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Malinda McAleer-Pennington

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CAN BIOFUELS SOLVE THE PROBLEMS OF AMERICAN FOREIGN OIL DEPENDENCE?

MALINDA MCALEER-PENNINGTON

I. OIL DEPENDENCE IS A GROWING PROBLEM FOR AMERICA

America's oil consumption continues to increase,[1] while capacity for domestic oil production steadily decreases.[2] America, as a result of this

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[1] Energy Info. Admin., U.S. Weekly Petroleum Products Supplied (Thousand Barrels Per Day), http://tonto.eia.doe.gov/dnav/pet/hist/wrpupus24.htm (last visited June 1, 2008) (showing that America's petroleum demand has increased from an average of more than 17,000 thousand barrels per day in 1990 to over 21,000 thousand barrels per day in 2007).

[2] Energy Info. Admin., U.S. Crude Oil Proved Reserves (Million Barrels), http://tonto.eia.doe.gov/dnav/pet/hist/rcrr01nus_1a.htm (last visited June 1, 2008) (showing that proven reserves have decreased from some 35,000 million barrels in 1973 to

dynamic,[3] is increasingly dependent on foreign oil;[4] and the financial cost of this dependence is a heavy burden.[5] For example, "oil imports in 2005 exceeded $300 billion and accounted for 35[%] of our nation's trade deficit."[6]

Additionally, oil dependence threatens American security because America is ill-equipped to deal with an interruption in supply.[7] The majority of its oil, furthermore, is imported "from unstable regions of the world with strong anti-American sentiment."[8] Involvement in these oil rich regions[9] also damages America's global image as protesters in national and international communities question just how much America is willing to risk securing its oil interest.[10] "No blood for oil" is a common slogan amongst

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approximately 21,000 million barrels in 2006); U.S. ENVTL. PROT. AGENCY, EPA420-R-07-004, REGULATORY IMPACT ANALYSIS: RENEWABLE FUEL STANDARD PROGRAM 15 (2007) [hereinafter RFS IMPACT ANALYSIS], *available at* http://earth1.epa.gov/OMSWWW/renewablefuels/420r07004.pdf (explaining that, even as the refining capacity for individual refineries has increased, the number of refineries has decreased by 47% since the 1970s).

3 RFS IMPACT ANALYSIS, *supra* note 2, at 16 ("The decrease in U.S. refining capacity . . . has resulted in increases in the amount of gasoline and diesel fuels imported in the U.S.").

4 *Id.* (America "imports approximately 70[%] of all petroleum products used, with two-thirds of these products being used for transportation." Crude oil imports from 1973 to 2004 tripled in volume, and "the amount of gasoline imported has increased from 2 to 7.4 billion gallons per year, more than three times the amount of volume.").

5 S.C. STRATEGIC & TACTICAL RESEARCH ON ENERGY INDEPENDENCE COMM'N, SOUTH CAROLINA'S STRATEGIC ENERGY ROADMAP: BREAKING THE DEPENDENCE ON OIL AND FUELING THE FUTURE THROUGH ECONOMIC DEVELOPMENT 7 (2007) [hereinafter STREIC ROADMAP], *available at* http://www.energy.sc.gov/news/STREIC%20Final%20Recommendations%201-23-07.pdf ("The U.S. Department of Energy estimates that each $1 billion in trade deficit costs the United States 27,000 jobs.").

6 *Id.*

7 NAT'L COMM'N ON ENERGY POLICY, ENDING THE ENERGY STALEMATE, A BIPARTISAN STRATEGY TO MEET AMERICA'S ENERGY CHALLENGES 7 (2004) [hereinafter ENDING THE ENERGY STALEMATE], *available at* http://www.energycommission.org/files/contentFiles/report_noninteractive_44566feaabc5d.pdf (explaining that the Strategic Petroleum Reserve at its 2004 level of 92% is only "the equivalent of 53 days of imports").

8 STREIC ROADMAP, *supra* note 5, at 7.

9 Bob Ingles, Hydrogen: Can Work, Can Run!, http://www.inglis.house.gov/issues.asp?content=sections/issues/hydrogen_homepage (last visited June 1, 2008) (providing a diagram showing the extent to which American oil reserves are exceeded by those of Middle Eastern nations); U.S. Dep't of State, Background Note: Kuwait, http://www.state.gov/r/pa/ei/bgn/35876.htm (last visited June 1, 2008) (indicating that the five nations with the largest oil reserves are Saudi Arabia, Canada, Iran, Iraq, and Kuwait).

10 *See, e.g.*, Editorial, *Thousands Protest Iraq War on 3rd Anniversary: Across the Globe, Demonstrators Demand U.S. Withdraw its Troops*, ASSOC. PRESS, Mar. 20, 2006, *available at* http://www.msnbc.msn.com/id/11887714/; *Australia Launches Anti-War Protests*, BBC NEWS, Feb. 14, 2003, http://news.bbc.co.uk/2/hi/asia-pacific/2761437.stm (last visited June 1,

these protesters.[11] Moreover, competition for this limited resource continues to increase,[12] unaffected by record high prices,[13] as "Asian economies, led by India and China, rapidly expand."[14]

Oil dependence also causes financial and security concerns on a state level. South Carolina, for example, "consume[s] over 4.6 billion gallons of petroleum each year . . . [and] spent about $10 billion on petroleum products in 2005."[15] Most of the money leaves the state because "South Carolina lacks petroleum reserves or refining capacity."[16] Additionally, South Carolina's dependence on "two vulnerable pipelines originating in Louisiana"[17] subjects it to dramatic price increases[18] when natural disasters, such as Hurricane Katrina, affect that region's petroleum facilities.[19]

American oil dependence also has created environmental problems. Pollutants from the combustion of oil[20] are proven to produce a variety of health problems, for example, respiratory irritation and asthma.[21] They are

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2008); *Secret U.S. Plans for Iraq's Oil* (BBC television broadcast, *Newsnight*, Mar. 17, 2005), transcript *available at* http://news.bbc.co.uk/1/hi/programmes/newsnight/4354269.stm.

[11] *See, e.g.*, Bernd Debusmann, Op-Ed., *Greenspan, Oil, and Osama bin Laden*, REUTERS, Sept. 26, 2007, *available at* http://www.reuters.com/article/latestCrisis/idUSL2666303; *Australia Launches Anti-War Protests*, *supra* note 10; CNN.com, Democratic National Convention Daily Schedule, http://www.cnn.com/ELECTION/2004/special/president/convention/dnc/schedules/ (last visited June 1, 2008).

[12] *See* STREIC ROADMAP, *supra* note 5, at 7.

[13] *See* Steve Hargreaves, *Oil Tops $80 a Barrel, An All Time High*, CNN MONEY, Sept. 12, 2007, http://money.cnn.com/2007/09/12/markets/oil_record/index.htm?eref=rss_topstories (last visited June 1, 2008).

[14] STREIC ROADMAP, *supra* note 5, at 7.

[15] *Id.*

[16] *Id.*

[17] S.C. BIOMASS COUNCIL, ENERGY FREEDOM AND RURAL DEVELOPMENT ACT: WHY THIS LEGISLATION IS NEEDED NOW 1 (2007), *available at* http://www.scbiomass.org (search for "Energy Freedom and Rural Development Act").

[18] SouthCarolinaGasPrices.com, Historical Gas Price Charts, http://www.southcarolinagasprices.com/retail_price_chart.aspx (last visited June 1, 2008) (reporting that prices at South Carolina pumps have increased in 5 years from $1.23 in May 2003 to $3.77 in May 2008).

[19] *Id.* (showing a dramatic increase in gas prices during August 2005 that reflects the impacts of Hurricane Katrina on Louisiana's petroleum facilities).

[20] These harmful pollutants include various hydrocarbons ("NMHC"), carbon monoxide ("CO"), oxides of nitrogen ("NOx"), particulate matter ("PM") (precursors to ozone and haze), and toxics (which include benzene, acetaldehyde, formaldehyde). *See* Control of Hazardous Air Pollutants from Mobile Sources, 72 Fed. Reg. 8428, 8441 (Feb. 26, 2007) (codified at 40 C.F.R. Parts 59, 80, 85, and 86).

[21] U.S. Envtl. Prot. Agency, Ozone, http://epa.gov/ARD-R5/naaqs/ozone.htm (last visited June 1, 2008); *see also*, Press Release, S.C. Dep't of Health & Envtl. Control, Residents Cautioned About Ozone Conditions (Aug. 13, 2007), *available at* http://www.scdhec.gov/

also suspected of causing more serious diseases, for example, cancers and heart disease.[22] Petroleum emissions also include greenhouse gases ("GHGs")[23] that are linked to the acceleration of climate change.[24] Carbon dioxide ("CO_2") is recognized as a primary GHG,[25] and motor vehicles contribute about one-third of America's overall CO_2 emissions.[26] While state and federal governments have worked together to reduce health threatening oil combustion emissions since the enactment of the Clean Air Act,[27] recently increased interest in climate change[28] has invigorated

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administration/news/2007/nr20070813-01.htm. *See generally* Press Release, Greenville County (S.C.) Govt., Ground-level Ozone and Particle Pollution (PM2.5), *available at* http://www.greenvillecounty.org/County_Administrator/Administrators_Report.asp (stating that ozone causes acute respiratory problems such as shortness of breath, chest pain, wheezing, and coughing; aggravates asthma; and impairs the body's immune system defenses, making people more susceptible to respiratory illness, including bronchitis and pneumonia).

[22] U.S. Envtl. Prot. Agency, Particulate Matter, http://www.epa.gov/ARD-R5/naaqs/pm.htm (last visited June 1, 2008) ("A March 2002 study suggests . . . that airborne particles can cause lung cancer" and the "EPA has estimated that airborne particles cause over 15,000 premature deaths in the United States per year.").

[23] Massachusetts v. EPA, 127 S. Ct. 1438, 1459-62 (2007) (holding that the greenhouse gases carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and hydrofluorocarbons (HCFCs) "from new motor vehicles" are within the EPA's regulatory).

[24] *See* Richard B. Alley et al., *Summary for Policymakers*, *in* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS OF CLIMATE CHANGE: CONTRIBUTION OF WORKING GROUP I TO THE FOURTH ASSESSMENT REPORT OF THE IPCC 2-3 (Susan Solomon et al. eds., Cambridge Univ. Press 2007) [hereinafter IPCC WORKING GROUP I], *available at* http://ipcc-wg1.ucar.edu/wg/wg1-report.html.

[25] *Id.* at 2; *see also*, U.S. ENVTL. PROT. AGENCY, INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990-2005, at 2-1 (2007), *available at* http://www.epa.gov/climatechange/emissions/downloads06/07CR.pdf (CO_2 has accounted for "77[%] of global warming potential (GWP) weighted emissions since 1990.").

[26] MICHAEL DWORKIN, AN ENERGY POLICY FOR AMERICA: AN INTRODUCTION TO OUR TRILEMMA 29 (2007) (on file with author).

[27] *See, e.g.*, Clean Air Act § 107, 42 U.S.C. § 7407 (2000); DAVID FARREN & GUDRUN THOMPSON, SOUTHERN ENVIRONMENTAL LAW CENTER, CLEAN AIR FOR THE COLUMBIA AREA 5 (2005), *available at* http://www.southernenvironment.org/publications/columbia_air_report.pdf; S.C. Dep't of Health & Envtl. Control, Air Quality: About Us, http:// www.scdhec.gov/environment/baq/about.aspx (last visited June 1, 2008).

[28] *See, e.g.*, Gregory M. Lamb, *Deeper Level of Interest in Climate Fix*, CHRISTIAN SCI. MONITOR, Sept. 27, 2007, at 12; *Gore: Nobel Win a Chance 'to Change the Way People Think,'* CNN, Oct. 12, 2007, http://www.cnn.com/2007/POLITICS/10/12/nobel.gore/ (last visited June 1, 2008); Scott Horsley, *Interest in Climate Change Heats Up in 2008 Race* (NPR radio broadcast June 8, 2007), *available at* http://www.npr.org/templates/story/story.php?storyId=10840816 (follow "Listen Now" hyperlink).

federal[29] and state[30] governments to seek more thoroughly reduction of greenhouse gas emissions from motor vehicles.

America's policy makers and lawmakers support biofuels as one answer to ease the burdens of oil dependence.[31] The following section of this article will briefly present federal and—using South Carolina as the example—state legislation through 2007 that supports biofuels implementation in the transportation sector. It will then evaluate the results of implementation efforts subsequent to that legislation revealing two seemingly insurmountable limitations. This article then examines the recently enacted legislative response to these limitations, the fuels that this new legislation promotes, and the limits of this recent legislative solution. This article concludes by offering a state-based plan that is capable of furthering the federal government's efforts to implement biofuels.

II. FEDERAL AND STATE GOVERNMENTS' ACTION THROUGH 2007 TO ADVANCE BIOFUELS AS PART OF THE SOLUTION TO AMERICA'S OIL DEPENDENCE

On the federal level, the Energy Policy Act of 2005[32] ("EPAct05") and the Bush Administration's "Twenty in Ten" campaign[33] advance biofuels as a means to reduce oil dependence by: (1) implementing and expanding goals for a renewable fuel content in gasoline; (2) maintaining and extending

[29] *See, e.g.*, H.R. REP. NO. 102-474(IX) (1992), *reprinted in* 1992 U.S.C.C.A.N. 1953, 2422; ENDING THE ENERGY STALEMATE, *supra* note 7 (providing recommendations to meet America's growing energy challenges); NAT'L COMM'N ON ENERGY POLICY, ENERGY POLICY RECOMMENDATIONS TO THE PRESIDENT AND THE 110TH CONGRESS (2007), *available at* http://www.energycommission.org/files/contentFiles/NCEP_Recommendations_April_2007_4656f9759c345.pdf (providing recommendations on the best ways to address "the economic, national security, and environmental challenges" presented by current and future energy needs).

[30] *See, e.g.*, Governor Mark Sanford, Exec. Order No. 2007-04 (2007), *available at* http://www.scgovernor.com/executive/orders/ex_orders_2007.htm (establishing the South Carolina Climate, Energy & Commerce Advisory Committee ("CECAC")); South Carolina Climate, Energy, and Commerce Advisory Committee Homepage, http://www.scclimatechange.us/index.cfm (last visited June 1, 2008) (CECAC's purpose is to create policy recommendations that address the "implications that global climate change may have on the economy, environment and quality of life in South Carolina . . . .").

[31] *See infra* Part II.

[32] Energy Policy Act of 2005, Pub. L. No. 109-58, 119 Stat. 594 (2005) (codified as amended in scattered sections of 42 U.S.C., 7 U.S.C., 30 U.S.C., 16 U.S.C., 15 U.S.C., 10 U.S.C., 33 U.S.C., 25 U.S.C., & 26 U.S.C.).

[33] The White House, Twenty in Ten: Strengthening America's Oil Security, http://www.whitehouse.gov/stateoftheunion/2007/initiatives/energy.html [hereinafter Twenty in Ten] (last visited June 1, 2008).

financial incentives for soybean oil biodiesel and corn ethanol; and by (3) adding tax incentives to research, develop, and introduce other promising biofuels options to market.

EPAct05 charged the Environmental Protection Agency Administrator to "promulgate regulations to ensure that gasoline sold or introduced into commerce in the United States . . . on an annual average basis, contains the applicable volume of renewable fuel . . . ."[34] This Act set an original applicable volume of 7.5 billion gallons by 2012,[35] and EPA promulgated the Renewable Fuel Standard Program ("RFS") on September 1, 2007.[36] The Bush administration proposed to expand the RFS goal to 35 billion gallons by 2017 as a part of its "Twenty in Ten" campaign, the primary goal of which is to reduce American gasoline usage by 20% in 10 years.[37]

EPAct05 enacted and extended tax incentives to promote the production, distribution, and retail sales of biofuels. It specifically extended the volumetric excise tax for ethanol and biodiesel established by The Jobs Creation Act of 2004.[38] The volumetric excise tax allows any gas supplier—including producers, importers, and retailers[39]—to blend ethanol or biodiesel into another taxable fuel, such as gasoline, and to receive tax credit against the tax owed on the base fuel. The credit ranges from $0.50 to $1.00 per gallon for the total ethanol or biodiesel sold.[40] Additionally, the EPAct05 provided tax credit for retailers installing "alternative fueling stations"[41] and tax credit to consumers who purchase alternative fuel vehicles.[42]

EPAct05 also established a biofuels and bioproducts program. The program's goals include bringing the most promising biofuels to market by partnering "with industry and institutions of higher education" to develop commercial bioenergy applications, including "integrated biorefineries that may produce biopower, biofuels, and bioproducts."[43] These programs intend

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[34] Energy Policy Act of 2005 § 1501(c)(2)(A)(i), 119 Stat. at 1068 (amending 42 U.S.C. § 7545).

[35] *Id.* § 1501(c)(2)(B)(i), 119 Stat. at 1069.

[36] Renewable Fuel Standard, 40 C.F.R. § 80.1100 (2007).

[37] Twenty in Ten, *supra* note 33.

[38] Energy Policy Act of 2005 § 1344, 119 Stat. at 1052 (amending 26 U.S.C. §§ 40A, 6426, 6427); *see also* American Jobs Creation Act of 2004, Pub. L. No. 108-357, § 301, 118 Stat. 1418, 1459-63 (2004) (codified at scattered sections of 26 U.S.C.).

[39] American Jobs Creation Act of 2004 § 302(a), 118 Stat. at 1464 (amending 26 U.S.C. § 40A).

[40] *Id.* § 301(a), 118 Stat. at 1459 (amending 26 U.S.C. § 6426).

[41] Energy Policy Act of 2005 § 1342, 119 Stat. at 1050-51 (amending 26 U.S.C. § 30C).

[42] *Id.* § 1341, 119 Stat. at 1038-49 (amending 26 U.S.C. § 30B).

[43] *Id.* § 932(b), 119 Stat. at 871 (amending 42 U.S.C. § 16232).

to advance biofuels production processes that produce fuel, electricity, and other products, but do not utilize crops grown for food. Instead, the program centers on "biomass"[44] starting material. Biomass is defined as: waste from "food production and processing;"[45] waste from "forest-related resources"[46] such as thinning; and "wood waste materials" from a variety of industries.[47] Biomass also includes "lingnocellulosic feedstock" ("cellulosic"), which is defined as "any portion of a plant or coproduct from conversion, including crops, trees, forest residues, and agricultural residues not specifically grown for food . . . ."[48] Executive branch policy also supports the advanced biofuels and bioproducts program.[49] On February 28, 2007, the United States Department of Energy ("DOE") announced "that it will invest up to $385 million in six biorefineries [that utilize cellulosic starting materials] over the next four years."[50]

South Carolina legislation exemplifies state efforts to promote biofuels with tax incentives that echo EPAct05.[51] South Carolina's legislation: (1) extends tax incentives for the production and retail of corn ethanol and soybean oil biodiesel;[52] (2) provides income tax credits against taxes incurred pursuant to research, development, or demonstration of projects that utilize the most recent technologies—including enzymes and catalysts—for producing ethanol and biodiesel;[53] and (3) provides tax incentives for production processes that utilize the most "cost efficient feedstocks for South Carolina"—cellulosic starting materials.[54] South Carolina's legislation also supports the infrastructure required to promote biofuels by offering tax rebates to consumers who purchase "Flex Fuel"

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[44] *Id.* § 932(a)(1), 119 Stat. at 870 (amending 42 U.S.C. § 16232).
[45] *Id.* § 932(a)(1)(B).
[46] *Id.* § 932(a)(1)(C)(i).
[47] Energy Policy Act of 2005 § 932(a)(1)(C)(ii), 119 Stat. at 870.
[48] *Id.* § 932(a)(2), 119 Stat. at 870 (amending 42 U.S.C. § 16232).
[49] *See* Twenty in Ten, *supra* note 33.
[50] Press Release, U.S. Dep't of Energy, Energy Efficiency and Renewable Energy Office, DOE Invests $385 Million in Six Cellulosic Ethanol Projects (Feb. 28, 2007), http://www1.eere.energy.gov/biomass/news_detail.html?news_id=10603 (last visited June 1, 2008).
[51] Income Tax Act, S.C. CODE ANN. §§ 12-6-10 to -5595 (2007); Energy Freedom and Rural Development Act, S.C. CODE ANN. §§ 12-63-10 to -30 (2007); General Appropriation Act, 2006 S.C. Acts 116.
[52] Income Tax Act, S.C. CODE ANN. § 12-6-3600(A); Energy Freedom and Rural Development Act, S.C. CODE ANN. § 12-63-20(B)(1).
[53] Income Tax Act, S.C. CODE ANN. § 12-6-3631.
[54] *Id.* § 12-6-3631(D); *see also id.* § 12-6-3600(B) (explaining that the credit is limited to those ethanol facilities using "a feedstock other than corn" and those biodiesel facilities "using a feedstock other than soy oil").

vehicles—those designed to run on high blends of ethanol—[55]and tax credits for retailers who install biofuels distribution equipment.[56]

South Carolina's legislation, similar to federal legislation, on its face supports currently deployed biofuels and also promotes new biofuels.[57] However, the primary effect of government tax incentives through 2007 was to advance soy biodiesel and corn ethanol.

III. PROBLEMS WITH CROP-BASED BIOFUELS: FINANCIAL VIABILITY, CROPLAND EXPANSION, AND TRANSPORTABILITY

A. *Financial Viability*

The market share occupied by soy biodiesel[58] and corn ethanol[59] impressively progressed under legislation through 2007;[60] however, there

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[55] Energy Freedom and Rural Development Act, S.C. CODE ANN. § 12-63-20(A)(1)(a) (2007).
[56] *Id.* § 12-63-20(B)(1).
[57] *See supra* notes 43-56 and accompanying text.
[58] Biodiesel may use plant or animal matter and must produce a fuel that meets both the requirements promulgated by EPA and the American Society of Testing Materials ("ASTM") standard specifications for biodiesel fuel blend stock. American Jobs Creation Act of 2004 § 302(a), 118 Stat. 1418, 1463-65 (2004) (codified at 26 U.S.C. § 40A); *see also* I.R.C. § 40A (West Supp. 2008) (Biodiesel is "agri-biodiesel" if it is "derived solely from virgin oils, including esters derived from vegetable oils from corn, soybeans, sunflower seeds, cottonseeds, canola, crambe, rapeseeds, safflowers, flaxseeds, rice bran, and mustard seeds, and from animal fats."). The production process used to convert these starting materials to biodiesel is "transesterification," in which an acid or a base is used to catalyze the chemical reaction producing glycerin (sold for soaps) and soy meal (sold for animal feed) as co-products. ANTHONY RADICH, ENERGY INFO. ADMIN., BIODIESEL PERFORMANCE, COSTS, AND USE 4 (2004), *available at* http://tonto.eia.doe.gov/FTPROOT/environment/biodiesel.pdf.
[59] *See* Biomass Energy and Alcohol Fuels Act of 1980 § 102(1), 42 U.S.C. § 8802(1) (2000) (Ethanol was statutorily defined by as an "'alcohol' . . . which is produced from biomass and which is suitable for use by itself or in combination with other substances as a fuel or as a substitute for petroleum."); *see also* RFS IMPACT ANALYSIS, *supra* note 2, at 20 (providing an overview discussion of current ethanol production in the U.S.). "[A]lthough grain sorghum (milo), wheat, barley, beverage waste, cheese whey, and sugars/starches [can also be] fermented to make fuel-grade ethanol," corn is the most common starch crop used to produce ethanol in the U.S. There are two prevalent production methods for corn ethanol: dry milling and wet milling. In the future, "the vast majority of plants are expected to pursue dry milling technology." U.S. Dep't of Energy, Alternative Fuels and Advanced Vehicles Data Center: Ethanol, http://www.eere.energy.gov/afdc/fuels/ethanol.html (last visited June 1, 2008). The dry milling process, in which the "whole corn kernel is ground and converted to ethanol . . . . is relatively cost effective and requires less equipment than wet milling." Jim Core, *New Milling Methods Increase Corn Ethanol Production*, AGRIC. RESEARCH, July 2004, at 16, 16. However, dry milling has less food co-products and is criticized for directly competing with essential corn products. *See, e.g.*, Michael S. Rosenwald, *The Rising Tide of Corn*, WASH. POST, June 15, 2007, at D01; Brittany Sauser, *Ethanol Threatens Food Prices*,

are dynamic factors that limit the growth of these fuels. For soy biodiesel and corn ethanol blends to sell, and the biofuels market to achieve and maintain viability, such fuels must consistently remain cheaper than pure petroleum-based fuels. The energy content of biofuels is less;[61] and consequently, biofuels deliver fewer miles per gallon when used in engines designed for petroleum-based fuels.[62] This difference is minimized when the biofuels are mixed into conventional gasoline[63] and petrodiesel[64] and sold as blends.[65] However, even slightly fewer miles to the gallon translates into more fill ups for the American consumer.[66]

Moreover, both soy biodiesel and corn ethanol depend on the blender's tax credit[67] to maintain prices lower than petroleum fuels.[68] These biofuels are derived from crops with competing high demand uses, such as food and exports.[69] Resulting competition drives up the cost of the crops,[70] which

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TECH. REV. (SPECIAL REPORT), Feb. 13, 2007, http://www.technologyreview.com/Energy/18173/ (last visited June 1, 2008).

[60] *See* ENDING THE ENERGY STALEMATE, *supra* note 7, at 72-73; Jim Core, *New Method Simplifies Biodiesel Production*, AGRIC. RESEARCH, Apr. 2005, at 13, 13.

[61] ENERGY INFO. ADMIN., DOE/EIA-0383, ANNUAL ENERGY OUTLOOK 2007: WITH PROJECTIONS TO 2030, at 59 (2007) [hereinafter ANNUAL ENERGY OUTLOOK 2007], *available at* http://www.eia.doe.gov/oiaf/archive/aeo07/pdf/ 0383(2007).pdf.

[62] *Id.*

[63] *See* RFS IMPACT ANALYSIS, *supra* note 2, at 19-20, 158 (discussing how renewable fuels are blended with traditional motor vehicle fuels).

[64] Interview with Eric L. Baumholser, Safety Compliance Coordinator, The Spinx Co., Inc., in Greenville, S.C. (Aug. 30, 2007) (stating that pure biodiesel, referred to as B100 or "blend stock," is blended into petrodiesel at varying levels). The numerical designation in the representation B5 or B20, for example, indicates the percentage of blend stock within a biodiesel petrodiesel blend—B5 is 5% biodiesel and B20 is 20% biodiesel. U.S. ENVTL. PROT. AGENCY, EPA420-F-06-044, ALTERNATIVE FUELS: BIODIESEL 1 (2006), *available at* http://www.epa.gov/otaq/smartway/growandgo/documents/420f06044.pdf.

[65] Proponents argue that blending ethanol at 10% makes the blend more attractive to consumers because it increases the octane of the base fuel and because the difference in miles per gallon performance is slight; it "is not expected to have a significant effect on purchases." ANNUAL ENERGY OUTLOOK 2007, *supra* note 61, at 59.

[66] *See, e.g.*, Alex Halperin, *Ethanol: Myths and Realities*, BUSINESSWEEKONLINE, May 19, 2006, http://www.businessweek.com/technology/content/may2006/tc20060519_225336.htm (last visited June 1, 2008).

[67] *See supra* notes 38-42 and accompanying text.

[68] *See, e.g.*, ANNUAL ENERGY OUTLOOK 2007, *supra* note 61, at 60; Environmental Science & Technology Online, *Biofuels Require Subsidies*, http://pubs.acs.org/subscribe/journals/esthag-w/2006/aug/policy/mb_biofuels.html (last visited June 1, 2008).

[69] *See* RADICH, *supra* note 58, at 4-5; PAUL C. WESTCOTT, U.S. DEP'T OF AGRIC., FDS-07D-01, ETHANOL EXPANSION IN THE UNITED STATES: HOW WILL THE AGRICULTURAL SECTOR ADJUST? 4 (2007), *available at* http://www.ers.usda.gov/publications/fds/2007/05may/fds07d01/fds07d01.pdf; U.S. Dep't of Agric., Econ. Research Serv., Soybeans and Oil

comprise the majority of both soy biodiesel and corn ethanol prices.[71] Increases in crop prices threaten the financial viability of the fuels, even with the blender's tax credit.[72]

As biofuel demand increase, the only way to keep crop prices sufficiently low is to produce more feedstock.[73] Accordingly, America must produce much greater quantities of feedstock if it hopes to displace a meaningful quantity of oil imports. The 250 million gallon biodiesel expansion that occurred in 2006 only accounted for about 0.6% of the on-road diesel sold annually in America,[74] and the corn ethanol produced

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Products: Market Outlooks, http://www.ers.usda.gov/Briefing/SoybeansOilCrops/2007baseline.htm (last visited June 1, 2008).

[70] In 2007, America's season-average soybean price range was up approximately 50% from 5 years before with current projections ranging from $10.50-$12.00 per bushel. *Compare* U.S. DEP'T OF AGRIC., WASDE-391, WORLD AGRICULTURAL SUPPLY AND DEMAND ESTIMATES (2002), *with* U.S. DEP'T OF AGRIC., WASDE-450, U.S. AND WORLD CROP SUPPLY AND DEMAND (2007); *see also* WESTCOTT, *supra* note 69, at 6 ("Corn prices at [current] levels are record high and are unprecedented on a sustained basis, exceeding the previous high average over any 5-year period by more than 50 cents a bushel."); U.S. Dep't of Agric., Econ. Research Serv., Soybeans and Oil Crops, http://www.ers.usda.gov/Briefing/SoybeansOilCrops/ (last visited June 1, 2008) ("Farm value of U.S. soybean production in 2003/04 was $18.0 billion, the second-highest value among U.S.-produced crops, trailing only corn.").

[71] *Oversight on Federal Renewable Fuels Program: Hearing Before the S. Comm. on Environment and Public Works*, 109th Cong. (2006) (statement of Keith Collins, Chief Economist, U.S. Department of Agriculture) [hereinafter *Collins Before the Committee on Environment and Public Works*], transcript *available at* http://epw.senate.gov/hearing_statements.cfm?id=262516 ("Corn costs are the primary input cost in corn ethanol production" and since 2002, increased demand for ethanol has caused corn costs to rise across the nation on average of $1.06 per bushel.); ANNUAL ENERGY OUTLOOK 2007, *supra* note 61, at 60 (stating that soybean feedstock is 70-78% "of the total production cost" of biodiesel).

[72] *See Collins Before the Committee on Environment and Public Works*, *supra* note 71 ("A combination of declining gasoline prices, sharply rising corn prices, or a decline in the price premium ethanol has had relative to gasoline could curtail the expansion in ethanol production."); RADICH, *supra* note 58, at 8 ("Unless soybean oil prices decline dramatically, it does not appear that biodiesel can be produced in large quantities at a cost that is competitive with petroleum diesel.").

[73] *Collins Before the Committee on Environment and Public Works*, *supra* note 71.

[74] *See* Nat'l Biodiesel Board, Estimated U.S. Biodiesel Sales, http://www.biodiesel.org/pdf_files/fuelfactsheets/Biodiesel_Sales_Graph.pdf (last visited June 1, 2008); U.S. Dep't of Energy, Biofuels for Transportation, http://genomicsgtl.energy.gov/biofuels/transportation.shtml (last visited June 1, 2008) ("[R]oughly 40 billion gallons of diesel [is] used each year for on-road transportation.").

displaced less than 4% of America's gasoline demand.[75] While better farming techniques that increase yield per acre can achieve some increase in available crops,[76] the only way to produce much greater quantities of feedstock is to expand cropland.[77]

B. Cropland Expansion

The effects of expanding cropland to the extent required to displace significant quantities of oil imports will negate much of the environmental benefit that America expects to gain from its biofuels investment. Three negative effects of cropland expansion defeat the claim that soy biodiesel and corn ethanol are environmentally beneficial.

The first effect of cropland expansion goes to the very heart of the claim that soy biodiesel and corn ethanol are environmentally friendly fuels because they reduce harmful emissions.[78] Exhaust emissions reports for biofuels, while inconsistent,[79] as a whole do not indicate that biofuels significantly reduce exhaust emissions.[80] Soy biodiesel reportedly reduces

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[75] CLARE RIBANDO SEELKE & BRENT D. YACOBUCCI, CRS REPORT FOR CONGRESS, ETHANOL AND OTHER BIOFUELS: POTENTIAL FOR U.S.-BRAZIL ENERGY COOPERATION 10 (2007), *available at* http://www.opencrs.com/rpts/RL34191_20070927.pdf.

[76] U.S. Dep't of Agric., Econ. Research Serv., Soybeans and Oil Crops: Background, http://www.ers.usda.gov/Briefing/SoybeansOilCrops/ (last visited June 1, 2008) (showing that improved farming technology and practices has resulted in "steadily rising yield improvements").

[77] *Collins Before the Committee on Environment and Public Works*, *supra* note 71; WESTCOTT, *supra* note 69, at 7-8.

[78] *See* CLEAN FUELS DEV. COALITION, ETHANOL FACT BOOK 26 (2007), *available at* http://www.ne-ethanol.org/pdf/ethanolfactbook.pdf; RFS IMPACT ANALYSIS, *supra* note 2, at 250.

[79] *See* U.S. DEP'T OF AGRIC. & U.S. DEP'T OF ENERGY, LIFE CYCLE INVENTORY OF BIODIESEL AND PETROLEUM DIESEL FOR USE IN AN URBAN BUS 181-84 (1998) [hereinafter USDA & DOE LIFECYCLE INVENTORY], *available at* http://www.nrel.gov/docs/legosti/fy98/24089.pdf; U.S. ENVTL. PROT. AGENCY, EPA420-P-02-001, A COMPREHENSIVE ANALYSIS OF BIODIESEL IMPACTS ON EXHAUST EMISSIONS, at iii (2002) [hereinafter EPA ANALYSIS BIODIESEL EXHAUST EMISSIONS], *available at* http://www.epa.gov/otaq/models/analysis/biodsl/p02001.pdf; RFS IMPACT ANALYSIS, *supra* note 2, at 124-29, 135-39, 144, 153-58, 160; HAIBO ZHAI ET AL., FUEL CONSUMPTION AND EMISSIONS COMPARISONS BETWEEN ETHANOL 85 AND GASOLINE FUELS FOR FLEXIBLE FUEL VEHICLES 3, 5 (2007), *available at* http://www4.ncsu.edu/~frey/Zhai_et_al_2007a.pdf (prepared for the 100th Annual Meeting of the Air & Waste Mgmt. Ass'n); *The Ethanol Myth: Consumer Reports' E85 Tests Show that You'll Get Cleaner Emissions but Poorer Fuel Economy . . . If You Can Find It*, CONSUMER REPORTS, Oct. 2006, at 15.

[80] *See infra* notes 82, 84-85, 88-89, 96-104 and accompanying text.

some pollutants that contribute to ozone and haze.[81] However, it produces higher quantities of NOx, which is a primary contributor to ozone.[82] Corn ethanol shows considerably greater divergence in results[83] with agreement only that ethanol reduces carbon monoxide ("CO")[84] but increases the toxic acetaldehyde.[85] Speculation as to the causes of research inconsistency include the wide range of vehicle models that comprise the test groups[86] and complex fuel parameters.[87] Despite the lack of uniformity in these reports,

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[81] B20 reduces nonmethane hydrocarbons ("NMHC") in a range from 7.3% to 21.1% and B100 by about 36.7%. B20 reduces particulate matter ("PM") in a range from 10.1% to 13.6% and B100 by about 68%. B20 reduces carbon monoxide ("CO") in a range from 9.3% to 11% and B100 by about 46.23%. *Compare* USDA & DOE LIFECYCLE INVENTORY, *supra* note 79, at 259, *with* EPA ANALYSIS BIODIESEL EXHAUST EMISSIONS, *supra* note 79, at iii tbl.ES-A.

[82] *See* USDA & DOE LIFECYCLE INVENTORY, *supra* note 79, at 259 (stating that B20 increases the oxides of nitrogen ("NOx") by about 2% and B100 by about 8.89%); EPA ANALYSIS BIODIESEL EXHAUST EMISSIONS *supra* note 79, at iii tbl.ES-A.

[83] The effect of E10 blending on nonmethane hydrocarbons ("NMHC"), a contributor to ozone, "is particularly unclear." RFS IMPACT ANALYSIS, *supra* note 2, at 144. Testing by the Coordinating Research Council ("CRC") on light emissions vehicles involved a variety of fuel parameters and resulted in a range of NMHC levels from about a 6% decrease to almost a 50% increase. *Id.* at 128 fig.3.1-2. The Alliance of Automobile Manufacturers, the Association of International Automobile Manufacturers, and Honda ("AAM-AIAM") tested with a specific focus on maintaining a low-sulfur parameter. Their test resulted in a 12.6% decrease in NMHC. *Id.* at 135 tbl.3.1-9 (using 11% ethanol). Toyota also indicated a decrease based on other testing, but only of 0.8%. *Id.* at 139 tbl.3.1-15 (using 9% ethanol as compared with MTBE blended gasoline). In contrast, Exxon indicated an increase of 5%. *Id.* at 137 tbl.3.1-12 (using a 10% ethanol blend). The effect of E10 blending on the oxides of nitrogen ("NOx"), a primary contributor to ozone, is also, according to these tests, unclear. Testing by the CRC on light emissions vehicles involved a variety of fuel parameters and resulted in a range of NOx levels from about 5% decrease to over a 10% increase. *Id.* at 127 fig.3.1-1. AAM-AIAM, who tested with a specific focus on maintaining the low-sulfur parameter, showed a decrease of 6.6%. *Id.* at 135 tbl.3.1-9. Toyota indicated a 3.8% increase. *Id.* at 139. And Exxon indicated a 28% increase. *Id.* at 137 tbl.3.1-15. The effects of E10 blending on exhaust emissions are not discernibly significant for particulate matter ("PM"). While the EPA states that "ethanol blending might reduce exhaust PM emissions under very cold weather conditions," it explains that "[t]here is no indication of PM emission reductions at higher temperatures and under warmed up conditions." *Id.* at 153.

[84] *Id.* at 124 tbl.3.1-1, 135 tbl.3.1-9, 137 tbl.3.1-12, 139 tbl.3.1-14.

[85] *Id.* at 156 tbl.3.1-24, 160 tbl.3.1-27.

[86] *See id.* at 121-46.

[87] EPA test results, when juxtaposed with its current modeling results, suggest that there are "fuel parameters which are more complex than those which could be included in the model[s]" and fuel parameters that "confound[] the ability of the model[s] based just on ethanol" to accurately predict emissions *Id.* at 127. Congress has mandated research into the complexities of gasoline characteristics and additive blending, and how a combination of these two problematic issues affects the public health. Energy Policy Act of 2005 §§ 1505, 1506, 119 Stat. 594, 1080-81 (2005) (amending 42 U.S.C. § 7545).

they do consistently either state that biofuels do not significantly decrease CO_2 in exhaust emissions[88] or they appear to sidestep the question entirely.[89]

As a consequence of the controversial reporting of biofuels' exhaust emissions, the real heart of biofuels proponents' claim that the biofuels are environmentally beneficial rests upon "lifecycle analysis."[90] The lifecycle analysis compares greenhouse gas emission calculations for the lifecycle of the biofuels—including growth of the crops, production, transportation, and use[91]—with the greenhouse gas emissions calculations for the entire production process for petroleum products.[92] Biofuels' lifecycle analyses discounts the CO_2 emissions produced by vehicle combustion on the assumption that vehicle combustion emissions are equivalent to the CO_2 captured by the crop starting material during photosynthesis.[93]

While biofuels proponents assert that lifecycle calculations reveal that biofuels produce significantly less greenhouse gases than petroleum products,[94] there is very little actual consensus.[95] More important than the lack of consensus, however, is the fact that many analyses that show that biofuels emit greater emissions are those that account for cropland

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[88] *See, e.g.*, EPA ANALYSIS BIODIESEL EXHAUST EMISSIONS *supra* note 79, at iii; USDA & DOE LIFECYCLE INVENTORY, *supra* note 79, at 18; ZHAI, *supra* note 79, at 3.

[89] *See, e.g.*, RFS IMPACT ANALYSIS, *supra* note 2 (this 352 page report contains an extensive section on exhaust emissions, yet nowhere does it state whether there is a reduction of CO_2 in exhaust emissions from biofuels).

[90] *See* U.S. DEP'T OF ENERGY, ENERGY EFFICIENCY & RENEWABLE ENERGY OFFICE, ETHANOL: THE COMPLETE ENERGY LIFECYCLE PICTURE 2 (2d ed. 2007), *available at* http://www.transportation.anl.gov/pdfs/TA/345.pdf.

[91] *See* RFS IMPACT ANALYSIS, *supra* note 2, at 227-44 (outlining a complete lifecycle analysis).

[92] *See id.* at 245-46.

[93] *See id.* at 232.

[94] *Id.* at 250 tbl.6.2-6 (showing that for each unit of diesel fuel that is replaced by biodiesel GHG emissions will be reduced by 67.7% and CO_2 emissions will be reduced by 69.8%; for each unit that is replaced by corn ethanol GHG emissions will be reduced by 21.8% and CO_2 emissions will be reduced by 40.3%); USDA & DOE LIFECYCLE INVENTORY, *supra* note 79, at 21 fig.8.

[95] *Compare* RFS IMPACT ANALYSIS, *supra* note 2, at 250 tbl.6.2-6, *and* USDA & DOE LIFECYCLE INVENTORY, *supra* note 79, at 21 fig.8, *with* MARK A. DELUCCHI, DRAFT REPORT: LIFECYCLE ANALYSES OF BIOFUELS 14, 27 tbl.6, 32 tbl.11 (2006), *available at* http://www.its.ucdavis.edu/publications/2006/UCD-ITS-RR-06-08.pdf, TAD W. PATZEK & CE24 FRESHMAN SEMINAR STUDENTS, UNIV. OF CAL. DEP'T OF CIVIL & ENVTL. ENG'G, ETHANOL FROM CORN: CLEAN RENEWABLE FUEL FOR THE FUTURE, OR DRAIN ON OUR RESOURCES AND POCKETS? 9-10, 11-16 (2003), *available at* http://www.energyjustice.net/ethanol/ PatzekEthanolPaper.pdf, *and* USDA & DOE LIFECYCLE INVENTORY, *supra* note 79, at 18.

expansion[96] and include the cultivation processes of these additional croplands.[97] If these analyses are correct, the conclusion is that expanding cropland for biofuels will cause biofuels to ultimately produce greater greenhouse gas emissions than oil.

At least one recent study indicates that this conclusion applies on a worldwide scale.[98] In Brazil, a country heralded as successfully achieving oil independence through biofuels implementation,[99] critics assert that cropland expansion for biofuels causes small farmers, like soybean farmers, to clear the Amazon rainforest as they are pushed out of existing cropland.[100] Ultimately, this leads to greater greenhouse gas production because the sequestering effect of the forest[101] is forever lost and the process of destroying the forest leads to a large release of greenhouse gases.[102] Additionally, Brazilian soybean farmers must expand cropland into the Amazon in response to diminishing corn and soybean imports from America.[103] Diminished American food exports are also projected to similarly increase cropland in India and China.[104]

Yet it is two additional effects of cropland expansion that have recently piqued the interest of the scientific community. The first additional concern is the strain on water resources projected to result from increased cropland irrigation.[105] Corn, the biofuel precursor, is described as "the greediest of plants,"[106] and critics argue that because of the intense needs of corn crops,

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[96] *See, e.g.*, DELUCCHI, *supra* note 95, at 54-55; PATZEK ET AL., *supra* note 95, at 9-10.
[97] *See, e.g.*, PATZEK ET AL., *supra* note 95, at 8-9.
[98] Timothy Searchinger et al., *Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land Use Change*, 319 SCI. 1238, 1238-39 (2008).
[99] *See* Energy Info. Admin., Brazil Energy Data, http://www.eia.doe.gov/emeu/cabs/Brazil/Oil.html [hereinafter Brazil Energy Data] (last visited June 1, 2008).
[100] Douglas C. Morton et al., *Cropland Expansion Changes Deforestation Dynamics in Southern Brazilian Amazon*, 103 PROC. NAT'L ACAD. SCI. U.S.A. 14,637, 14,637 (2006); Searchinger et al., *supra* note 98, at 1238.
[101] Searchinger et al., *supra* note 98, at 1238; Press Release, Smithsonian Inst., Smithsonian Scientist Predicts Widespread Loss of Rainforest to Development, Computer Models Show Impact of Planned Infrastructure Projects (Jan. 18, 2001), *available at* http://www.trfic.msu.edu/news_info/news_archive/20010118amazonia.html.
[102] Searchinger et al., *supra* note 98, at 1238; Press Release, NASA Earth Observatory, Deforestation Plays Critical Climate Change Role (May 11, 2007), *available at* http://earthobservatory.nasa.gov/Newsroom/MediaAlerts/2007/ 20070511124943.html.
[103] Searchinger et al., *supra* note 98, at 1238.
[104] *Id.* at 1239.
[105] *See* PATZEK, *supra* note 95, at 9-10; NAT'L ACAD. OF SCI., WATER IMPLICATIONS OF BIOFUELS IN THE UNITED STATES 2 (2007) [hereinafter WATER IMPLICATIONS OF BIOFUELS IN THE U.S.], *available at* http://dels.nas.edu/dels/rpt_briefs/biofuels_brief_final.pdf.
[106] PATZEK, *supra* note 95, at 9.

including large amounts of irrigation, "groundwater is being mined much faster than the recharge rate, and midwestern states will face soon a severe water shortage."[107]

The second additional concern of cropland expansion is fertilizer runoff. Intense fertilization of croplands in the Midwest has led to a "dead zone" where the Mississippi river dumps into the Gulf of Mexico.[108] In this dead zone, the oxygen levels are so depleted that the fish and shellfish are dying.[109] Corn crops, which "demand[] more nitrogen fertilizer and pesticide than any other food crop,"[110] are a primary contributor. Headlines that read: *As Ethanol Demand Grows, So Does "Dead Zone" in Gulf of Mexico*[111] reflect growing public fear that expanding cropland may exacerbate environmental issues previously unanticipated by biofuels proponents.

In 2007, there was a notable increase in the quantity of cropland devoted to biofuels.[112] America produced record amounts of soybean biodiesel and corn ethanol that year.[113] This expansion revealed another significant limitation on soy biodiesel and corn ethanol implementation: transportation.

C. Transportability

Although biodiesel requires special handling in colder temperatures[114] and ethanol requires special cleaning and drying of transport containers,[115] trucks, trains, and barges can transport both biofuels without major

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[107] *Id.*

[108] WATER IMPLICATIONS OF BIOFUELS IN THE U.S., *supra* note 105, at 2.

[109] *Id.*; Greg Roth, Penn. St. Dep't of Crop & Soil Sci., *The Dead Zone: A New Concern For Corn Growers*, http://cornandsoybeans.psu.edu/articles/ca3.cfm (last visited June 1, 2008).

[110] PATZEK, *supra* note 95, at 9.

[111] Tony Cox, *As Ethanol Demand Grows, So Does "Dead Zone" in Gulf of Mexico*, INT'L HERALD TRIBUNE, July 23, 2007, at 12, 12.

[112] *Collins Before the Committee on Environment and Public Works*, *supra* note 71.

[113] *See supra* notes 60, 74-75 and accompanying text.

[114] U.S. DEP'T OF ENERGY, ENERGY EFFICIENCY & RENEWABLE ENERGY OFFICE, DEO/GO-102006-2358, BIODIESEL HANDLING AND USE GUIDELINES 19, 28 (3d ed. 2006) [hereinafter DOE BIODIESEL HANDLING AND USE GUIDELINES], *available at* http://www.nrel.gov/vehiclesandfuels/npbf/pdfs/40555.pdf.

[115] ENERGY INFO. ADMIN., ELIMINATING MTBE IN GASOLINE IN 2006, at 1 (2006) [hereinafter ELIMINATING MTBE IN GASOLINE], *available at* http://www.eia.doe.gov/pub/oil_gas/petroleum/feature_articles/2006/mtbe2006/mtbe2006.pdf ("[E]thanol . . . must be transported and stored separately from the base gasoline mixture to which it is added until the last step of the distribution chain."). *See generally* RENEWABLE FUELS ASS'N, FUEL ETHANOL INDUSTRY GUIDELINES, SPECIFICATIONS, AND PROCEDURES 4-19 (2003) [ETHANOL INDUSTRY GUIDELINES, SPECIFICATIONS, AND PROCEDURES], *available at* http://www.ethanolrfa.org/objects/pdf/MemberDocuments/RFA_IndustryGuidelines.pdf (discussing specifications for transportation, storage, and conversion of ethanol).

modification.[116] However, limited resources constrain the capacity of "[a]ll three modes"[117] and threaten to hamper biofuels growth.[118]

Additionally, common carrier pipelines, a form of transportation crucial to petroleum fuels,[119] are currently not feasible for either soy biodiesel or corn ethanol.[120] While several major pipelines have demonstrated successful biodiesel transport, widespread pipeline transport of biodiesel is prevented by concerns that residue in the pipeline might contaminate subsequent transported fuels or that the high solvency properties of biodiesel may dissolve gaskets and seals.[121] Moreover, because ethanol mixes with water easily and water is frequently present inside oil pipelines, ethanol pipeline transport would likely require major modification of the existing pipeline or construction of a new waterproof pipeline.[122]

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[116] ELIMINATING MTBE IN GASOLINE, *supra* note 115, at 1 n.3 (explaining that delivery systems simply need to keep ethanol-blended gasoline away from water); ETHANOL INDUSTRY GUIDELINES, SPECIFICATIONS, AND PROCEDURES, *supra* note 115, at 8 (suggesting that the most important step in selecting the ethanol transportation method is inspecting the delivery system to ensure that unacceptable commodities are not present); DOE BIODIESEL HANDLING AND USE GUIDELINES, *supra* note 114, at 28 (providing recommendations for transporting biodiesel).

[117] U.S. DEP'T OF AGRIC., ETHANOL TRANSPORTATION BACKGROUNDER, EXPANSION OF U.S. CORN-BASED ETHANOL FROM THE AGRICULTURAL TRANSPORTATION PERSPECTIVE 7 (2007) [hereinafter USDA TRANSPORTATION BACKGROUNDER], *available at* http://www.ams.usda.gov (search for "Ethanol Backgrounder") ("All three modes used to transport ethanol . . . are at or near capacity."); *see also* U.S. GOV'T ACCOUNTABILITY OFFICE, BIOFUELS: DOE LACKS A STRATEGIC APPROACH TO COORDINATE INCREASING PRODUCTION WITH INFRASTRUCTURE DEVELOPMENT AND VEHICLE NEEDS 23 (2007) [hereinafter DOE LACKS A STRATEGIC APPROACH], *available at* http://www.gao.gov/new.items/d07713.pdf ("The biofuel distribution infrastructure has limited capacity to transport the fuels . . . .").

[118] *See* DOE LACKS A STRATEGIC APPROACH, *supra* note 117, at 23-24; *see also* Clifford Krauss, *Ethanol's Boom Stalling as Glut Depresses Price*, N.Y. TIMES, Sept. 30, 2007, at A1.

[119] Pipeline Safety: Hazardous Liquid Pipelines Transporting Ethanol, Ethanol Blends, and other Biofuels, 72 Fed. Reg. 45,002, 45,002 (Aug. 10, 2007); USDA & DOE LIFECYCLE INVENTORY, *supra* note 79, at 93.

[120] *See* USDA TRANSPORTATION BACKGROUNDER, *supra* note 117, at 16 ("No ethanol is currently shipped by pipeline due to its corrosive nature and ability to attract water."); Anduin Kirkbride McElroy, *Pipeline Potential*, BIODIESEL MAGAZINE, Feb. 2007, at 122, 122-28.

[121] McElroy, *supra* note 120, at 122-28.

[122] Pipeline Safety, 72 Fed. Reg. at 45,003-04.

IV. THE ENERGY INDEPENDENCE AND SECURITY ACT OF 2007[123] RESPONDS TO THE LIMITATIONS OF CROP-BASED BIOFUELS

A. The Promise of Second-Generation Biofuels

In addition to the current tax incentives for advanced biofuels production[124] and the recent dedication of funds by DOE for the advanced biofuels and bioproducts program,[125] the Energy Independence and Security Act ("EISA"), enacted in December of 2007, mandates that a percentage of the RFS[126] include a suite of advanced biofuels that utilize new technologies and alternative starting materials.[127] This requirement greatly improves America's opportunity to displace meaningful quantities of imported oil because advanced biofuels hold some promise to overcome the limitations of crop-based biofuels.[128] Also, second-generation biofuels may integrate immediately into the current pipeline,[129] which may offer consumers performance-value more equivalent to petroleum fuels,[130] while reducing municipal waste.[131] The suite of second-generation biofuels includes cellulosic ethanol, thermal depolymerization biodiesel, biobutanol, and algae biodiesel.

1. Cellulosic Ethanol

Cellulosic ethanol,[132] an advanced biofuel that was already mandated by the RFS in EPAct05,[133] has received, to date, the bulk of the biofuels and

[123] Energy Independence and Security Act of 2007, Pub. L. No. 110-140, 121 Stat. 1492 (2007) (to be codified in scattered sections of 2 U.S.C., 7 U.S.C., 15 U.S.C., 16 U.S.C., 23 U.S.C., 42 U.S.C., 46 U.S.C., & 49 U.S.C.).

[124] *See supra* notes 38-42 and accompanying text.

[125] *See supra* notes 43-50 and accompanying text.

[126] *See supra* notes 34-37 and accompanying text.

[127] The new RFS requires displacement of 36 billion gallons of pure petroleum-based fuels with biofuels by 2022. Energy Independence and Security Act of 2007, Pub. L. No. 110-140, § 201, 121 Stat. 1492, 1522 (2007). Biofuels that fulfill the standard are "advance biofuels," such as "cellulosic biofuel," and "biomass-based diesel." *Id.* §§ 201, 202, 121 Stat. at 1519-28. For a more specific discussion of some of these advanced biofuels, see *infra* Parts IV.A.1-4.

[128] *See* discussion *supra* Part III.

[129] *See infra* note 174 and accompanying text.

[130] *See infra* notes 169-170 and accompanying text.

[131] *See infra* notes 151, 155-161 and accompanying text.

[132] *See supra* note 48 and accompanying text.

[133] Energy Policy Act of 2005 § 1501(a), 119 Stat. 594, 1070 (2005) (amending 42 U.S.C. § 7545) (The RFS requires that as of 2013 "and each calendar year thereafter . . . the [quantity of biofuel that the act requires be blended into gasoline each year] shall contain a minimum of 250,000,000 gallons that are derived from cellulosic biomass.").

bioproducts program funding[134] and continues to receive legislative support in the EISA.[135] Cellulosic ethanol is produced from a variety of non-food sources ("biomass"), such as crop waste,[136] grasses,[137] and wood waste cleared from forests.[138] Because biomass sources are not limited to annual crops, they can be grown, harvested, or gathered year round.[139] Additionally, "energy crops" like perennial grasses are not limited to croplands, but also can grow in "marginal" soils.[140] While there is little discussion about the expansive implications of this fact, this author suggests that these marginal soils are available in many non-traditional places—for example along the side of highways and on the grounds of large corporations and industrial facilities. Grasses, in particular, have "extensive root systems [that] increase nutrient capture, improve soil quality, sequester carbon, and reduce erosion."[141] As innovators grow tall grasses for biofuels, these additional benefits could be manifest in diverse locations.

The net emissions projections for cellulosic ethanol are more clearly positive than corn and soybean crops.[142] Emissions projections range from

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[134] *See supra* notes 43-50 and accompanying text.

[135] Energy Independence and Security Act of 2007, Pub. L. No. 110-140, § 202, 121 Stat. 1492, 1521-28 (2007) (amending § 42 USC § 7545). The EISA places an additional requirement on biofuels from facilities constructed after its enactment. For biofuels from these facilities to qualify they must show actual reduction in lifecycle emissions. *Id.* § 202(c), 121 Stat. at 1524-27.

[136] LEE R. LYND, CELLULOSIC ETHANOL FACT SHEET 1 (2003), *available at* http://www.energycommission.org/files/finalReport/IV.4.c%20-%20Cellulosic%20Ethanol%20Fact%20Sheet.pdf (prepared for the Nat'l Comm'n on Energy Policy Forum: The Future of Biomass and Transportation Fuels, June 13, 2003, in Wash., D.C.).

[137] U.S. DEP'T OF ENERGY, DOE/SC-0095, BREAKING THE BIOLOGICAL BARRIERS TO CELLULOSIC ETHANOL: A JOINT RESEARCH AGENDA 8 (2006) [hereinafter BREAKING THE BIOLOGICAL BARRIERS TO CELLULOSIC ETHANOL], *available at* http://genomicsgtl.energy.gov/biofuels/ 2005workshop/b2blowres63006.pdf.

[138] Renewable Fuels Ass'n, Cellulosic Ethanol, http://www.ethanolrfa.org/resource/cellulosic/ (last visited June 1, 2008).

[139] *See* GDS ASSOC. & LA CAPRA ASSOC., ANALYSIS OF RENEWABLE ENERGY POTENTIAL IN SOUTH CAROLINA 11-12 (2007), *available at* http://www.ecsc.org/newsroom/RenewablesStudy.ppt (addressing the potential of wood as a source of biomass); BREAKING THE BIOLOGICAL BARRIERS TO CELLULOSIC ETHANOL, *supra* note 137, at 8 (addressing the potential of perennial grasses as a source of biomass). *See generally* Press Release, Natural Res. Conservation Serv., USDA Awards $12.6 Million for Biomass Research and Development (Oct. 6, 2005), *available at* http://www.nrcs.usda.gov/technical/grants.html (highlighting eleven federally-funded biomass research projects focusing on a variety of fuel sources).

[140] BREAKING THE BIOLOGICAL BARRIERS TO CELLULOSIC ETHANOL, *supra* note 137, at 60.

[141] *Id.* at 8.

[142] *See* National Geographic, Biofuels Compared, http://magma.nationalgeographic.com/ngm/2007-10/biofuels/biofuels-interactive.html (last visited June 1, 2008) (showing that

50%[143] to 100%[144] less than gasoline because the cultivation process for many energy crops do not require extensive irrigation[145] or liberal fertilization.[146] Additionally, in cellulosic ethanol production there are large quantities of unfermentable parts of the biomass source that contain lignin, "a material that can be burned to generate power to run the cellulose ethanol facility."[147] This reduces lifecycle emissions by eliminating electricity purchased from other sources such as coal-fired power plants.[148]

2. Thermal Depolymerization Biodiesel

Thermal depolymerization biodiesel ("TDP") is diesel produced using TDP technology. This technology "mimics the earth"[149] and boasts the ability to convert a full range of materials,[150] including municipal waste, into biodiesel.[151] TDP was recognized by EPAct05[152] and was supported by its tax credits.[153] However, it was not promoted by inclusion in the RFS until the EISA.[154] The EISA requires that the RFS include biomass-based

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cellulosic ethanol contains 2 to 36 times the fossil energy required to produce it, while corn ethanol may only contain 1.3 times the output potential).

143 DELUCCHI, *supra* note 95, at 17.

144 ENDING THE ENERGY STALEMATE, *supra* note 7, at 73.

145 BREAKING THE BIOLOGICAL BARRIERS TO CELLULOSIC ETHANOL, *supra* note 137, at 65.

146 *Id.* at 8.

147 Iogen Corp., Cellulose Ethanol Lowers GHGs, Increases Energy Security, Helps Build Rural Economies, http://www.iogen.ca/key_messages/overview/m3_reduce_ghg.html#1 (last visited June 1, 2008); *see also* DELUCCHI, *supra* note 95, at 11.

148 Iogen Corp., *supra* note 147.

149 Changing World Tech., Inc., What is Thermal Conversion, http://www.changingworldtech.com/what/index.asp (last visited June 1, 2008) (TDP "mimics the earth's natural geothermal process by using water, heat and pressure to transform organic and inorganic wastes into oils, gases, carbons, metals and ash. Even heavy metals are transformed into harmless oxides.").

150 *See generally* Brad Lemley, *Anything Into Oil*, DISCOVER, Apr. 2006, at 46-51, *available at* http://discovermagazine.com/2006/apr/anything-oil/ (discussing the various materials that can be converted into fuel with TDP technology).

151 ENDING THE ENERGY STALEMATE, *supra* note 7, at 77.

152 Energy Policy Act of 2005 § 1346(a), 119 Stat. 594. 1055 (2005) (amending 26 U.S.C. § 40A) (TDP biodiesel must meet "the registration requirements for fuels and fuel additives established by the Environmental Protection Agency . . . and the requirements of the American Society of Testing and Materials D975 or D396.").

153 *Id.* (requiring that TDP biodiesel receive a $1.00 blenders tax credit per gallon blended into a retail petroleum product).

154 Energy Independence and Security Act of 2007, Pub. L. No. 110-140, § 202, 121 Stat. 1492, 1523 (2007) (amending 42 U.S.C. § 7545) (establishing annual standards for production of "biomass-based diesel").

biodiesel, which is defined by reference to the Energy Policy Act of 1992 as diesel derived from municipal wastes or animal waste products.[155]

A pilot plant in Carthage, Missouri currently produces diesel from Butterball Turkey processing waste.[156] Although the plant had many startup hurdles, including production costs that were much higher than originally projected[157] and a controversial lawsuit over the plant's unpleasant odor,[158] it appears to have survived.[159] Its owner continues to assert that TDP converts "slaughterhouse waste, municipal sewage, old tires, mixed plastics, virtually all the wretched detritus of modern life . . . [to] . . . high-quality oil."[160] This second-generation biofuel is completely independent of the agricultural industry and may also offer a valuable service to municipalities.

3. Biobutanol

Biobutanol, while not specifically listed in EPAct05, is arguably within its federal tax credits.[161] It was not mandatory in the RFS, however, until the EISA specifically listed it as an "advanced biofuel."[162] Its starting materials traditionally include "sugar cane, sugar beet, corn, wheat, cassava and sorghum,"[163] and DuPont and BP are currently working on a joint venture to commercially introduce biobutanol into the global market.[164] In the future,

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155 *Id.* § 201, 121 Stat. at 1520 (amending 42 U.S.C. § 7545) (incorporating, by reference, the Energy Policy Act of 1992 § 312(f)(1), 42 U.S.C. § 13220(f)(1) (2000)).

156 *See* Lemley, *supra* note 150, at 46.

157 *Id.* at 48.

158 Sundy v. Renewable Envtl. Solutions, L.L.C., 2007 U.S. Dist. LEXIS 75762, at *3 (W.D. Mo. 2007); Lemely, *supra* note 150, at 48.

159 Lemely, *supra* note 150, at 48.

160 *Id.* at 46.

161 Biobutanol arguably qualifies for the blenders' tax credit as a "Mixture Not Containing Ethanol" that should receive a credit of $0.60 per gallon blended into a retail petroleum product. *See* American Jobs Creation Act of 2004 § 301(a), 118 Stat. 1418, 1459 (2004) (codified at 26 U.S.C. § 6426); Energy Policy Act of 2005 § 1344, 119 Stat. 594, 1052 (2005) (amending 26 U.S.C. §§ 40A, 6426, 6427).

162 Energy Independence and Security Act of 2007, Pub. L. No. 110-140, §§ 201, 202, 121 Stat. 1492, 1519-28 (2007) (amending 42 U.S.C. § 7545).

163 BP & Dupont, Biobutanol Fact Sheet, http://www2.dupont.com/Biofuels/en_US/facts/BiobutanolFactSheet.html [hereinafter Biobutanol Fact Sheet] (last visited June 1, 2008).

164 BP, MOBILE SOURCES TECHNICAL REVIEW SUBCOMM., 1-BUTANOL AS A GASOLINE BLENDING BIO-COMPONENT 2-3 (2007) [hereinafter BP REVIEW SUBCOMM.], *available at* http://www.epa.gov/air/caaac/mstrs/March2007/Wolf.pdf. Although ButylFuel, L.L.C. has conducted biobutanol research for over a decade, BP Oil and DuPont have recent designs to bring this second-generation biofuel to the market first. Telephone Interview with David Ramey, Founder of ButylFuel, L.L.C., in Blacklick, Oh. (Oct. 5, 2007) [hereinafter Telephone Interview with David Ramey]. In early 2008 BP-Dupont applied for "more than [sixty] patents in the areas of biology, fermentation processing, chemistry and

the Dupont-BP venture plans to use "energy crops" such as grasses, or "agricultural byproducts" such as straw and corn stalks.[165] Additionally, waste materials from various industries—for example the cheese industry or agriculture—are potential starting materials for biobutanol.[166] Waste materials are an extremely low-cost starting material and they virtually eliminate the need to devote cropland to the production of source crops.[167]

There are other benefits to this fuel. A 2007 release by the Department of Energy reports that 100% biobutanol tested lower in exhaust emissions than gasoline without any engine modifications.[168] The release also reports that biobutanol has higher energy content than corn ethanol[169] and, consequently, gets better gas mileage.[170]

Furthermore, biobutanol is "much less corrosive"[171] than ethanol and it is not water-soluble.[172] For these reasons, America will forego many of the infrastructure difficulties associated with ethanol if or when we turn to biobutanol.[173] The fuel is suited to current petroleum dispensers and storage tanks, and can be transported through existing common-carrier pipelines.[174]

Finally, it is possible to both retrofit corn ethanol production facilities to produce biobutanol and to blend biobutanol with ethanol and gas (either

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end uses for biobutanol." Jessica Ebert, *Biobutanol: The Next Big Biofuel?*, BIOMASS MAGAZINE, May 2008, at 31.

165 Biobutanol Fact Sheet, *supra* note 163.

166 DAVID RAMEY & SHANG-TIAN YANG, PRODUCTION OF BUTYRIC ACID AND BUTANOL FROM BIOMASS 4, 12 (2004), *available at* http://www.osti.gov/energycitations/servlets/purl/843183-rqlY2a/843183.pdf; ButylFuel, L.L.C. Homepage, http://www.butanol.com/ (last visited June 1, 2008).

167 ButylFuel, L.L.C., *supra* note 166 ("[W]hen waste material is used as feedstock instead of corn . . . the price to produce a gallon is $0.85. In such cases the need and cost to grow and prepare the corn for fermentation, by far among the major cost items, are eliminated."); *see also* RAMEY & YANG, *supra* note 166, at 3 ("Butanol can now be made for less than ethanol . . . .").

168 RAMEY & YANG, *supra* note 166, at 3, app.C at 95 (reporting reductions in hydrocarbons, carbon monoxide and nitrogen oxides). *But cf.* BP REVIEW SUBCOMM., *supra* note 164, at 12 (reporting that biobutanol did not change emissions when used as a gasoline additive).

169 RAMEY & YANG, *supra* note 166, at 3 (asserting that Butanol "yields more Btu's from the same corn").

170 *Id.*

171 *Id.* app.B at 77.

172 *Id.* at 12 ("[B]utanol is more miscible with gasoline and diesel fuel but less miscible with water.").

173 *See id.*

174 *Id.* app.B at 77; Biobutanol Fact Sheet, *supra* note 163. Additionally, biobutanol can be used in America's current vehicle fleet "*without any modifications.*" RAMEY & YANG, *supra* note 166, app.B at 77 (emphasis in original).

individually or in a blend containing all three) for mass distribution.[175] BP and Dupont suggest that biobutanol, through this kind of custom blending, will meaningfully "expand the biofuels market."[176]

4. Algae

As with biobutanol, although algae biodiesel is arguably within the tax credits of EPAct05,[177] it was not included in the RFS until the EISA.[178] Algae are, according to the EISA, a renewable biomass that will qualify fuel derived from it as "advanced fuel."[179] Additionally, EISA mandates a study of "any regulatory or other barriers . . . that hinder the use of this resource . . . ."[180]

Fuel from algae farms avoids cropland expansion concerns while still maintaining the benefit of CO_2 sequestration in its growth process.[181] Proponents promise greater than 100% reduction in net GHGs.[182] In fact, a demonstration farm is currently co-located with an Arizona power plant where the algae are "fed" by the exhaust from the power plant.[183] The co-located algae farm directly sequesters the CO_2 from the power plant emissions.[184] Several more algae farms are planned for 2008 with hope for a full production-scale facility in 2009.[185] Algae proponents claim that these farms can produce commercial grade biodiesel that can "compet[e] with gasoline and diesel when the price of oil is $55/barrel" or greater.[186]

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[175] Biobutanol Fact Sheet, *supra* note 163.
[176] *Id.*
[177] *See* Energy Policy Act of 2005 § 1344, 119 Stat. 594, 1052 (2005) (amending 26 U.S.C. §§ 40A, 6426, 6427); American Jobs Creation Act of 2004 § 302, 118 Stat. 1418, 1463-66 (2004) (codified at 26 U.S.C. § 40A).
[178] Energy Independence and Security Act of 2007, Pub. L. No. 110-140, §§ 201, 202, 121 Stat. 1492, 1519-28 (2007) (amending 42 U.S.C. § 7545).
[179] *Id.*
[180] *Id.* § 228 (requiring reporting within ninety days to determine the progress of algae fuel and "any regulatory or other barriers . . . that hinder the use of this resource . . .").
[181] MARK ALLEN BERNSTEIN, GREENFUEL TECHNOLOGY CORPORATION'S EMISSIONS-TO-BIOFUELS™ ALGAE TECHNOLOGY: A VIABLE OPTION FOR BIOFUEL FEEDSTOCK 3-4, 12-13, 14 (2007), *available at* http://www.greenfuelonline.com/gf_files/WhitePaperBernstein051607.pdf.
[182] *Id.* at 23 fig.9.
[183] National Geographic, *supra* note 142.
[184] *Id.*
[185] Mark Clayton, *Algae—Like a Breath Mint for Smokestacks*, CHRISTIAN SCI. MONITOR, Jan. 10, 2006, at 1, 1.
[186] BERNSTEIN, *supra* note 181, at 22.

5. Fulfilling the Promise

Inclusion of these second-generation biofuels in the RFS will ensure demand[187] and, consequently, lower the risk for ventures into biofuels research and production.[188] These advanced fuels promise to resolve some of the current limitations of soy biodiesel and corn ethanol.[189] Because they are not derived from crop feedstock,[190] they are not reliant upon cropland expansion for their financial viability. They are distinct from traditional croplands. Cellulosic starting materials, even when grown on cropland, do not require intense irrigation or fertilizer,[191] and biofuels, derived from algae or waste, do not require any agricultural activity.[192] However, aside from biobutanol, which claims compatibility with America's current common carrier pipeline,[193] transportation is still a limitation on widespread biofuels deployment.

The Energy Independence and Security Act implements feasibility studies for ethanol and other biofuels transport in common carrier pipelines;[194] however, EISA does not set forth a path for action. This author posits that state action can best remove this limitation on successful implementation of biofuels. State governments have the greatest potential to overcome the transportation hurdle by acting strategically and creatively.

B. The Next Step: Decentralized Production

Localized production of biofuels eliminates transportation issues associated with current production, which is largely centralized in the Midwest.[195] Developing local production eliminates the need for long haul transport[196] because resources and distribution are local. Reliance on crop-based starting materials currently forecloses this option.[197] However, changing the fuels—in accordance with the RFS—to make use of a blend of perennial grasses,[198] municipal waste,[199] waste products from food

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[187] *See* RFS IMPACT ANALYSIS, *supra* note 2, at 5.
[188] *See* DOE LACKS A STRATEGIC APPROACH, *supra* note 117, at 20.
[189] *See* discussion *supra* Parts III.A-C.
[190] *See supra* note 48 and accompanying text.
[191] *See supra* notes 105-111 and accompanying text.
[192] *See supra* Parts IV.A.2-3.
[193] *See supra* note 174 and accompanying text.
[194] Energy Independence and Security Act of 2007, Pub. L. No. 110-140, §§ 243, 248(a), 121 Stat. 1492, 1540-41, 1548 (2007) (codified at 42 U.S.C. §§ 17051, 17054).
[195] *See* DOE LACKS A STRATEGIC APPROACH, *supra* note 117, at 19-24.
[196] *See* USDA TRANSPORTATION BACKGROUNDER, *supra* note 117, at 7.
[197] *See supra* Part III.C.
[198] BREAKING THE BIOLOGICAL BARRIERS TO CELLULOSIC ETHANOL, *supra* note 136, at 8, 63.

industries,[200] and residual forest and crop wastes[201] gives potential to localized production.

For example, locating two production facilities per county[202] can progress states like South Carolina toward displacing a meaningful quantity of its imported oil with locally produced fuels.[203] As production technology advances,[204] states like South Carolina can bring locally produced fuels to local consumers and have the potential to become net exporters of biofuels. In addition, localized production means less all-or-nothing risk. If many small production plants are constructed there is less financial loss if one facility must be taken off line.[205] Moreover, producing and deploying biofuels locally can increase local jobs and tax revenue.

However, implementing a localized generation plan will require a strategic, creative and goal-oriented government approach.[206] In addition to offering traditional investor incentives such as loan guarantees, states that

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[199] *See supra* notes 150-155 and accompanying text.

[200] *See supra* notes 156-161 and accompanying text.

[201] *See supra* notes 136, 138 and accompanying text.

[202] Two plants per county would give South Carolina ninety-six biofuels facilities. SC Detailed County Maps, http://www.sciway.net/maps/cnty/ (last visited June 1, 2008). In 2006, the U.S. ethanol industry produced 4.9 billion gallons of ethanol from 110 traditional biofuels refineries. RENEWABLE FUELS ASS'N, ETHANOL INDUSTRY OUTLOOK 2007: BUILDING NEW HORIZONS 2 (2007), *available at* http://www.ethanolrfa.org/objects/pdf/outlook/RFA_Outlook_2007.pdf.

[203] *See* STREIC ROADMAP, *supra* note 5, at 7 ("South Carolina citizens . . . consume over 4.6 billion gallons of petroleum each year . . . ."). The point here is not that S.C. would immediately produce 4.6 billion gallons if it put two second-generation production facilities in each county, but only that the goal is not too far-fetched. As each production facility advances its technology, S.C. could displace increasingly greater quantities of petroleum fuel products.

[204] The production capacity of corn ethanol plants is much greater than that of current demonstration facilities for second-generation facilities such as cellulosic ethanol. *See* Core, *supra* note 60, at 13; Iogen Corp., FAQ, http://www.iogen.ca/company/faq/index.html#Q4 (last visited June 1, 2008).

[205] Nuclear power plants offer an example of the investment risks of large energy production facilities. When nuclear plants must go offline for maintenance, repair, or other reasons the financial cost is extremely high for investors and the community; and frequently federal relief is required. *See* PETER BRADFORD, RISKS, REWARDS, RESOURCES, REALITY: BRIEFING ON THE LOAN GUARANTEE PROVISIONS IN THE 2007 ENERGY BILLS 10-11 (2007), *available at* http://www.eesi.org/briefings/2007/2007%20briefings.htm (follow "Loan Guarantee Provisions in the 2007 Energy Bills: Does Nuclear Power Pose Significant Taxpayer Risk and Liability?" hyperlink).

[206] *See generally* DAVID OSBORNE & TED GAEBLER, REINVENTING GOVERNMENT: HOW THE ENTREPRENEURIAL SPIRIT IS TRANSFORMING THE PUBLIC SECTOR (Plume 1993) (discussing the benefits of "entrepreneurial government" that promotes decentralized authority, minimal bureaucracy, and internal and external competition).

have strategically used government spending to initiate development "leverage private-sector action with small public investments."[207] Two models for strategic government venture investing are Michigan's Venture Capital fund that authorizes it to invest "5[%] of state pension funds . . . in venture capital,"[208] and its "loan loss reserve fund" that allows its banks to make high-risk loans to new businesses that would ordinarily not qualify.[209] Similar strategic investing models can guide local governments in implementing local biofuels production and deployment programs.

Many local governments have access to government resources and can often get "local actors interacting in new ways."[210] They can start and coordinate diverse local supply chains; tailor land use and development (specifically regarding where and how the feedstock was grown); and coordinate transportation routes, route distances, and route schedules. Local implementation of small facilities—representing a suite of second generation biofuels—would enable many local governments to co-locate TDP facilities with municipal waste processing,[211] co-locate algae farms with coal fire power plants to reduce emissions,[212] and co-locate perennial grasses with traditional crops to minimize fertilizer and sediment runoff.[213]

Local governments can advance local biofuels by creating "public-private partnerships"[214] and using "resources in new ways to maximize productivity and effectiveness."[215] They may be able to maximize their strengths[216] by partaking in the local biofuels supply chains with public resources—for example public land and public transportation. Moreover, localized production would allow many local governments to commit government fleets exclusively utilizing locally produced fuels.

This author believes that state and local governments should strategically develop programs that help America meaningfully reduce oil imports through accelerated biofuels deployment. Approaching this project on a state and local level solves transportation issues by allowing local governments to locate small, diverse production facilities with the sources of

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207 DAVID OSBORNE, LABORATORIES OF DEMOCRACY: A NEW BREED OF GOVERNOR CREATES MODELS FOR NATIONAL GROWTH 260 (Harvard Bus. School Press 1988).
208 *Id.* at 155.
209 *Id.* at 159.
210 *Id.* at 261.
211 *See* discussion *supra* Part IV.A.2.
212 *See* discussion *supra* Part IV.A.4.
213 *See supra* text accompanying notes 105-111, 138-141.
214 OSBORNE, *supra* note 207, at 260.
215 OSBORNE & GAEBLER, *supra* note 206, at xix.
216 OSBORNE, *supra* note 207, at 258-60.

RFS non-crop based starting materials. Localized small-scale production, additionally, would give many local governments the control necessary to optimize biofuels implementation and to ensure America the greatest possible environmental and financial gain from its biofuels investment.

V. CONCLUSION

America's dependence on foreign oil is prominent as it draws international pressure to cap carbon emissions,[217] ceases stocking of the national strategic oil reserve,[218] and faces high gasoline prices at the pumps.[219] At the same time, the American public grows increasingly aware of the limitations of soy biodiesel and corn ethanol.[220] Perception that these biofuels increase food costs, offer lower performance value, and do not clearly advance environmental goals makes public reception increasingly cold.[221] Recently, there was even an effort by some members of Congress to repeal the requirements of the RFS.[222] However, by advancing second-generation biofuels that: (1) utilize starting materials which do not compete with food; (2) more clearly serve environmental goals because they do not rely on traditional farming techniques; and (3) promise consumers performance value equivalent to petroleum products, EISA rejuvenates the possibility that biofuels can solve the problems of foreign oil dependence.[223] EISA's requirement that second-generation biofuels fulfill an annually increasing portion of the RFS[224] guarantees that a market exists for entrepreneurs seeking to venture into production of second-generation biofuels.

State and local governments are key to successful implementation of these fuels.[225] Michigan's successful implementation of initiatives targeted to promote the success of environmental technology and lower the risk for

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[217] *See* KLAUS DEUTSCH, DEUTSCHE BANK RESEARCH, CAP AND TRADE IN AMERICA: U.S. CLIMATE POLICY AT A CROSSROADS 10 (2008), *available at* http://www.dbresearch.com (search for "Cap and Trade in America").
[218] *See* Richard Simon, *Congress Votes to Stop Shipments to the Nation's Reserves*, L.A. TIMES, May 14, 2008, at A18.
[219] *See, e.g.*, SouthCarolinaGasPrices.com, *supra* note 18.
[220] *See* discussion *supra* Parts III.A-C.
[221] John R. Lott, Jr., *Ethanol Mandates Cause Rising Food Prices*, FOX NEWS, Apr. 28, 2008, http://www.foxnews.com/story/0,2933,352968,00.html (last visited June 1, 2008).
[222] H. Josef Hebert, *Congress Split Over Choice of Corn for Fuel or for Food*, S.F. CHRON., May 7, 2008, at C-4.
[223] *See* Energy Independence and Security Act of 2007, Pub. L. No. 110-140, §§ 201, 202, 121 Stat. 1492, 1519-28 (2007) (amending 42 U.S.C. § 7545).
[224] *Id.* § 202, 121 Stat. at 1521-28.
[225] *See* discussion *supra* Part IV.B.

entrepreneurs exemplifies the possibilities of creative state government.[226] By focusing on local production of second-generation biofuels, including: growing or collecting the starting materials; manufacturing the fuels; and selling the fuels, states can overcome many implementation hurdles of transporting raw and finished products and also invigorate local economies by decentralizing supply streams and consumer spending on fuel.

[226] *See* Mich. Econ. Dev. Corp., Targeted Initiatives, http://www.michiganadvantage.org/Targeted-Initiatives/Default.aspx (last visited June 1, 2008).