where the previously unchallenged benefits of ethanol were challenged and the requirement was not passed.[157]

### *B. Will Support Continue*

There is now the potential for a change in interest group competition because of policies that could greatly affect the production of corn and corn ethanol. For example, many livestock producers are opposed to incentives for expanding ethanol production.[158] The reason behind their opposition has to do with the rising corn prices that have resulted in part from government programs supporting ethanol. Already, corn prices have risen from $2.00 per bushel in 2005 to about $3.50 per bushel in 2007.[159] The U.S. Department of Agriculture released agricultural projections to 2016 that describe the effect projected corn prices will have on other sectors.[160] If ethanol tax credits stay in place, corn is projected to rise to a high of $3.75 per bushel in 2009 and then slowly fall to $3.30 per bushel in 2016 as ethanol production slows and other sectors ad-

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[153] *See* Linda R. Cohen & Roger G. Noll, *The Technology Pork Barrel*, Brookings Institution Press (1991) and See Steve Isser, *The Economics and Politics of the United States Oil Industry, 1920-1990*, (Garland Publishing 1996).

[154] *See* Johnson & Libecap, *supra* note 151. Even then the scholars believe that inefficient policies can be maintained if the issue is very technical and voters find it difficult to evaluate competing information.

[155] *See* Gavett et al., *supra* note 114.

[156] *See* Johnson & Libecap, *supra* note 151, at 45.

[157] For details on the hearings, see Johnson & Libecap, *supra* note 151, at 46.

[158] *Ethanol Boom, Rising Prices Divide Corn Lobby*, ASSOCIATED PRESS, September 13 (2007), *available at* http://www.msnbc.msn.com/id/20760839/ [hereinafter *Ethanol Boom*].

[159] U.S. Department of Agriculture, *USDA Agricultural Projections to 2016*, Office of the Chief Economist, World Agricultural Outlook Board, Prepared by the Interagency Agricultural Projections Committee, Long-term Projections Report OCE-2007-1, (2007) at 38, http://www.usda.gov/oce/commodity/archive_projections/USDA%20Agricultural%20Projections%20to%202016.pdf [hereinafter USDA, *Projections*]. *See* also Westcott, *supra* note 43.

[160] *See* USDA, *Projections*, *supra* note 159.

just.[161] High corn prices translate into higher feedstock costs for livestock producers, leading to reduced meat production, especially in the first few years of rapidly increasing ethanol production.[162] The price of meat is expected to increase and the per capita consumption of meat to decrease, leading to lower revenues for meat producers.[163] Some livestock producers are expected to be hit harder than others. Animals such as beef and dairy cattle, for example, can use leftovers from ethanol production, called distillers dried grains or co-product, more readily than other animals, such as hogs and poultry.[164] In addition, though the use of the co-product will offset some of the costs for beef and dairy cattle, the potential effect on quality may be an important issue in the future.[165]

The opposition is speaking out against ethanol incentives. The executive director of the North Dakota Policy Council blamed government support of ethanol as the reason behind the shrinking profit margins of North Dakota livestock producers.[166] In fact, in June 2007, a coalition of livestock organizations revealed a new website called BalancedFoodandFuel.org meant to inform the public about the impact of ethanol policy.[167] The coalition members include the American Meat Institute, the National Chicken Council, the National Cattlemen's Beef Association, the National Meat Association, the National Milk Producers Federation, the National Pork Producers Council, the National Turkey Federation, and United Egg Producers.

The livestock interest groups have already shown that they can organize themselves and they have large resources to dispense in Washington. The eight members of the coalition that developed BalancedFoodandFuel.org spent over $16 million in the last ten years on lobbying expenses. In 2006 alone, they spent about $2.6 million. It appears that these organizations have the resources to be heard if they decide to enter the ethanol debate.[168] In various speeches in

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[161] *Id at 25.* If ethanol tax credits end, corn prices are not expected to rise as rapidly and will rest at about $3.00 per bushel in 2016.

[162] *See* Westcott, *supra* note 43, at 11.

[163] *See* Westcott, *supra* note 43, at 11. See also Amani Elobeid et al., *The Long-Run Impact of Corn-Based Ethanol on the Grain, Oilseed, and Livestock Sectors: A Preliminary Assessment*, Center for Agricultural and Rural Development, CARD Briefing Paper 06-BP 49 (2006), at 11, who state: "…pork and poultry producers who do not own shares in ethanol plants will lose." Some of the rural development due to ethanol production will be offset by the decreased livestock production.

[164] *See* Westcott, *supra* note 43, at 11.

[165] *See* Westcott, *supra* note 43, at 13.

[166] Brett Narloch, *Government & Ethanol: Cutting Taxes vs. Corporate Welfare*, North Dakota Policy Council, March 21 (2007), at 20-21, *available at* http://policynd.org/content/Ethanol%20Report.pdf. Other livestock groups, such as the American Meat Institute, publicly denounced increasing ethanol production. See *Ethanol Boom*, *supra* note 158.

[167] American Meat Institute, *Meat, Livestock and Poultry Coalition Launches Web Site Calling for Balanced Food and Fuel Policy*, press release, June 11 (2007), *available at* http://www.meatami.com/Template.cfm?Section=Archived_Statements&template=PressReleaseDisplay.cfm&PressReleaseID=3315..

[168] Importantly, however, Johnson and Libecap note that interest group competition does not necessary mean that the voters will correctly assess research. Ethanol may be the type of issue that is too technical for voters to correctly evaluate competing research. This will make it less likely that the increasing strength of livestock lobby will have an effect on voters' opin-

2007, President Bush acknowledged the increasing strain rising corn prices impose on many livestock producers and reiterated his hope for future advances in cellulosic ethanol technology.[169] The Center for Responsive Politics already thinks some effect of livestock lobbying is apparent. The 2007 energy bill requires increases in ethanol production from corn and other feedstocks, language that differs from past bills, which focused on corn ethanol.[170]

The political interest in supporting ethanol has been and continues to be strong. There are signs, however, that other interest groups could limit the popularity of extending certain kinds of policies. The trend appears to be towards a less positive view of ethanol. The political science literature on policy persistence suggests that it is much easier to start a subsidy program than to end one.[171] The import tariff expires at the end of 2008, while the tax credit expires at the end of 2010. The period between 2008 and 2010 is expected to mark the height of projected corn prices. I believe that it is likely that other interest groups will have some success in limiting the reach of these two government programs. At the very least, I believe that new ethanol production may not enjoy the same level of effective subsidization as existing domestic production.[172]

### *C. Implications for the efficiency of Energy and Climate Policy*

Ethanol is but one example, albeit an important one, of the politicization of energy policy.[173] There are a host of advocates for different kinds of alternative fuels, including hydrogen, methanol, and nuclear. More broadly, rent-seeking occurs across the wide array of different fuels including "clean" coal, oil and nuclear, to mention a few. With all this lobbying, it should not come as a surprise that our energy policy does not look particularly "efficient" from an economic point of view. Several economists have tried to estimate these inefficiencies in different areas, such as with the pricing of gasoline at the pump.[174]

The key point that the reader should take away from this section is that such inefficiencies are likely to remain a fact of life because politics will fre-

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ions. See Johnson & Libecap, *supra* note 151.

[169] See White House speeches: George W. Bush, *President Bush Visits Cleveland, Ohio*, July 10 (2007), *available at* http://www.whitehouse.gov/news/releases/2007/07/20070710-6.html; George W. Bush, *President Bush Discusses Energy Initiatives in Missouri*, March 20 (2007), *available at* http://www.whitehouse.gov/news/releases/2007/03/20070320-7.html.

[170] Center for Responsive Poltics Newsletter, http://www.capitaleye.org/inside.asp?ID=275 June 21 (2007).

[171] Stephen Coate & Stephen Morris, *Policy Persistence*, 89(5) THE AM. ECON. REV., 1327-1336 (1999).

[172] Plants already in use offer jobs for many Americans, which may make it politically difficult to shut them down or reduce their benefits. For a discussion of the rate at which plants are being built, see Clifford Krauss, *Ethanol's Boom Stalling as Glut Depresses Price*, N. Y. TIMES, September 30 (2007). Also, venture capitalists that have invested in ethanol production may try to protect their investments, especially for plants already in production.

[173] *See, e.g.*, JOHN E. CHUBB, INTEREST GROUPS AND THE BUREAUCRACY: THE POLITICS OF ENERGY (Stanford University Press 1983); PIETRO S. NIVOLA, THE POLITICS OF ENERGY CONSERVATION (Brookings Institution 1986).

[174] *See, e.g.*, Ian W.H. Parry & Kenneth A. Small, *Does Britain or the United States Have the Right Gasoline Tax?*, 95(4) AM. ECON. REV., 1276-1289 (2005).

quently trump economics in the making of policy. The degree of inefficiency may change because of interest group politics, but in general, there is no reason to expect that either energy policy or climate change policy is economically efficient. Indeed, one would expect quite the opposite.

That is not to say that economic analysis, such as the one sketched in Section IV, will not help inform policy, but in most cases, it is not likely to be the driving force. For climate change policy, for example, this means that it would be foolhardy to presume that the U.S. will achieve its national, or international, goals in a manner that minimizes costs.[175] The problem is simply too important to politicians for them to not take into account the myriad political interests surrounding this issue.

## VI. CONCLUSION AND RECOMMENDATIONS

It is difficult to build an economic case for providing special support for ethanol on the basis of alleged market failures. Ethanol made from corn is not likely to boost energy security much and its environmental benefits appear to be relatively small. Our analysis of the projected increase in ethanol production demonstrates that the costs are likely to exceed benefits by hundreds of millions of dollars annually in 2012 if current policies continue. The tax credit, the largest component of current support, is generally accepted to be an inefficient method for dealing with externalities.[176]

Contrary to conventional wisdom, I believe that continued support for ethanol along current lines is not a sure thing. My best guess is that ethanol can expect to receive some level of government support in the future, but will not enjoy the same kind of open-ended support it has in the past. The reason is that some interest groups will likely mobilize in opposition to further support for ethanol, and other interest groups may reduce their support. As increases in the price of corn affect other interest groups, such as beef producers, they will become more vocal in their opposition to corn ethanol. Furthermore, as it becomes clearer that the environmental benefits of ethanol are small, or even negative, environmentalists are likely to reduce their support.

The U.S. Congress should consider more sensible approaches to environmental and energy goals that take advantage of market signals to achieve the desired end.[177] The government should learn a lesson from its ethanol policy, and refrain from picking winners and losers.

We suggest three policies related to ethanol that can promote energy security and environmental goals more efficiently. First, the U.S. should repeal the ethanol import tariff. The tariff prevents the U.S. from diversifying its fuel use

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[175] I explore these ideas in more detail in a forthcoming paper on that subject.

[176] After analyzing the ethanol tax credit, the Congressional Research Service stated that tax expenditures are generally an inefficient way to deal with environmental or energy security concerns because they do not directly address any of the external costs of gasoline. *See* GAO, *DOE Lacks a Strategic Approach*, *supra* note 83, at 43.

[177] Some scholars suggest modifying the nature of the tax credit, so that it is tied to gasoline prices. *See* Miranowski, *supra* note 37. Given that corn ethanol cannot survive on its own even in times of high gasoline prices, it is unreasonable to subsidize it at all.

by taking advantage of a relatively low cost source of ethanol.[178] For that reason alone, the costs of the tariff are likely to outweigh its benefits. When one also includes the likely negative benefits from increased domestic production of corn-based ethanol, removing the tariff is an even more attractive policy.

Second, the U.S. should limit direct domestic support for alternative energy sources to basic research. Basic research for ethanol could be supported, but it is only one of many alternative fuels that should be considered. There is only so much land in the U.S. that could be effectively planted and other uses should not have to compete with a subsidized ethanol program. For example, biotechnologists are working on other substitutes to ethanol that may have greater benefits.[179] Biomass to electricity and nuclear represent two other greenhouse gas abatement methods that are likely to be more cost-effective than ethanol. In fact, some scholars, such as Patzek, worry that the increased attention to ethanol takes focus away from real energy solutions.[180]

Third, the U.S. should consider taxing key externalities, such as those related to energy security and the environment. Implementing such taxes is not a simple matter; however, it can be done. Moreover, taxes represent a simple, cost-effective method for inducing appropriate levels of conservation for different types of fuels.[181]

I am not optimistic that legislators will ignore political realities and implement an economical solution to the problems of energy security and improving the environment. At the same time, I believe policy makers are more likely to consider changes when the consequences of their policy decisions are more widely appreciated. Moreover, I believe that other political imperatives, such as those driven by beef producers and the need to respond to climate change, may present opportunities to adopt more economically efficient policies.

## APPENDIX

**Table A1: Federal Ethanol Tax Credit Authorities**

| Year | Law/Regulation | Value / gallon* |
|---|---|---|
| 1978 | Energy Tax Act | $0.40 |
| 1980 | Crude Oil Windfall Tax Act | $0.40 |
| 1982 | Surface Transportation Assistance Act | $0.50 |
| 1984 | Tax Reform Act | $0.60 |

[178] Wolak makes a strong case for repealing the ethanol import tariff based on the relative costs of ethanol production in the U.S. and Brazil. *See* Frank A. Wolak, *An Ethanol Policy That Benefits All Americans*, Stanford Institute for Economic Policy Research, Policy Brief (2007).

[179] *Advanced Biofuels: Ethanol, Schmethanol*, THE ECONOMIST, Science & Technology, Sept. 27, 2007.

[180] *See* Patzek, *supra* note 86.

[181] Energy conservation and efficiency should be encouraged by the government.

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|---|---|---|
| 1990 | Omnibus Budget Reconciliation Act | $0.54 |
| 2001 | Transportation Equity Act for the 21st Century (reductions through 2005 set by the Intermodal Surface Transportation Efficiency Act) | $0.53 |
| 2003 | Intermodal Surface Transportation Efficiency Act | $0.52 |
| 2005 | Intermodal Surface Transportation Efficiency Act | $0.51 |
| | Volumetric Ethanol Excise Tax Credit (through American Jobs Creation Act of 2004) | $0.51 |

We exclude applicability details.

Sources: Energy Information Administration and Koplow (2006).

**Table A2: Federal Laws and Regulations Related to Ethanol**

| Type | Program | Description | Reason |
|---|---|---|---|
| Grant | Congestion Mitigation and Air Quality Improvement Program | Funds projects and programs in air quality non-attainment and maintenance areas that reduce transportation-related emissions. | Air Quality |
| Grant | Petroleum Violation Escrow Account | Money from oil company fines that may be used for energy efficiency and renewable energy projects | Not specified |
| Grant | Clean Construction USA | Promotes the reduction of diesel exhaust emissions from construction equipment and vehicles by giving money | Air Quality |
| Grant | Clean Ports USA | Encourages port authorities and terminal operators to use cleaner fuels | Air Quality |
| Grant | Clean Fuels Grant Program | Assists transit agencies in purchasing low-emission buses and related equipment, constructing alternative fuel stations, modifying garage facilities to accommodate clean fuel vehicles, and assisting in the utilization of biodiesel | Air Quality |
| Grant/ Loan | Renewable Energy Systems and Energy Efficiency Improvements Grant | Provides grants, loans, and loan guarantees for the purchase of renewable energy systems and energy improvements for agricultural producers and small rural businesses. Not R&D. | Not specified |

| | | | |
|---|---|---|---|
| Grant/ Loan | State Energy Program Funding | Provides funding to states and territories to deploy emerging renewable energy and energy efficiency technologies | Not specified |
| Grant/ Loan | Voluntary Airport Low Emission Program | Funding for airports so that they can delopy low-emission technologies | Air Quality |
| Grant/ Renewable Fuels Mandate | EPA Renewable Fuel Standard Requirements for 2006 | Sets targets for renewable fuel use in the future | Energy Security/ Air Quality |
| Grant/ Tax Incentives | Energy Policy Act of 1992 | Encourages the use of domestically produced alternative fuels by mandating that federal, state, and alternative fuel provider fleets purchase alternative fuel vehicles | Energy Security/ Air Quality |
| Grant/ Tax Incentives | State and Alternative Fuel Provider Rule | Requires that 75% of new light-duty vehicles acquired by covered state fleets must be alternative fuel vehicles and 90% of light-duty vehicles acquired by alternative fuel providers must be alternative fuel vehicles | Not specified |
| Grant/ Tax Incentives | Requirements for Regulated Federal Fleets | Requires that 75% of new light-duty vehicles acquired by federal fleets must be alternative fuel vehicles and that federal fleets use alternative fuels in dual-fuel vehicles unless have a waiver | Not specified |
| Tax Incentives | Biodiesel and Ethanol (VEETC) Tax Credit | Created tax incentives forbiodiesel fuels and extended the tax credit for fuel ethanol. | Not specified |
| Tax Incentives | Alternative Fuel Infrastructure Tax Credit | Provides a tax credit equal to 30% of the of cost alternative refueling property and up to $30,000 for business property (E85). | Not specified |

| | | | |
|---|---|---|---|
| Tax Incentives | Small Ethanol Producer Credit | Tax credit for small ethanol producers, now defined as those with a production capacity of up to 60 million gallons (instead of the up to 30 million gallons originally established by Congress in 1990) | Not specified |
| Tariff | Import Duty for Fuel Ethanol | Applies a 2.5% ad valorem tariff and a most-favored-nation duty of 54 cents per gallon of ethanol for fuel use from most countries, except Caribbean Basin Initiative countries | Not specified |
| Other | Alternative Motor Fuels Act of 1988 | Encourages the production of motor vehicles capable of operating on alternative fuels by giving a credit toward an automobile manufacturer's average fuel economy | Not specified |
| Other | Clean Cities Initiative | Supports local decisions to adopt practices that contribute to the reduction of petroleum consumption | Energy Security/ Air Quality |

Source: Department of Energy, Energy Efficiency and Renewable Energy, Alternative Fuels Data Center