MOONSHINE TO MOTORFUEL: TAX INCENTIVES FOR FUEL ETHANOL

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ABSTRACT

Biofuels have been embraced by supporters ranging from President George W. Bush to the Natural Resources Defense Council. Before 1930, the U.S. Treasury focused on shutting down small alcohol producers. After 1978, U.S. energy policy sought to encourage ethanol production to reduce dependence on foreign oil. Federal and state incentives have been credited with increasing ethanol production from 175 million gallons in 1980 to 6.8 billion gallons in 2007. The Internal Revenue Code contains three income tax credits designed to encourage ethanol use: the alcohol mixture credit, the pure alcohol credit, and the small ethanol producer’s credit. The credits, together with other subsidies, come close to making the price of ethanol competitive with petroleum-based fuels. This article examines the tax incentives for ethanol and considers their economic and environmental effectiveness.

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In theory, ethanol use could reduce dependence on foreign oil and greenhouse gas emissions. In practice, the environmental benefits of ethanol are in doubt. Using the tax system to encourage conservation and discourage driving may be a better way to reduce greenhouse gas emissions and oil dependency.

I. INTRODUCTION

In 1876, incoming Commissioner of Internal Revenue, Green B. Raum, declared war on ethanol producers.\(^1\) A few years later, Henry Ford “built the first flex fuel vehicle: a 1908 Model T designed to operate on either ethanol or gasoline.”\(^2\) Nearly a hundred years later, in 1978, Congress enacted the first tax incentives for ethanol production to reduce dependence on foreign oil.\(^3\) In the search for oil and gas substitutes, biofuels have emerged as another panacea. Touting diverse supporters such as President George W. Bush and the Natural Resources Defense Council (NRDC), biofuels are receiving worldwide attention and money.\(^4\) For example, federal incentives are credited with increasing ethanol production from 175 million gallons in 1980 to 6.8 billion gallons in 2007.\(^5\) The first major federal subsidy exempted ethanol from the motor fuel excise tax.\(^6\)

Revised in 2005 and 2008, federal tax law now contains three income tax credits designed to encourage ethanol use.\(^7\) These credits, together with other subsidies, stimulate ethanol production by making ethanol prices competitive with petroleum-based fuels.

Despite its possibilities for reducing dependence on traditional fuel sources, ethanol is not universally viewed as the solution to reducing petroleum use. Scientific studies draw different conclusions.


\(^5\) YACOBUCI, supra note 4, at 27.


about whether ethanol produces a net energy gain when the energy used in planting, growing, harvesting, and processing the raw materials is considered. Concerns expressed by critics of wide-scale ethanol production include: that using food crops for fuel would exacerbate world hunger; that ethanol subsidies amount to corporate welfare for large agricultural firms; and that the United States’ capacity to produce ethanol would be overstimulated by subsidies, resulting in bankruptcies and industry collapse.

Ethyl alcohol is found in alcoholic beverages. The largest single use of ethanol is as a motor fuel and fuel additive. Ethanol produces less energy per gallon than gasoline and costs more to produce per unit of energy. In addition, U.S. import tariffs protect domestic production and increase industry prices of ethanol. Currently, the economic survival of the U.S. ethanol business depends on government support. The web of government support is extensive and complicated. Federal support includes tax incentives and use mandates. States also provide financial support to the ethanol industry. Today, the ethanol industry is well placed to benefit from government support that is anticipated to increase.

8. See infra notes 169–78 and accompanying text.

9. See infra notes 204–32 and accompanying text.


11. Id.

12. Jason Hill et al., Environmental, Economic, and Energetic Costs and Benefits of Biodiesel and Ethanol Biofuels, 103 PROC. OF THE NAT’L ACADEMY OF SCI. 11206, 11208 (2006), available at http://www.pnas.org/cgi/doi/10.1073/pnas.0604600103 (“In 2005, ethanol net production cost was $0.46 per energy equivalent liter (EEL) of gasoline, while wholesale gasoline prices averaged $0.44/liter.”). Another study finds the wholesale price difference between the energy equivalent amount of ethanol and a gallon of gasoline to be between $1.68 and $1.82 (not counting government incentives). See YACOBUCCI, supra note 10, at 11. A recent retail price comparison from the Department of Energy (DOE) found that while ethanol costs less per gallon than gasoline ($2.63 ethanol vs. $3.03 for gasoline), on an energy equivalent basis, ethanol is more expensive ($3.72 ethanol vs. $3.04 for gasoline). See U.S. DEP’T OF ENERGY, CLEAN CITIES ALTERNATIVE FUEL PRICE REPORT 3 (July 2007), available at http://www.afdc.energy.gov/afdc/pdfs/afpr_jul_07.pdf.


15. H. Josef Hebert, U.S. Ethanol Production Set to Skyrocket: Congressional Plan Calls for Sevenfold Increase in Biofuels Production in Next 15 Years, WILMINGTON NEWS J., May 2, 2007,
production in the United States has quadrupled over the past ten years, and with the addition of new ethanol plants under construction, it is anticipated to double again by 2009.\footnote{See RENEWABLE FUELS ASS’N, ETHANOL INDUSTRY OUTLOOK 2007: BUILDING NEW HORIZONS 2–3 (2007), \url{available at http://www.ethanolrfa.org/objects/pdf/outlook/RFA_Outlook_2007.pdf}.}

Many researchers have raised concerns about the U.S. government’s support of ethanol.\footnote{See, e.g., KOPLOW, supra note 13.} First, ethanol consumption may not produce a net reduction in petroleum use. Growing, harvesting, and processing ethanol is fossil fuel intensive, offsetting the petroleum saved by using ethanol.\footnote{See infra notes 169–91 and accompanying text.} Second, ethanol production can create environmental problems, such as pesticide use, excessive water use, and loss of biodiversity.\footnote{M ICHAEL B. MCELROY, E THANOL FROM BIOMASS: CAN IT SUBSTITUTE FOR GASOLINE? (forthcoming), \url{available at http://www-as.harvard.edu/people/faculty/mbm/Ethanol_chapter1.pdf}.} Third, using crops to generate motor fuel may exacerbate worldwide food shortages.\footnote{U.N. ENERGY, SUSTAINABLE BIOENERGY: A FRAMEWORK FOR DECISION MAKERS 31 (2007), \url{available at http://esa.un.org/un-energy/pdf/susdev.Biofuels.FAO.pdf}.} Finally, if encouraging ethanol use is appropriate, existing government incentives to stimulate ethanol production are not effectively or efficiently designed, and a few big industry players have reaped a disproportionate benefit.\footnote{See James Bovard, CATO INST., CATO POLICY ANALYSIS NO. 241, ARCHER DANIELS MIDLAND: A CASE STUDY IN CORPORATE WELFARE (1995), \url{available at http://www.cato.org/pubs/pas/pa-241.html}.}

Tax incentives for ethanol production could be structured to operate more effectively. For example, corn constitutes about 90\% of the feedstock for U.S. ethanol production, although cellulosic sources show increasing promise.\footnote{U.S. Dep’t of Energy, Alternative Fuels & Advanced Vehicles Data Center, Ethanol: Starch- and Sugar-Based Ethanol Feedstocks, \url{http://www.afdc.energy.gov/afdc/ethanol/feedstocks_starch_sugar.html} (last visited Oct. 30, 2008).} Changing the source and methods of
agriculture can limit adverse environmental and economic effects of ethanol production. Taxes and other subsidies should be structured to take these variables into account. As analysts continue to evaluate energy subsidies, policy-makers must respond by eliminating wasteful subsidies and crafting tax incentives and other subsidies for biofuels that will facilitate the move away from fossil fuels toward renewable energy sources. In doing so, policy-makers must address whether providing ethanol incentives is the best solution to reduce fossil fuel use and greenhouse gas (GHG) emissions.

This article describes the current and proposed federal tax incentives for fuel ethanol. Ethanol can play a role in reducing dependence on foreign oil and GHG emissions, particularly in the transport sector. The article presents a framework for evaluating the ethanol tax incentives to determine their economic and environmental effectiveness. First, the article identifies the broad and narrow goals of the ethanol tax incentives. Next, it evaluates the success of the provisions in meeting the goals, including the impact of other legal and societal factors that may influence the outcome. However, meeting goals is not enough—the provisions must meet those goals without inflicting collateral damage on the environment. Current ethanol incentives fail to meet this criterion. Moreover, the goals should be met efficiently, without creating windfalls for some and catastrophes for others. Because the ethanol tax incentives do not meet these criteria, this article considers potential next steps and the barriers those actions may face.

II. ETHANOL INCENTIVES

Federal tax incentives for ethanol began in 1978, with an exemption from the motor fuels excise tax for alcohol fuels. Between 1978 and 2004, the size of the exemption varied from $0.40 to $0.60 per gallon of pure ethanol. The Energy Act of 2005 restructured federal tax incentives for ethanol production to include three income tax credits and one excise tax credit. As part of the

general business credit, the three income tax credits are added together to become the alcohol fuels credit.\textsuperscript{28} The alcohol fuels tax credit is the sum of the alcohol fuel mixture credit (or blenders credit), the straight alcohol credit, and the small ethanol producer credit.\textsuperscript{29}

The most widely used income tax incentive for ethanol is the blenders credit because ethanol is rarely used alone as a fuel. The credit, set at $0.51 per gallon for 2008, is allowed for each gallon of alcohol used to produce a mixture if the sale or use is in the taxpayer’s trade or business. Ninety-nine percent of fuel ethanol is blended into E10, a mixture containing 90% gasoline and 10% ethanol.\textsuperscript{30} The other 1% is consumed as E85, a mixture containing 85% ethanol and 15% gasoline.\textsuperscript{31} In the recently passed Food, Conservation, and Energy Act of 2008 (2008 Farm Bill), Congress responded to concerns about rising food prices by modifying the credit.\textsuperscript{32} The blenders credit is reduced to $0.45 per gallon in 2009 if production exceeds a set threshold.\textsuperscript{33} Certain small ethanol producers also receive an additional $0.10 producer’s credit.\textsuperscript{34} The production capacity of an eligible small producer may not exceed sixty million

\begin{itemize}
\item \textsuperscript{27} I.R.C. § 6426(a)(1) (2006).
\item \textsuperscript{28} I.R.C. § 38(b)(3) (2006). The credit allowed under Internal Revenue Code (Code) section 38 for any taxable year cannot exceed the excess (if any) of the taxpayer’s net income tax over the greater of (i) the taxpayer’s tentative minimum tax for the taxable year, or (ii) 25% of the excess of the taxpayer’s net regular tax liability over $25,000. I.R.C. § 38(c)(1) (2006). For these purposes, a taxpayer’s “net income tax” is the sum of the taxpayer’s regular tax liability and the alternative minimum tax liability imposed by Code section 55, reduced by the credits allowable under Code sections 21–30A, and “net regular tax liability” means the regular tax liability reduced by the same set of credits. \textit{Id.} A taxpayer’s tentative minimum tax is defined in Code section 55(b). I.R.C. § 55(b) (2006).
\item \textsuperscript{30} Yacobucci, \textit{supra} note 10, at 1–2.
\item \textsuperscript{31} Id. at 2.
\item \textsuperscript{32} Hebert, \textit{supra} note 20 (“\textit{C}ongressional unease about the food-for-fuel debate is showing itself in a number of places. In a massive farm bill—for the first time in memory—lawmakers recently trimmed back the federal tax subsidy for corn ethanol.”).
\item \textsuperscript{34} I.R.C. § 40(b)(4) (2006).
\end{itemize}
gallons per year. Nonetheless, the producer’s credit is limited to fifteen million gallons of production, so the maximum credit any producer could receive is $1.5 million per year. The 2008 Farm Bill eliminates the fifteen million gallon cap if the fuel is produced from cellulosic sources. The 2008 Farm Bill provides that biofuels made from cellulosic sources, including ethanol, may receive a maximum $1.01 per gallon credit.

Prior to 2004, the federal government subsidized ethanol blended fuels through a reduced excise tax rate as compared to the excise tax rate for gasoline. In general, the motor fuels excise tax must be paid upon removal of a taxable fuel, such as gasoline, from a refinery or terminal, or when it enters the United States. The ethanol subsidy structure through 2004 had the effect of reducing highway funding, because the money collected from the motor fuels excise tax directly funds the Highway Trust Fund. The tax exemption for ethanol resulted in reduced excise tax revenues, decreasing highway funding for all states, including those states which did not produce or use ethanol. As restructured by the Energy Act of 2005, all users pay the full excise tax on fuels, but ethanol users may take a $0.51 per gallon credit against the excise tax under the Volumetric Ethanol Excise Tax Credit (VEETC). The VEETC is funded from general government revenue, eliminating the drain on the Highway Trust Fund. As amended by the 2008 Farm Bill, the VEETC will be reduced to $0.45 if designated U.S. ethanol production thresholds are exceeded.

38. Id. at 1048. If a taxpayer is eligible for the blenders credit and/or the small producer’s credit, those amounts will reduce the $1.01 cellulosic credit so that the total credit received will not exceed $1.01. The blenders credit and the small producer’s credit expire on December 31, 2010. The cellulosic biofuel producer credit expires on December 31, 2012. Cellulosic biofuel producers must be registered with the IRS to receive the credit. Id. at 1048–49.
41. KOPLOW, supra note 13, at 24 n.31.
42. I.R.C. § 6426(a)(1).
In addition to the ethanol production credits, taxpayers investing in fuel equipment that dispenses at least 85% ethanol are eligible for accelerated cost recovery under the alternative refueling stations tax credit.\(^{44}\) This credit is intended to increase the number of alternative fuel gas stations, as currently only 1,120 stations (of 170,000 stations nationwide) dispense E85.\(^{45}\) Taxpayers installing alternative fuel refueling property are eligible for a credit of up to 30% of the property cost. The credit is capped at $30,000 per taxable year per location.\(^{46}\)

The interaction between the ethanol tax benefits is complex. The small producer’s credit only benefits ethanol producers, while the alcohol mixture credit and the alcohol fuel credit benefit taxpayers consuming ethanol fuel only if the sale or use is in the course of the taxpayer’s trade or business. If the same taxpayer is eligible for both the VEETC and the alcohol fuels tax credit,\(^{47}\) the amount of the alcohol fuels tax credit is reduced.\(^{48}\) The alcohol fuels credit is included in gross income, although it is not subject to the general business credit limitation imposed under the alternative minimum tax.\(^{49}\) The VEETC provides a greater subsidy than the alcohol fuels credit. In addition, under the VEETC, taxpayers may get a tax refund within twenty days of payment of the excise tax. The ethanol


\(^{45}\) RENEWABLE FUELS ASS’N, supra note 16, at 8; see also YACOBUCCI, supra note 10, at 9 (using different numbers: 556 fuel stations with E85, 65% of which were located in the five highest ethanol-producing states—Minnesota, Illinois, Iowa, South Dakota, and Nebraska).

\(^{46}\) I.R.C. § 30C(b) and (c). The alternative fuel refueling property credit was originally enacted in 2005. The cost of the credit is anticipated to be just under $100 million over the five-year period between 2006 and 2010. STAFF OF JOINT COMM. ON TAXATION, 109TH CONG., ESTIMATES OF FEDERAL TAX EXPENDITURES FOR FISCAL YEARS 2006–2010 32 (Joint Comm. Print 2006).

\(^{47}\) The VEETC is the single largest energy tax expenditure, with a five year revenue cost of $12.7 billion. With the increased production mandates found in the Energy Independence and Security Act of 2007, see infra notes 92–98 and accompanying text, the amount will likely increase significantly. However, reducing the amount of the credit from $0.51 to $0.45 is anticipated to save $1.2 billion through 2011.

\(^{48}\) I.R.C. § 40(c) (2006). The Joint Committee on Taxation estimates the cost of the alcohol fuels tax credit at $200 million from 2006 through 2010. STAFF OF JOINT COMM. ON TAXATION, supra note 46, at 31. This is about the same amount estimated for biodiesel credits, but represents a pittance compared to the total energy tax expenditures of $55.1 billion over the same time period.

\(^{49}\) See I.R.C. §§ 87(1), 38(b)(3), (c)(4).
tax incentives are scheduled to expire in 2010, although Congress will likely extend these subsidies or make them permanent.50

III. EVALUATING ETHANOL TAX INCENTIVES

Part A of this section considers the narrower, shorter-term goals of the ethanol fuel incentives, while Part B considers the broader, longer-term goals of the provisions. Congress enacted ethanol tax incentives to achieve a number of goals. The article discusses three relatively limited, short-term goals and three fairly broad, long-term goals. The immediate goals include: (1) increasing ethanol production, (2) increasing ethanol consumption, and (3) creating rural jobs. The broader goals include: (1) increasing energy security, (2) decreasing dependence on foreign oil, and (3) reducing GHG emissions from transport.51 In evaluating the effectiveness of the ethanol tax, this article also discusses the interplay between the tax incentives and the non-tax governmental actions that play a large role in promoting ethanol production and use.

Given the significant government support for ethanol fuel, this section then considers the extent to which ethanol tax incentives achieve their intended goals and benefit their intended beneficiaries. The analysis suggests that these incentives achieve, to some degree, their more limited objectives, but that the economic benefits are skewed toward large corporate agribusinesses. Furthermore, the ethanol tax incentives are not very effective or efficient in achieving the United States’ broader environmental and security objectives. As discussed in section IV, these subsidies contribute to collateral environmental damage and societal problems—issues extending beyond U.S. borders—that result from increased ethanol production and consumption.


51. President George W. Bush outlined these broad goals when signing the 2005 Energy Policy Act. He said: “Using ethanol and biodiesel will leave our air cleaner. And every time we use a home-grown fuel, particularly these, we’re going to be helping our farmers, and at the same time, be less dependent on foreign sources of energy.” President George W. Bush, supra note 4.
A. Shorter-Term Goals of Ethanol Fuel Tax Incentives

1. Increasing Ethanol Production

In response to early oil embargos, Congress enacted the first tax incentives to encourage the development of ethanol as a renewable alternative to petroleum in 1978. Ethanol tax incentives are credited with significantly contributing to U.S. ethanol production. Analysts on both sides of the ethanol debate agree that without tax incentives the ethanol industry might not survive. A 1998 economic analysis “concluded that elimination of the exemption would cause annual ethanol production from corn to decline roughly 80% from 1998 levels.” Prior to 1980, virtually no market existed for ethanol. Between 1980 and 1996, ethanol production grew to reach over one billion gallons annually. U.S. ethanol production doubled between 1996 and 2002, and doubled again from 2002 to 2006.

While increasing gasoline prices have influenced ethanol production, at least three other non-tax policies also significantly contributed to ethanol’s rise in the market. First, the Clean Air Act Amendments of 1990 required the use of oxygenated or reformulated gasoline (RFG). Ethanol is the primary oxygenate used to meet these requirements. Second, the Energy Policy Act of 2005 (EPA 2005) mandated the phase-in of renewable fuel standards. The renewable fuel standard (RFS) mandates that commercial ethanol use meet minimum targets set by Congress. The law set the minimum target at 4 billion gallons for 2006, increasing to 7.5 billion gallons by 2012. In 2007, the Energy and Independence Security Act (EISA 2007) increased the renewable fuel standard to 15.2 billion gallons.

52. Yacobucci, supra note 4, at 24.
53. Id. at 12.
54. Id.
60. Id. § 1501.
by 2012, and up to 36 billion gallons by 2022. Finally, ethanol imports are subject to a $0.54 per gallon tariff, creating a significant obstacle to ethanol produced outside the United States. Nonetheless, the United States’ ability to meet its ethanol production goals is hampered by ineffectiveness and inefficiency.

In 2005, the United States surpassed Brazil by becoming the world’s largest ethanol producer. However, unlike the United States, Brazil’s ethanol policies have successfully enabled it to produce ethanol cheaply and to greatly reduce its need to import oil. In fact, Brazil is the largest net exporter of ethanol. Therefore, by comparing U.S. policies with those of Brazil, problems with the structure of U.S. ethanol incentives are illuminated. For instance, even though ethanol can be produced from a variety of biomass sources, in Brazil, ethanol is made from sugarcane. Producing ethanol from sugarcane is significantly more efficient than producing ethanol from corn. Sugarcane ethanol produces 8.2 joules of energy per unit of fossil fuel input compared to approximately 1.5 joules for corn ethanol. In addition, sugarcane produces more ethanol per acre—about 605 gallons per acre compared to about 314 gallons per acre for corn ethanol.

Until December 20, 2006, U.S. ethanol tax incentives did not specify the source material for the ethanol; but U.S. policy to date has largely steered ethanol production toward corn. In the United

62. Id. § 202(a)(2)(B).
63. YACOBUCCHI, supra note 4, at 22.
64. RENEWABLE FUELS ASS’N, supra note 16, at 18.
66. Id.; see also RENEWABLE FUELS ASS’N, supra note 55.
68. See id. at 5 (4.9 billion gallons = 4900 million gallons / 15.6 million acres = 314 gallons per acre for U.S. corn-based ethanol. 4.6 billion gallons = 4600 million gallons / 7.6 million acres = 605 gallons per acre for Brazilian sugarcane-based ethanol). Brazilian sugarcane ethanol uses 48.3% of the raw material, while U.S. corn ethanol uses 20.4%. Id.
States, corn constitutes 95% of the raw material for ethanol production.\(^70\) In 2006, farmers planted 78.3 million acres of corn.\(^71\) One year later, in 2007, 92.9 million acres were planted with corn as a result of increased demand due to ethanol production.\(^72\) In 2006, ethanol production accounted for almost 20% of the corn harvest.\(^73\) In 2007, the United States produced more than 13 billion bushels of corn, and ethanol production consumed 2.3 billion bushels.\(^74\)

U.S. ethanol production exceeds Brazil’s production even though sugarcane is a better feedstock and Brazilian ethanol is cheaper to produce.\(^75\) Import tariffs currently protect the U.S. ethanol industry from lower cost foreign imports, although these tariffs are scheduled to expire in 2009.\(^76\) Most imported ethanol is subject to a $0.54 per gallon tariff.\(^77\) This tariff magnifies the federal ethanol subsidies for domestically produced ethanol. In the recently passed Energy Improvement and Extension Act of 2008, Congress clarified that the alcohol fuels credits are designed to provide an incentive for U.S production only.\(^78\) Brazil has filed a formal complaint with the World Trade Organization challenging the tariff.\(^79\) Despite the tariff, however, the United States imported over 10% (about 650 million gallons) of its ethanol supply in 2006, two thirds of which came from Brazil.\(^80\)

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70. YACOBUCCI, supra note 4, at 2.
72. Id.
73. HESTER, supra note 58, at 2.
74. Renewable Fuels Ass’n, supra note 16, at 14.
75. Id. at 16.
77. YACOBUCCI, supra note 4, at 22. “Under certain conditions imports of ethanol from Caribbean Basin Initiative (CBI) countries are granted duty-free status.” Id. Under the North American Free Trade Agreement (NAFTA), Canada and Mexico can export ethanol to the United States duty-free. KOPLOW, supra note 13, at 20.
79. Alan Beattie & Sheila McNulty, Green Barricade Trade Faces a New Test as Carbon Taxes Go Global, Fin. Times, Jan. 23, 2008, at 7. Brazil seeks to have ethanol classified as an “environmental good” in the Doha Development Round, which would result in tariff cuts. Id.
80. Renewable Fuels Ass’n, supra note 16.
Brazilian ethanol costs substantially less than U.S. produced ethanol, even though Brazil has not provided significant government incentives for ethanol production since the late 1980s. However, Brazil imposes higher taxes on gasoline, and has invested in, and developed, a significant ethanol infrastructure. For example, all Brazilian gas stations are required to offer at least E85 ethanol. As a result of these policies, Brazil gets 40% of its motor fuel from ethanol, and over 80% of the light vehicles sold in Brazil are flex fuel cars. Brazil’s experience offers some insight on how the United States might produce biofuels more efficiently and support biofuel use more effectively.

Although ethanol tax incentives reduce the cost of producing and using ethanol for individuals and businesses, thereby driving up demand, ethanol demand has also increased due to requirements established under the 1990 Clean Air Act. The Clean Air Act’s RFG standard requires the addition of oxygenate to gasoline. Congress designed the RFG program to improve air quality by reducing emissions of toxic air pollutants. The most commonly used oxygenates are ethanol and, to a much lesser extent, methyl tertiary butyl ether (MTBE). A number of studies concluded that MTBE, a petroleum derivative, contaminates groundwater and it has thus been banned in over twenty states. Accordingly, ethanol has replaced MTBE as the gasoline oxygenate additive when required by the RFG program in one of those states.

81. BUDNY, supra note 67, at 5–6. Budny reports that the production cost of Brazilian sugarcane ethanol is about $0.22 per liter, compared to U.S. corn ethanol at $0.35 per liter. Id. at 5.
82. Id. at 6. Brazil imposes a 44% tax on gasoline, compared to 18% in the United States. Id.
83. Id.; see also RENEWABLE FUELS ASS’N, supra note 16, at 8 (noting that less than 10% of U.S. gas stations offer E85).
84. Brazil’s experience is not problem-free, however. A recent article reports that ethanol sugarcane threatens Brazil’s wooded savanna, an endangered ecosystem hosting an estimated 160,000 species of animals and plants, many threatened with extinction. See Sabrina Valle, Losing Forests to Fuel Cars, WASH. POST, July 31, 2007, at D1.
86. YACOBUCCI, supra note 4, at 13.
87. Id. at 12–13.
The RFS imposed by EPA 2005 has significantly increased demand for ethanol. The RFS mandates the increasing use of ethanol and other renewable fuels as additives to gasoline. Under these standards, the minimum renewable content to be blended into the national fuel supply is 4.7 billion gallons for 2007, increasing to 7.5 billion gallons by 2012. A number of states also mandate the use of renewable fuels. EISA 2007 included a new RFS which added a cellulosic ethanol component, as well as new GHG reduction targets for renewable fuels. The U.S. fuel supply must include enough renewable fuels to meet a targeted 20% reduction in GHG emissions over “baseline lifecycle greenhouse gas emissions.” EISA 2007 added several new categories of renewable fuels that may be part of the fuel mix. The advanced biofuel category includes: (1) ethanol derived from cellulose, hemicellulose, or lignin; (2) ethanol derived from sugar or starch (other than corn starch); (3) ethanol derived from waste material, including crop residue, other vegetative waste material, animal waste, and food waste and yard waste; (4) biomass-based diesel; (5) biogas (including landfill gas and sewage waste treatment gas) produced through the conversion of organic matter from renewable biomass; (6) butanol or other alcohols produced


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<th>Year</th>
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91. Koplow, supra note 13, at 20 (noting that Minnesota, Iowa, Hawaii, Washington, Montana, Louisiana, and Missouri all have renewable fuels mandates).


93. Id. The term “baseline lifecycle greenhouse gas emissions” means the average lifecycle greenhouse gas emissions for gasoline or diesel (whichever is being replaced by the renewable fuel) sold or distributed as transportation fuel in 2005. Id. § 201, 121 Stat. at 1520.
through the conversion of organic matter from renewable biomass; or (7) other fuel derived from cellulosic biomass. § 201, 121 Stat. at 1519.

The 2007 law includes a separate advanced biofuel RFS, which is a component of the overall RFS. § 202(a), 121 Stat. at 1521–22.

An advanced biofuel must have lifecycle GHG emissions that are at least 50% less than the baseline. § 201, 121 Stat. at 1519.

The law also provides a separate RFS for cellulosic biofuels (which make up a component of the advanced biofuel RFS), and these fuels must have lifecycle emissions that are at least 60% less than the baseline. § 201, 121 Stat. at 1520.

The Environmental Protection Agency (EPA) administrator may reduce the lifecycle GHG reduction target for renewables by up to 10% for each type of renewable, if the new mandated reduction is not commercially feasible. § 202(c), 121 Stat. at 1525.

Given its significant requirements, the RFS will likely have a major impact on ethanol production. For example, the mandated RFS for 2011 (achieved primarily with ethanol) exceeds the entire 2006 worldwide ethanol production of approximately 13.5 billion gallons. The mandate will require a dramatic increase in U.S. ethanol supplies. Lawmakers have had second thoughts about the magnitude of the RFS and have asked the EPA to cut this year’s requirement for corn ethanol in half. One of the requestors, Texas Governor Rick Perry, believes that “the billions of bushels of corn being used to produce all that mandated ethanol would be better suited as livestock feed than as fuel.” Congress also held hearings on the RFS’s impact on the food-fuel debate. Despite the controversy, on August 7, 2008, the EPA announced that it would not reduce the mandate.

94. Id. § 201, 121 Stat. at 1519.
95. Id. § 202(a), 121 Stat. at 1521–22.
96. Id. § 201, 121 Stat. at 1519.
97. Id. § 201, 121 Stat. at 1520.
98. Id. § 202(c), 121 Stat. at 1525.
99. Hebert, supra note 20 (“The governor of Texas and 26 senators, including the GOP’s presumptive presidential nominee John McCain, are asking the Environmental Protection Agency to cut this year’s requirement for 9 billion gallons of corn ethanol in half to ease, they say, food costs.”).
101. See Hebert, supra note 20.
2. Encouraging Ethanol Use

With government subsidies driving the production of ethanol, government subsidies also stimulate ethanol demand. However, use and consumption may not follow production unless proper infrastructure, ethanol-fueled vehicles, and convenient refueling and repair stations are in place. Consumers must be able to use ethanol in their vehicles, but conventional gasoline vehicles cannot operate on gasoline with high concentrations of ethanol.\(^\text{103}\) Consumers must also

\(^{103}\) See ALTERNATIVE FUELS, supra note 2.
be able to purchase ethanol that is priced competitively with gasoline and conveniently located for refueling. Conventional gasoline pumps, however, are not designed and manufactured to dispense ethanol or ethanol blends above E10. 104

Several federal income tax incentives support ethanol fuel consumption and the development of U.S. ethanol infrastructure, although these federal income tax incentives provide significantly less support than ethanol production tax incentives. As discussed in section II above, the alternative fuel refueling station credit subsidizes the installation of ethanol (and other “clean fuel”) refueling equipment for up to 30% of the cost (capped at $30,000). In addition, federal and state laws provide incentives for alternative fuel vehicles. Federal tax law provides tax credits for consumers purchasing hybrid and alternative fuel vehicles. Enacted in 2005 and replacing the clean fuel vehicle deduction, the Alternative Motor Vehicle credit for up to 30% of the cost is available for purchasers of new alternative fuel vehicles. 105 The same legislation added the Hybrid Motor Vehicle credit providing a fuel economy and conservation credit for light-duty hybrid vehicles based on fuel efficiency gains and lifetime fuel savings. This credit phases out after the vehicle manufacturer sells 60,000 qualified vehicles. 106 These demand-side tax credits for infrastructure and consumer vehicles are small in comparison to the supply-side credits discussed above. Non-tax incentives likely have an appreciably greater impact on U.S. ethanol consumption.

The Energy Policy and Conservation Act of 1975 included the Corporate Average Fuel Economy (CAFE) standards for motor vehicles to encourage the manufacture of E85-capable vehicles. 107 Unfortunately, because of a design flaw in the application of the CAFE standards, manufacturers are able to comply with the law without reducing their gas-guzzling fleet. The average fuel economy for all vehicles of a class sold by a manufacturer must be equal to or greater than the standard. For 2006, the CAFE standards were set at 27.5 miles per gallon (MPG) for cars and 21.6 MPG for light trucks. 108


108. See CONG. RESEARCH SERV., AUTOMOBILE AND LIGHT TRUCK FUEL ECONOMY: THE CAFE STANDARDS 4 (2003); see also U.S. DEP’T. OF TRANSP., AUTOMOTIVE FUEL ECONOMY
EISA 2007 increased the CAFE standards for the years 2011 to 2020 to thirty-five MPG for both passenger and non-passenger vehicles combined. The new law also allows credit trading among manufacturers. See 49 U.S.C. § 32903(f) (2007).

After 2020, the required CAFE standard for each fleet of passenger and non-passenger automobiles manufactured for sale in the United States will be the maximum feasible average fuel economy standard for each fleet for that model year. Credits toward a manufacturer’s CAFE requirements are added for vehicles capable of running on higher blends of ethanol, such as E85. For example, a dual-fuel Chevrolet Impala that gets twenty-nine MPG combined highway and city on gasoline is credited with forty-eight MPG. Most of these vehicles (flex fuel vehicles or “FFVs”) can run on either gasoline or E85. About 6 million of the 230 million U.S. passenger vehicles qualify as FFVs, but 98% of them run on gasoline only. Yet, for purposes of determining the CAFE credit for FFVs, the gasoline mileage rating is determined assuming FFVs run on E85 half of the time. Because the credits lower the manufacturer’s overall CAFE, auto makers can churn out low-mileage vehicles without triggering the monetary penalty for not meeting MPG standards. Analysts estimate that the FFV credit actually increases petroleum use by roughly eighty thousand barrels per day. One report

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111. Energy Independence and Security Act § 32906. EISA 2007 retained this credit, and extended the availability until 2019. Energy Independence and Security Act § 109(a) (mandating that the maximum credit be 1.2 MPG through 2014, and providing that from 2014 through 2019, the credit phases down by 0.2 MPG per year, and is fully phased out in 2020).


113. RENEWABLE FUELS ASS’N, supra note 16, at 8.


evaluating the FFV credit estimated that with alternative fuel consumption of 1%, the credit’s perverse impact would result in an increase in GHG emissions from 2001 through 2008 of 52.7 MMTCE (million metric tons of carbon equivalent). The Big Three U.S. automakers (Chrysler, GM, and Ford) have avoided $1.6 billion in CAFE fines from 1998 to 2004 by use of the dual-fuel loophole.

Lack of infrastructure explains why FFVs run mainly on gasoline. Less than 1% of U.S. gas stations sell E85 or higher blends. Rather than an exemption from CAFE standards, the U.S. government, like Brazil, should mandate that gas stations supply E85. In a recent analysis, the Government Accountability Office (GAO) concluded that the failure to coordinate ethanol production with ethanol infrastructure—beyond the refueling station credit—limits the effectiveness of ethanol incentives. Currently, the industry can absorb roughly fifteen billion gallons of E10, but the RFS will exceed fifteen billion gallons in 2012. Thus, the RFS requirements combined with the lack of infrastructure could lead to a glut of unused ethanol.

Most of the ethanol produced today is used in low concentration blends with gasoline. Using a 90% gasoline fuel will do little to alter energy dependence or increase energy security. As noted above, consumer demand for high-blend ethanol vehicles remains low because less than 1% of U.S. gas stations sell high-blend ethanol fuels. The alternative fuel vehicle refueling credit provides a financial incentive for E85 pumps, but that incentive may not be enough if ethanol continues to cost more than gasoline per energy equivalent unit. The U.S. Department of Energy (DOE) estimates that converting an existing tank to E85 would cost $20,000. For the

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117. DOT, DOE, & EPA, supra note 115, at 44.
118. See Dual-Fuel Vehicle, supra note 112.
119. RENEWABLE FUELS ASS’N, supra note 16, at 8.
120. See Budny, supra note 67, at 6.
122. Kiley, supra note 104, at 43.
123. See supra text accompanying notes 107–18 for a description of the CAFE credit.
conversion to be considered sufficiently profitable, the taxpayer would need at least a $0.15 gross margin on E85 sales.  If the price of ethanol is close to the price of gasoline, E85 sales would not be profitable. Even if the per gallon price of ethanol is less than gasoline, consumers will pay more for ethanol because cars get approximately two-thirds the mileage per gallon of ethanol than they do per gallon of gasoline. In July 2008, ethanol cost $3.27 per gallon and gasoline cost $3.91 per gallon. However, ethanol costs $4.62 on a per gasoline gallon equivalent basis.

The recent GAO report that criticized the DOE for failing to coordinate ethanol production with infrastructure development found that “[a]bsent a coordinated, strategic approach, the nation runs the risk of unnecessarily investing in fueling stations or FFVs that cannot be effectively utilized or of producing significant quantities of ethanol but not having an effective way to deliver the fuel to stations and consumers.” A 2007 legislative proposal designed to stimulate infrastructure development would have increased the alternative refueling station tax credit from 30% to 50% of the cost of qualified property, and increased the dollar cap to $50,000. The 2008 Farm Bill directed the Treasury to study the future production of biofuels and the effects of a dramatic increase in biofuel production.

3. Creation of Rural Jobs

A recent Congressional Research Service (CRS) report asserts that “there appears to be no doubt about the potential positive value of biofuels production to rural economies.” One study found that the ethanol industry created over 200,000 new jobs in all sectors.

125. Id.
127. Id.
128. Id.
129. GAO BIOFUELS, supra note 121, at 44. The GAO recommended that the DOE and the Treasury collaborate to evaluate and report on the effectiveness of biofuel-related tax expenditures in achieving their goals. Id. at 1.
during 2007. Yet, another recent study warns that “the gap between the rhetoric of promotion and the analysis of state economists is often immense.” This study indicated a much more modest economic impact. Another researcher noted that “the contributions [of ethanol] to the agricultural sector of our economy are... extensive.” While recognizing that estimates of the magnitude of the economic impact vary, the CRS concluded that rural economies reaped a net gain from ethanol production.

4. Conclusions Regarding the Shorter-Term Goals of Ethanol Tax Incentives

Since 1978, when Congress first introduced tax and other incentives for ethanol, production and demand have grown dramatically. Thus, the tax incentives have facilitated increasing ethanol production, even if the magnitude of their impact cannot be accurately assessed. Early ethanol users primarily consisted of federal and state government fleet vehicles required to use alternative fuels, and later, E10 users. Nonetheless, ethanol use will not meaningfully increase unless consumers can easily purchase vehicles that use higher blends of ethanol. The tax credit for refueling equipment encourages the development of infrastructure, although it may not be enough. An amended CAFE credit for flex fuel vehicles should continue to encourage manufacture of high blend ethanol cars. While incentives encouraging ethanol use lag behind those that

135. Id. at 13.
137. YACOBUCCHI & SCHNEPF, supra note 132, at 18.
Encourage production, the tax provisions nonetheless have a positive impact on nurturing demand.

Ethanol production does increase employment in rural areas. To the extent that tax incentives encourage production of ethanol, they have contributed to the creation of these rural jobs. In sum, the ethanol tax provisions are in large part responsible for progress made in achieving the United States’ shorter-term ethanol policy objectives outlined in this article. Meeting these goals, however, is not enough. If ethanol production and use do not significantly contribute to the United States’ broader policy goals of energy independence, then their efficacy is limited.

B. Longer-Term Goals of Ethanol Fuel Tax Incentives

1. Increasing Energy Security and Reducing Dependence on Foreign Oil

Encouraging the use of ethanol and other alternative fuels continues to be a U.S. government priority because reliance on imported oil subjects the U.S. economy to the volatility of the international petroleum market, implicating both price and supply effects. Three policy-makers succinctly described the U.S. energy problem:

Energy is fundamental to U.S. domestic prosperity and national security. In fact, the complex ties between energy and U.S. national interests have drawn tighter over time. The advent of globalization, the growing gap between rich and poor, the war on terrorism and the need to safeguard the earth’s environment are all intertwined with energy concerns.139

Ethanol supporters contend that domestically produced fuels are vital to U.S. energy security.140 U.S. oil production continues to decline while U.S. oil consumption shows little sign of slowing, until recently.141 In 2005, the United States used 7.6 billion barrels of oil,

140. See, e.g., RENEWABLE FUELS ASS’N, supra note 16, at 16.
importing over half. One researcher maintains that ethanol use in 2006 reduced U.S. oil imports by 200 million barrels. Another researcher concluded that “the security benefits [of biofuels] are substantial.” A 1999 study by Argonne National Laboratory reported that “corn-based E10 leads to a 3% reduction in fossil energy use per vehicle mile relative to gasoline, while use of E85 leads to roughly a 40% reduction in fossil energy use.” Even President George W. Bush believes that “the truth of the matter is it’s in our national interests that our farmers grow energy, as opposed to us purchasing energy from parts of the world that are unstable or may not like us.”

However, not all agree that ethanol is poised to be the solution to U.S. energy security concerns. Studies questioning the Argonne report conclude that the energy needed to produce ethanol is roughly equal to the energy released from ethanol combustion. A Canadian researcher notes that “from a ‘public good’ perspective, there is questionable advantage in exchanging dependency on one group of supplies (oil companies) to another (agribusiness).” Exchanging political volatility in the oil producing regions of the Middle East, West Africa, or Latin America for agricultural unpredictability intensifies the debate over ethanol use. Agricultural yields are subject to great variability, and impending climate change will exacerbate matters. If the U.S. corn producing regions experienced

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142. EIA, Consumption, supra note 141 (20.8 million barrels per day x 365 days = 7.6 billion barrels per year); see also Energy Info. Admin., Petroleum Navigator, U.S. Imports by Country of Origin, http://tonto.eia.doe.gov/dnav/pet/pet_move_impuscu_a2_nus_ep00_im0_mblpld_a.htm (last visited Jan. 4, 2009) (13.7 million barrels imported per day / 20.8 million barrels used per day = 66% of oil used in 2005 was imported).
143. URBAN-RUCK, supra note 133, at 13.
144. Tomain, supra note 136, at 459 (footnotes omitted).
145. YACOBUCCI, supra note 4, at 15 (citing M. WANG ET AL., ARGONNE NAT’L LAB., EFFECTS OF FUEL ETHANOL ON FUEL-CYCLE ENERGY AND GREENHOUSE GAS EMISSIONS (1999)).
147. YACOBUCCI, supra note 4, at 15.
148. See HESTER, supra note 58, at 10.
a major drought, researchers estimate that yields would decrease by about 25%, resulting in a 42% price increase for corn.\footnote{Simla Tokgoz et al., Ctr. for Agric. 

Even though ethanol replaces gasoline, by volume, fuel ethanol only makes up about 2.5% of U.S. gasoline consumption and only 1.5% of energy content.\footnote{Yacobucci, supra note 4, at 16; see also Mona L. Hymel, Globalisation, Environmental Justice, and Sustainable Development: The Case of Oil, 7 Macquarie L.J. 125, 148 (2007).} Moreover, some experts believe that trepidation over the consequences of political instability in the Middle East is exaggerated.\footnote{Hester, supra note 58, at 13.} In 2005, the Middle East only accounted for 16% of U.S. petroleum imports, while Canada, Mexico, and Venezuela accounted for 40%.\footnote{Id.}

A recent Organisation for Economic and Co-operation and Development report finds that most countries cannot make a significant dent in their use of imported oil by using biofuels.\footnote{Richard Doornbosch 
& Ronald Steenblik, Org. for Econ. 
Cooperation 
& Dev., Biofuels: Is the Cure Worse Than the Disease? 5 (2007).} The report discusses the difficulty in making biofuels price competitive with petroleum products and notes that “[h]igher oil prices will both raise the production cost of biofuels (as fossil fuels are an important input in the production process) and exert upward pressure on agricultural commodity prices as a result of the increased demand for them.”\footnote{Id.} Indeed, the European Union is re-evaluating its renewable fuels standard in light of concerns about world food shortages and other environmental hazards.\footnote{See James Kanter, Europeans Reconsider Biofuel Goal, N.Y. Times, July 8, 2008, at C1, available at http://www.nytimes.com/2008/07/08/business/worldbusiness/08fuel (“[T]he allure [of biofuels] has dimmed amid growing evidence that the kind of goals proposed by the European Union are contributing to deforestation, which speeds climate change, and helping force up food prices.”).} Thus, the United States’ ability to reduce oil imports and alleviate national security concerns with ethanol remains tentative.\footnote{One researcher has concluded that ethanol tax credits are more effective at producing energy security than hybrid vehicle credits. See Martin A. Sullivan, Energy Matchup: Ethanol Credits Outperform Hybrid Credits, 120 Tax Notes 393 (2008) (noting that “in contrast to the hybrid credit, the per-gallon ethanol credit tailors incentive effects to drivers’ mileage”).}

\begin{footnotes}
\item[150] Simla Tokgoz et al., Ctr. for Agric. 
\item[151] Yacobucci, supra note 4, at 16; see also Mona L. Hymel, Globalisation, Environmental Justice, and Sustainable Development: The Case of Oil, 7 Macquarie L.J. 125, 148 (2007).
\item[152] Hester, supra note 58, at 13.
\item[153] Id.
\item[154] Richard Doornbosch 
& Ronald Steenblik, Org. for Econ. 
Cooperation 
\item[155] Id.
\item[156] See James Kanter, Europeans Reconsider Biofuel Goal, N.Y. Times, July 8, 2008, at C1, available at http://www.nytimes.com/2008/07/08/business/worldbusiness/08fuel (“[T]he allure [of biofuels] has dimmed amid growing evidence that the kind of goals proposed by the European Union are contributing to deforestation, which speeds climate change, and helping force up food prices.”).
\item[157] One researcher has concluded that ethanol tax credits are more effective at producing energy security than hybrid vehicle credits. See Martin A. Sullivan, Energy Matchup: Ethanol Credits Outperform Hybrid Credits, 120 Tax Notes 393 (2008) (noting that “in contrast to the hybrid credit, the per-gallon ethanol credit tailors incentive effects to drivers’ mileage”).
\end{footnotes}
2. Reducing GHG Emissions

Climate change is a by-product of increased GHG emissions (primarily CO₂) in the atmosphere. Regardless of actions taken now, societies cannot prevent climate change (or global warming). The Earth’s temperature is rising, and the effects of climate change are increasingly visible. Growing biomass absorbs CO₂. But CO₂ is later released when the distilled biomass (e.g., ethanol) is used as fuel. Moreover, the additional fossil fuel needed to grow and process the ethanol releases additional GHGs into the atmosphere. Whether the GHGs emitted by the production and use of ethanol are greater than gasoline’s GHG emissions depends on both the feedstock used to produce the ethanol and the type of fossil fuel used in the ethanol manufacturing process. Ethanol can be produced from a variety of biomass sources, some more efficient than others and some with more environmental impact than others. In the United States, corn constitutes 90% of the raw material for ethanol production. Corn is a less efficient ethanol source than other sources, such as sugarcane. But unlike sugarcane, corn grows well in the heartland of America. As corn is currently the primary ethanol input, and will be so for the immediate future, this section discusses the GHG emissions from corn ethanol and its current production methods.

Supporters contend that ethanol combustion produces lower emissions of GHGs, as well as lower emissions of toxic and ozone-forming pollutants. In Brazil, researchers found that using ethanol lowered sulfur, particulate matter, and carbon monoxide emissions. Scientific research indicates that ethanol provides a net energy

158. See, e.g., Bill McKibben, Carbon’s New Math: To Deal with Global Warming, the First Step Is to Do the Numbers, NAT’L GEOGRAPHIC, Oct. 2007, at 33–34.
159. See, e.g., id.
160. YACOBUCCHI, supra note 10, at 2.
161. See BUDNY, supra note 67, at 4.
163. YACOBUCCHI, supra note 10, at “Summary.” A recent study disputes the claim that ethanol reduces harmful emissions, finding instead that ethanol increases ozone under certain circumstances and can harm respiratory health. See Mark Z. Jacobson, Effects of Ethanol (E85) versus Gasoline Vehicles on Cancer and Mortality in the United States, 41 ENVT. SCI. & TECH. 4150, 4153–54 (2007).
benefit (NEB). A NEB means that the energy value in the fossil fuel used to make ethanol is less than the energy value derived from the ethanol that is produced. The NRDC recently reviewed six studies on ethanol production and found flaws in the one study concluding that ethanol produces a negative energy return. Positive ethanol energy returns indicated in the other five studies ranged from 1.29 to 1.65, with a return over 1.0 representing a positive benefit. Determining whether these returns satisfy the EISA 2007 requirement that renewable fuels reduce GHG emissions by at least 20% is a complex task. Nonetheless, the EPA estimates that corn-based ethanol reduces fuel-cycle GHG emissions by 21.8% per mile relative to gasoline.

U.S. ethanol is largely produced from corn feedstock. Each acre of corn will produce, on average, 138 bushels of grain, and 2.7 bushels of grain will produce a gallon of ethanol. Yield varies according to weather and soil conditions. In 2006, the United States had 78.3 million acres planted in corn with about 15% of the corn harvest used for ethanol production. The farm equipment needed to plant, grow, and harvest corn typically runs on fossil fuels. In addition, farmers use pesticides and fertilizers, in varying amounts depending upon the type of corn planted and the soil conditions. Fertilizer is frequently made from natural gas, a fossil fuel. Planting, growing, and harvesting corn accounts for approximately 30% of the total

165. See McElroy, supra note 19, at 20.
167. Id.
171. Pike & Robinson, supra note 169.
fossil energy used in the production of ethanol.173 The remaining 70% is expended while processing the corn starch into ethanol.174 Also, ethanol cannot be transported by pipeline because of its corrosive properties and its tendency to precipitate water.175 Thus, ethanol must be transported by fossil fuel-intensive transport, such as truck, rail, or ship.176 On the other hand, the production of ethanol also yields valuable co-products, such as animal feed.177 Counting the energy value of the co-products increases ethanol’s NEB, although the NEB of corn ethanol is slightly positive even without co-products.178

A positive NEB, however, does not necessarily equal a net saving in GHG emissions. The distilling process requires heat, and heat requires fuel. The United States primarily uses natural gas (38%) or coal (51%) as distilling fuel,179 and these emissions increase the CO₂ cost of ethanol.180 In contrast, a number of Brazilian ethanol plants use waste sugarcane material to fuel the stills, resulting in no net carbon emissions.181 In Brazil, the Renewable Fuels Association (RFA) claims that using ethanol instead of gasoline significantly reduces carbon emissions.182 The study by the RFA concluded that


174. See id. (distinguishing between energy required for corn production and energy for ethanol production; 30% of energy is used in corn production). There are two main methods of producing ethanol: wet milling and dry milling. See Michael S. Graboski, Fossil Energy Use in the Manufacture of Corn Ethanol 15 (2002), available at http://www.ncga.com/ethanol/pdfs/energy_balance_report_final_R1.PDF. Production of ethanol requires separation of the starch from the corn, followed by fermentation, followed by a series of distillations to remove the water and concentrate the alcohol. Id.

175. Hester, supra note 58, at 8. Hester notes, however, that in Brazil, one operator does transport ethanol and gasoline on the same pipeline but in different batches. Id.

176. Id. at 3 (“In the absence of an existing pipeline and transportation infrastructure, part of the [increasing] expense [of ethanol plants] is attributed to the need to build appropriate rail transportation terminals in each plant.”).


178. Id. at 10.


181. McElroy, supra note 19, at 13. In fact, burning bagasse (the waste sugarcane) generates more energy than needed to produce the ethanol. The excess energy generates electricity that is sold to the national grid. Id.

“energy balance results of ethanol depend heavily on system boundary choices[,]” and “the debate on energy balance itself may have little practical meaning.”

Indeed, the array of variables affecting energy balance and GHG emissions is dizzyingly complex, ranging from ground preparation (no-till, low-till, conventional till, no residue) to the energy source used for distilling the final product. Further, even if the feedstock remains the same, increasing demand would result in increased GHG emissions from ethanol use because land formerly set aside for conservation will likely be returned to cropland. Two researchers recently observed that “uncultivated acres absorb atmospheric carbon, so farming them and converting the corn into ethanol could release more CO₂ into the air than would burning gasoline.”

The research also indicated that converting native grassland to corn production could lead to a “carbon debt” that would not be repaid for ninety-three years. Carbon debt is defined as the amount of CO₂ released during the first fifty years of land clearing. Until the carbon debt is repaid, biofuels produced on converted lands actually emit more GHG than the fossil fuels they replace. Research indicates that “even if corn-ethanol caused no emissions except those from land use change, overall GHGs would still increase over a 30 year period.” The GHG impacts of biofuels cannot be accurately determined without taking land use change into account.

If ethanol subsidies are intended to help reduce fossil fuel use and GHG emissions, assessing the effectiveness of these gasoline helps to reduce carbon dioxide (CO₂) emissions by up to 29% given today's technology.”


184. Graboski, supra note 174, at 14 (noting that reduced tillage reduces the need for fertilizer but increases the need for pesticides).


187. Id. at 1235.

188. Id.


190. See, e.g., id.
incentives will prove extremely difficult because so many variables can affect the results.\footnote{191}

Many scientists and policy-makers view the development of cellulosic ethanol as key to increasing U.S. biofuel use.\footnote{192} The Senate Farm Bill included a fossil-free alcohol production credit of $0.25 per gallon.\footnote{193} Such a credit would encourage the United States to go the way of Brazil, by stimulating the use of waste agricultural products to generate electricity to process ethanol, rather than using fossil fuel energy.\footnote{194} In testimony before the Senate Finance Committee, Vinod Kholsa, Sun Microsystems founder, stated that corn must be viewed as a gateway feedstock for ethanol, and that the development of cellulosic ethanol fuel can be cost effective as early as 2009.\footnote{195} Ethanol produced from switchgrass or other cellulosic sources could reduce lifecycle GHG emissions by 88\%, as compared to an average 18\% for corn-based ethanol.\footnote{196} Recognizing cellulosic ethanol’s potential, the 2005 Energy Bill increased the credit toward RFS for cellulosic ethanol.\footnote{197} Every gallon of cellulosic ethanol counts as 2.5 gallons of sugar- or starch-based ethanol.\footnote{198} Under EISA 2007, Congress added a separate mandate for cellulosic ethanol.\footnote{199} And if lawmakers’ support for corn ethanol is waning, support for cellulosic

\footnote{191. In an interesting recent analysis, Martin Sullivan concludes that “reduction in global warming is at best a sideshow in our ethanol policy.” Martin A. Sullivan, Putting New Energy Into Ethanol Policy, 120 TAX NOTES 285, 287 (2008). Assuming that substituting ethanol for gasoline results in an 18\% reduction in GHG emissions and a social cost of carbon of $30 per ton, Sullivan estimates that reduction of GHG emissions justifies an ethanol subsidy of just over six cents. \textit{Id}.}

\footnote{192. See David Tilman et al., Carbon-Negative Biofuels from Low-Input High-Diversity Grassland Biomass, 314 SCIENCE 1598 (2006); see also Alexander E. Farrell et al., Ethanol Can Contribute to Energy and Environmental Goals, 311 SCIENCE 506 (2006); Robert F. Service, Biofuel Researchers Prepare to Reap a New Harvest, 315 SCIENCE 1488 (2007).}


\footnote{194. \textit{See supra} note 181 and accompanying text (describing Brazil’s use of bagasse to fuel ethanol plants).}


\footnote{197. \textit{Yacobucci & Schnepp, supra} note 132, at 4.}

\footnote{198. \textit{Koplow, supra} note 13, at 20.}

\footnote{199. \textit{Id.} at 43.
ethanol remains strong.\footnote{200} In the 2008 Farm Bill, Congress added a $1.01 credit for biofuel produced from cellulosic sources.\footnote{201} However, commercial scale production of ethanol from cellulosic sources remains elusive, despite years of research.\footnote{202}

The current ethanol tax incentives do little to help the United States achieve the broader national policy objectives as intended by Congress. Although corn ethanol produces a modest positive NEB, after taking into account land use effects and the fossil fuel consumption during ethanol production, the United States’ current ethanol production likely increases GHG emissions.\footnote{203} In addition, considering production capacity limits and inefficiencies, along with historic trends toward increasing U.S. fuel consumption, ethanol production does not increase energy security or reduce dependence on foreign oil.

The biggest beneficiaries of ethanol subsidies are a small number of big agricultural companies, with Archer Daniels Midland (ADM) topping the list. In 2006, ADM produced more than one billion gallons of ethanol, representing over 20% of the total U.S. ethanol production.\footnote{204} In 1995, one analyst estimated that ADM received 43% of its profits from products heavily subsidized by the U.S. government.\footnote{205} Since 2000, ADM has contributed $3.7 million to state and federal politicians, reaping large returns.\footnote{206} In 2003, researchers calculated that for every dollar spent by ADM on campaign contributions, the company received $2,500 in tax benefits.\footnote{207} In short, independent farmers will not benefit nearly as much from ethanol subsidies as large agribusiness concerns. Ethanol production is geographically concentrated as well. The top ten ethanol producing states are (1) Iowa, (2) Nebraska, (3) Illinois, (4) Minnesota, (5)
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South Dakota, (6) Indiana, (7) Wisconsin, (8) Kansas, (9) Ohio, and (10) Texas.\footnote{208} Senator Charles Grassley of Iowa stated recently that “ethanol is good, good, good.”\footnote{209} Iowa’s key role in presidential election politics, as the first state to hold a presidential primary election, means all presidential candidates love ethanol, at least while they are in Iowa.\footnote{210} Such political maneuvering inhibits a balanced approach to the benefits and burdens of ethanol. One commentator complained that “the whole point of corn ethanol is not to solve America’s energy crisis, but to generate one of the great political boondoggles of our time.”\footnote{221}

IV. COLLATERAL DAMAGE

A. Food Supply

As a basic food grain, corn is an indispensable food in much of the impoverished world. Articles in the popular press debate whether using food for fuel will raise food prices and exacerbate world hunger.\footnote{212} Parties on either side of the issue take strong positions. On the one hand, the National Corn Growers Association (NCGA) asserts that if any corn shortage occurs, the setback will be temporary.\footnote{213} NCGA predicts corn prices will level off because farmers will overproduce.\footnote{214} In a Washington Post interview, Rick Tolman, NCGA’s Chief Executive, stated that “[f]armers have a way of, every time prices go high, they almost always overproduce until
they drive down the price to the marginal level where they can’t make any money anymore." On the other hand, Lester Brown of the Earth Policy Institute warns that in the battle between rich nations that want to fill their cars and poor nations that want to feed their people, the rich may win, to the detriment of the entire planet. Brown notes that even if the United States converted its entire (current) grain harvest to ethanol, the fuel would satisfy less than 16% of U.S. automotive fuel use. Jeff Goodell, an environmental journalist, points out that the 450 pounds of corn needed to make enough ethanol to fill an SUV tank also contains enough calories to feed a person for an entire year. Corn plays an important role in the U.S. and world economies even without considering corn-ethanol issues. With ethanol production increasing, policy-makers must assess changes in the corn economy and set priorities as changes in supply or demand occur.

The U.S. Department of Agriculture’s 2007 long-term projections indicate that corn prices will reach a record high of $3.75 per bushel by 2009. This price would exceed the previous high average over any 5-year period by more than $0.50 per bushel. Corn accounts for 50–60% of livestock feed, so increased prices for corn will result in higher priced milk, cereal, eggs, meat, and poultry.

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215. Id. Although this sentiment seems patronizing toward NCGA’s clients, it is undeniable that a similar situation occurred during the Dust Bowl era. See generally TIMOTHY EGAN, THE WORST HARD TIME: THE UNTOLD STORY OF THOSE WHO SURVIVED THE GREAT AMERICAN DUST BOWL 59 (2006) (When wheat prices went up, farmers planted more and more wheat, until the United States had a food surplus. Then, when wheat prices went down, farmers continued to plant more and more wheat, because they had debts to pay.). Moreover, these predictions appear to be coming true. See Clifford Krauss, Ethanol’s Boom Stalling as Glut Depresses Price, N.Y. TIMES, Sept. 30, 2007, at B1.

216. Brown, supra note 212.

217. Id.

218. Goodell, supra note 206, at 52.


220. See WESTCOTT, supra note 219, at 6, 17 (explaining that retail food prices are anticipated to rise more than the inflation rate); see also Rosenwald, supra note 212 (“‘Anybody that knows anything about the marketing of corn knows that when you raise the price of corn you are going to create problems in all of the markets that use corn.’” (quoting Ronald W. Cotherill, Director, The Food Marketing Policy Center at the University of Connecticut)).
The increased prices of U.S. corn will affect food costs worldwide because the United States typically accounts for 60–70% of world corn exports. In addition, crops that compete for farm land with corn, such as soybeans, wheat, and rice, are also anticipated to increase in price. A United Nations report found that liquid biofuel production could threaten the availability of adequate food supplies by diverting land and other productive resources away from food crops. Since 2003, maize (a form of corn) and wheat prices have more than doubled. Increased biofuel demand is estimated to have accounted for 30% of the weighted average increase of cereal prices. Moreover, rising oil prices spur increased biofuel demand, disrupting the food supply and triggering higher food prices.

The evidence of food supply disruption from increased corn ethanol production justifies significant concerns. Although increased food prices will impact people worldwide, people will suffer far more in less developed countries. A predicted 10% increase in U.S. retail prices for affected products could also lead to inflation and hardship in the United States. The average American spends about 10% of her disposable income on food. In contrast, for the developing world’s 820 million undernourished people, the percentage of disposable income spent on food ranges from 50% to 80%. A 10% price increase could be devastating, and even life-threatening in poorer parts of the world. Some scientists have called for a

\section*{B. Environmental Effects of Ethanol Production}

The most significant environmental effects of ethanol production result from increased acreage in corn. In 2006, the United States had 78.3 million acres planted in corn.\footnote{233 \textsc{Nat’l Agric. Statistics Serv.}, U.S. Dep’t of Agric., \textit{supra} note 71, at 5.} In one year, U.S. corn fields expanded to 92.9 million acres.\footnote{234 \textit{Id.}} Corn uses more fertilizers and pesticides per unit of land than any other biofuel feedstock.\footnote{235 \textsc{Comm. on Water Implications of Biofuels Prod. in the U.S.}, Nat’l Res. Council, \textit{Water Implications of Biofuels Production in the United States} 27 (2008).} The conversion of other crops or non-crop plants to corn will likely lead to much higher application rates of nitrogen fertilizer, increasing nitrogen runoff and nutrient pollution in the Gulf of Mexico and other waterways.\footnote{236 \textit{Id.} at 31.} Pesticide application also poses environmental risks causing detrimental human health effects. As pesticide use will increase with the growing corn-ethanol crop, higher human exposure to pesticides will exact a human toll as well.\footnote{237 See Rose Hoban, \textit{Premature Birth May Be Linked to Pesticides}, NewsVOA.com, May 15, 2007, http://www.voaenglish.com/english/archive/2007-05/2007-05-15-voa32.cfm?CFID=44409034&CFTOKEN=82465633 (explaining that the premature birth rate increases with exposure to pesticides).} Ethanol fuel combustion may also be hazardous to human health. Ethanol has been touted as a clean fuel,\footnote{238 In Brazil, researchers found that using ethanol lowered sulfur, particulate matter, and carbon monoxide emissions. See Goldemberg, \textit{supra} note 164, at 809.} yet one study concluded that ethanol increases ozone under certain circumstances and can harm respiratory health.\footnote{239 \textit{See Jacobson, supra} note 163, at 4150.} The human health effects of increased ethanol production and use must be analyzed as part of any NEB determination.

Ethanol production also requires significant amounts of water. A biorefinery that produces one hundred million gallons of ethanol per year would use as much water as a town of about five thousand people.\footnote{240 \textit{See Comm. on Water Implications of Biofuels Prod. in the U.S.}, Nat’l Res. Council, \textit{supra} note 235, at 5.} Moreover, chemical manufacturing plants must meet the
environmental pollution standards mandated under the Clean Air Act. A regulation promulgated in May 2007 exempts ethanol plants from the “major source” rules of the Clean Air Act.\textsuperscript{241} Yet, in 2002, EPA reported “[s]urprising” levels of volatile organic compound emissions from ethanol plants.\textsuperscript{242} The volatile organic compounds being released by ethanol plants include carcinogens, formaldehyde, and acetic acid.\textsuperscript{243} Policymakers should reevaluate ethanol’s exemption from the Clean Air Act.

V. CONCLUSIONS AND RECOMMENDATIONS

Ethanol’s role in the U.S. energy mix continues to unfold. This article evaluates the problems with ethanol production and use, the structure of federal ethanol tax incentives, and considers whether encouraging ethanol use is an appropriate function for the tax system.\textsuperscript{244} Since first enacted, U.S. tax incentives for ethanol production have, in fact, encouraged increased ethanol fuel production. However, increasing production of corn-based ethanol will not be effective in achieving the broader goals of energy security or reductions in GHG emissions.\textsuperscript{245} A recent economic study analyzing the benefits and costs of ethanol concluded that, at best, the costs of ethanol exceeded the benefits by a factor of five.\textsuperscript{246} Removing the ethanol tax credit and the import tariff would reduce ethanol production by four billion gallons and save taxpayers about one billion dollars annually.\textsuperscript{247} Federal Reserve Chairman Ben Bernanke agreed that eliminating the import tariff would help the economy.\textsuperscript{248}

\begin{itemize}
\item \textsuperscript{241} 40 C.F.R. § 71.2 (2007).
\item \textsuperscript{243} Id.
\item \textsuperscript{245} See OFFICE OF TRANSP. AND AIR QUALITY, U.S. ENVTL. PROT. AGENCY, GREENHOUSE GAS IMPACTS OF EXPANDED RENEWABLE AND ALTERNATIVE FUELS USE 1–2 (2007), available at http://www.epa.gov/oms/renewablefuels/420f07035.pdf. The same study found an over 90% GHG reduction for cellulosic ethanol. Id. at 2.
\item \textsuperscript{246} ROBERT HAHN & CAROLINE CECOT, AEI-BROOKINGS JOINT CTR., WORKING PAPER NO. 07-17, THE BENEFITS AND COSTS OF ETHANOL: AN EVALUATION OF THE GOVERNMENT’S ANALYSIS 21 (2007).
\item \textsuperscript{247} Id. at 14.
\item \textsuperscript{248} See Streitfeld, supra note 100.
\end{itemize}
Tax incentives, however, are only one tool in the government’s toolbox. Reducing oil use and GHG emissions could be addressed in a number of more efficient ways, such as enacting additional incentives for conservation and energy efficiency. In addition, rather than providing incentives for only specified alternative fuels, researching and developing new fuel technologies or increasing the efficiency of existing technologies would better serve U.S. energy independence goals. Indeed, the attention on ethanol may distract researchers from developing new energy possibilities.\textsuperscript{249} Professor John Dernbach believes that “energy efficiency is in many ways the most attractive of the major approaches to addressing climate change . . . . Improving energy efficiency and reducing overall energy consumption, in sum, involve more than the environment; they are also necessary for economic, security, and social reasons.”\textsuperscript{250} One analysis showed that the ethanol tax credit discourages rather than encourages fuel conservation.\textsuperscript{251}

The United States could achieve large efficiency gains if the government eliminated policies that encouraged driving. The tax system offers many incentives that encourage driving, such as the fringe benefit for parking and the home mortgage interest deduction.\textsuperscript{252} Instead of trying to produce more ethanol and make it cheaper, the government should tax gasoline and make it more expensive to drive, thus encouraging citizens to get out of their cars.\textsuperscript{253} The United States imposes the lowest gas tax of any industrialized country.\textsuperscript{254} Increasing the gas tax, and thereby pushing the environmental and security costs into the marketplace, would allow the market to determine how to deal with the true cost of fossil fuels—by conservation, alternative fuels, or some combination.

The government should not favor any specific fuel or technology, rather, the market should be permitted to weed out the losers and

\begin{footnotes}
\footnote{249. HAHN & CECOT, \textit{supra} note 246, at 15.}
\footnote{251. See Sullivan, \textit{supra} note 191, at 286.}
\footnote{253. See Sullivan, \textit{supra} note 191, at 286. “The best way for government to reduce bad things is to tax them. Providing a subsidy for good things in the hope that it will reduce bad things has side effects that diminish or even negate the policy’s potential benefit.” \textit{Id.}}
\footnote{254. Mann, \textit{supra} note 252, at 655.}
\end{footnotes}
cultivate the winners. And yet, competition, while efficient in the free market, is the very characteristic that makes an increased gas tax politically difficult. “Winners” of government subsidies will use their competitive advantages attained in the market to keep and increase their government (i.e., non-market) winnings. At least one political expert, Donald Susswein, believes that the gas tax could be increased in a politically palatable way by raising the gas tax by $0.15 per year for fifteen years. Phasing in the tax allows consumers time to adjust, and ultimately a $2.25 per gallon tax is still much less than in most Western European countries. To reduce any regressive effect of a gas tax, Susswein would use gas tax revenues to reduce employment taxes. Susswein advocates starting with a gas tax, and ultimately broadening the tax to other fuels or carbon sources. He explains:

The approach of starting with motor fuels—and turning later to other fuels—makes sense practically and politically. It will likely take several years to reach consensus on exactly how to structure new taxes on other fuels and carbon sources—perhaps with special rates or exemptions for cleaner fuels. In the meantime, we can make substantial progress in the motor fuel area, where we have a well-established and smoothly running tax collection system.

The evidence regarding ethanol’s promise as an alternative to gasoline fuel leads to the conclusion that ethanol does not deserve to be a big winner. Its positive net energy balance is small. With corn as the primary feedstock, ethanol has serious environmental drawbacks. Tax policymakers are not qualified to pick technology winners, but the ethanol tax incentives have that effect. Rather than spending billions of dollars encouraging the production and use of ethanol, the U.S. government should eliminate subsidies for gasoline transportation, encourage energy efficiency and conservation, and implement fuel taxes to more accurately reflect gasoline’s national security and environmental costs.

256. Id.