

COMMENTS

POWERED BY GREASE: THE CASE FOR STRAIGHT VEGETABLE OIL IN THE NEW FUEL ECONOMY

I. INTRODUCTION

The world is running out of oil.¹ It took centuries for the planet's oil reserves to naturally form;² but, at the world's current rate of consumption, oil reserves will be exhausted in less than 100 years.³ The United States is the world's leading consumer of oil,⁴ annually burning approximately one-quarter of the world's oil supply despite accounting for only 5% of the global population.⁵ Nonetheless, the United States has come to rely on imported oil more than ever.⁶

1. GREG PAHL, BIODIESEL: GROWING A NEW ENERGY ECONOMY 1 (2005); Joseph Nocera, *On Oil Supply, Opinions Aren't Scarce*, N.Y. TIMES, Sept. 10, 2005, at C1.

2. JOSHUA TICKELL, FROM THE FRYER TO THE FUEL TANK: THE COMPLETE GUIDE TO USING VEGETABLE OIL AS AN ALTERNATIVE FUEL 10 (Kaia Roman ed., 3d ed. 2003) [hereinafter TICKELL, FROM THE FRYER].

3. *Id.* at 12 (stating that at the current worldwide rate of oil consumption of 24 billion barrels per year, the planet will run out of oil by 2040); see also Daniel Ramish, Comment, *Government Regulatory Initiatives Encouraging the Development and Sale of Gas/Electric Hybrid Vehicles: Transforming Hybrids from a Curiosity to an Industry Standard*, 30 WM. & MARY ENVTL. L. & POL'Y REV. 231, 234-41 (2006).

4. Raci Orion Spaulding, Comment, *Fuel from Vegetables? A Modern Approach to Global Climate Change*, 13 TRANSNAT'L L. & CONTEMP. PROBS. 277, 278 (2003).

5. JOSH TICKELL, BIODIESEL AMERICA: HOW TO ACHIEVE ENERGY SECURITY, FREE AMERICA FROM MIDDLE-EAST OIL DEPENDENCE, AND MAKE MONEY GROWING FUEL 4 (Meghan Murphy & Claudia Graziano eds., 2006) [hereinafter TICKELL, BIODIESEL AMERICA] (stating that the United States consumes approximately 25% of the world's oil); see also Ramish, *supra* note 3, at 240 (stating that the United States consumes 26% of the world's oil, while producing

As global oil reserves continue to dwindle, extraction costs will continue to rise not only in economic terms, but also in terms of security and the environment.⁷ In this regard, United States Presidents have characterized our dependence on foreign oil as one of the single greatest threats to our nation's security.⁸ Indeed, it has been cited as an impetus for the terrorist attacks of September 11, 2001,⁹ as well as for the war in Iraq.¹⁰ Some commentators even suggest that spending on Middle-Eastern oil indirectly finances terrorism.¹¹ The vulnerability of the United States' domestic petroleum infrastructure is

less than 10% of the global oil supply); John Fohr, *How NAFTA Can Increase Global Energy Security*, 22 WIS. INT'L L.J. 741, 741 (2004); Michael J. Smolin, *Challenges and Opportunities for Energy Alternatives for Transportation in the United States*, 36 CUMB. L. REV. 479, 479 (2006) ("The United States, which consumes 25% of the world's demand, consumes approximately eight billion barrels of crude oil equivalents every year (or about 336 billion gallons per year). Transportation fuels account for approximately 40% of total consumption in the United States (or about 130 billion gallons per year)."); Chris Potter, *Seeds of Change: Can Biofuels Energize Pittsburgh—and Save the World?*, PITTSBURGH CITY PAPER, Feb. 16, 2006, available at <http://www.pittsburghcitypaper.ws/gyrobase/PrintFriendly?oid=oid%3A28273> (stating that the United States consumes 840 million gallons of oil per day).

6. See TICKELL, FROM THE FRYER, *supra* note 2, at 13; see also Fohr, *supra* note 5, at 741 (stating that, "[i]n 2003, the United States imported fifty-six percent of its total oil consumption, a level that the U.S. Department of Energy projects will rise to sixty-two percent by 2020").

7. See Ramish, *supra* note 3, at 233 ("Oil shortages will create worldwide economic instability, increase American dependence on oil from the Middle East, [and] aggravate this nation's vulnerability to terrorist attacks . . .").

8. For example, in the 1970s, as "fifty Americans were being held hostage in Iran," President Jimmy Carter stated, "Our excessive dependence on foreign oil is a clear and present danger to our Nation's security . . ." TICKELL, BIODIESEL AMERICA, *supra* note 5, at 6-7; see also Scott H. Segal, *Fuel for Thought: Clean Gasoline and Dirty Patents*, 51 AM. U. L. REV. 49, 80 (2002) ("The National Defense Council Foundation (NDCF) noted that five different Presidents—Eisenhower, Kennedy, Nixon, Ford and Carter—imposed restrictions on imports of refined petroleum products because they recognized that maintaining healthy domestic refining capacity was essential to national security.").

9. See Spaulding, *supra* note 4, at 293.

10. See IAN RUTLEDGE, ADDICTED TO OIL: AMERICA'S RELENTLESS DRIVE FOR ENERGY SECURITY xi (2005) (contending that the United States' invasion of Iraq was to secure domination and control of Iraq's oil).

11. Ramish, *supra* note 3, at 241; see, e.g., Spaulding, *supra* note 4, at 293. ("U.S. money used to purchase Saudi oil is most likely what funded the attacks.").

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further evidenced by the effects of Hurricane Katrina on offshore drilling¹² and the Alaskan pipeline leak in 2006.¹³ Finally, the severe environmental and health implications of petroleum consumption, such as global warming and air pollution, are finally being realized.¹⁴

Consequently, the consumption of oil has become one of the nation's most controversial topics, prompting politicians and the public to pursue alternative fuel sources.¹⁵ Politicians, sounding more and more like peddlers of snake oil from the old west, hawk hydrogen

12. See Mike Allen, *Crunching the Numbers on Alternative Fuels*, POPULAR MECHANICS, May 2006, available at <http://www.popularmechanics.com/science/earth/2690341.html>.

13. See Brad Knickerbocker, *Leak Is Latest of Alaska's Pipeline Woes*, CHRISTIAN SCIENCE MONITOR, Aug. 9, 2006, available at <http://www.csmonitor.com/2006/0809/p02s01-usgn.html>. In March 2006, 267,000 gallons of oil poured out of a corroded section of the Alaska Pipeline along the northern coast. *Id.* The leak remained undiscovered for five days. *Id.*

14. See Allen, *supra* note 12; see also Anya C. Musto, Comment, *California as a Model for Federal Regulation of Automobile Emissions Pollution: Replacing Title II of the Clean Air Act of 1990*, 5 DICK. J. ENVTL. L. & POL. 151, 152 (1996) ("The single most significant source of air pollution in the United States is the motor vehicle.").

15. Ian Hoffman, *Bush Pumps Millions into Biofuels*, TRI-VALLEY HERALD, Aug. 3, 2006 (stating that the Bush administration announced it would spend \$250 million on biofuel research); see Nisha Taneja, *How Public Policy and Market Forces are Converging to Provide Minnesota the Opportunity to Become a National Biodiesel Fuel Leader*, 25 HAMLINE J. PUB. L. & POL'Y 201, 201 (2003) ("The continuing Middle East conflict has prompted intense debate in the popular media about America's continued dependency on foreign oil."); U.S. Dep't of Energy, *Straight Vegetable Oil as a Diesel Fuel?*, CLEAN CITIES, Apr. 2006, available at http://www.biodiesel.org/pdf_files/fuelfactsheets/clean_cities_SVOpaper.pdf. The controversial nature of oil consumption is understandably exacerbated by recent reports of the oil industry's record profits. See, e.g., Scott Horsley, *Record Profits at Oil Companies Draw Criticism*, NAT'L PUBLIC RADIO, Apr. 27, 2006, <http://www.npr.org/templates/story/story.php?storyId=5367090> (stating that the world's largest oil company, ExxonMobil, earned \$8 billion in the first three months of 2006, while ConocoPhillips announced that it earned \$3.3 billion during the first quarter of 2006); Clifford Krauss, *Exxon Rides Oil and Gas Prices to 36% Gain in Profit*, N.Y. TIMES, July 28, 2006, at C1 (stating that "Exxon Mobile reported a 36 percent gain in second-quarter earnings" on July 27, 2006); Jeremy W. Peters, *Conoco's Profit Rises by Two-Thirds on Soaring Oil Prices*, N.Y. TIMES, July 27, 2006, at C2 (stating that ConocoPhillips announced a near two-thirds leap in profits for the second quarter).

fuel as the miracle elixir to solve our energy crisis.¹⁶ But there is no one solution to our reliance on oil.¹⁷ While hydrogen fuel cells are widely regarded as the ultimate solution to our energy dependence, the commercial viability of the technology is debatable.¹⁸ Moreover, while transition fuels such as biodiesel and ethanol have been the subject of many promising legislative and regulatory initiatives,¹⁹ there is not enough biological feedstock to replace even a quarter of the nation's growing demand for petroleum.²⁰ Even assuming one of

16. See, e.g., President George W. Bush, Hydrogen Fuel Initiative Can Make "Fundamental Difference," Remarks by the President on Energy Independence at the National Building Museum (Feb. 6, 2003), available at <https://www.whitehouse.gov/news/releases/2003/02/20030206-12.html>; see also Jeff Wise, *The Truth About Hydrogen*, POPULAR MECHANICS, Nov. 2006, at 83 (noting President Bush's announcement of "a \$1.2 billion initiative to begin developing a national hydrogen infrastructure"). According to David Garmin, assistant secretary of energy, while the government has been developing biofuels to alleviate oil consumption, "it's only hydrogen, ultimately, over the long term, that can delink light-duty transportation from petroleum entirely." *Id.*; see, e.g., Governor Arnold Schwarzenegger's California Hydrogen Highway Network Action Plan, available at www.hydrogenhighway.ca.gov/vision/vision.pdf (last visited Nov. 2, 2007) ("The 'Vision 2010' for California's Hydrogen Highways is to ensure that by the end of the decade every Californian has access to hydrogen fuel along the State's major highways. . . ."); see also Barry G. Rabe et al., *State Competition as a Source Driving Climate Change Mitigation*, 14 N.Y.U. ENVTL. L.J. 1, 38 (2006) ("During his election campaign in 2003, Schwarzenegger laid out a vision of a 'hydrogen highway' stretching from Baja California to British Columbia. This promise has been reiterated since the Governor took office, and he has presented a plan to build hydrogen fuel stations every twenty miles along major highways . . .").

17. Joe Jobe, *Foreword to TICKELL, BIODIESEL AMERICA*, *supra* note 5, at 4; see also Allen, *supra* note 12 ("[N]o single alternative fuel can replace imported oil alone.").

18. See Wise, *supra* note 16, at 84 ("Skeptics say that hydrogen promises to be a needlessly expensive solution for applications for which simpler, cheaper and cleaner alternatives already exist."); see also Jobe, *supra* note 17, at 4.

19. See generally Biomass Energy and Alcohol Fuels Act, 42 U.S.C. §§ 8801-8871 (1994); Energy Policy Act of 1992, 42 U.S.C. §§ 13201-13556 (2004).

20. See Michael Kanellos, *Forget Fueling Cars on Corn or Soybeans*, CNET NEWS.COM, July 11, 2006, http://news.com.com/Report+Forget+fueling+cars+on+corn+or+soybeans/2100-11389_3-6092888.html ("Even if all of the corn produced in the U.S. last year were used to make ethanol, it would quench only 12 percent of the country's gas thirst. . . . If the soybean crop were consumed as fuel, it would displace only 9 percent of the country's demand for diesel."). Kanellos notes that "[a]ny appreciable upsurge in the use of those plants for fuel would . . . cut into the

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these alternatives is sufficient to replace petroleum, we would be merely substituting one energy dependency for another. The solution to our oil dependence lies in a variety of sources.²¹

In this regard, a growing number of motorists nationwide are converting their diesel-fueled automobiles to run on straight vegetable oil—the cooking oil more commonly associated with human consumption.²² The niche market of vegetable oil consumers can fuel diesel engines with vegetable oil that has not been otherwise processed (i.e., pure vegetable oil) and waste vegetable oil, which is often used cooking oil that has been discarded by restaurants.²³ The result is environmentally-friendly vehicles with exhaust that carries the aroma of tempura or french fries.²⁴ Like biodiesel and ethanol, straight vegetable oil alone cannot displace the nation's reliance on oil because it is likewise dependent on the availability of feedstock.²⁵ However, it can alleviate at least some consumption of fossil fuels in light of the ability to convert post-consumer waste oil into fuel.

Unfortunately, while the United States has promoted a number of alternative fuel sources, it has been reluctant to encourage the use of straight vegetable oil as an alternative fuel. Straight vegetable oil is presently illegal because it does not comply with the United States Environmental Protection Agency's (EPA) testing and registration standards for vehicles and fuel authorized under the Clean Air Act

U.S. food supply." *Id.*

21. Jobe, *supra* note 17, at 4-5.

22. See, e.g., Robert Iafolla, *The Crisco Kid*, L.A. WEEKLY, July 12, 2006, available at <http://www.laweekly.com/general/features/the-crisco-kid/13976/>; Valli Herman, *Vegetable Juice: At Silver Lake's Lovecraft, Cars Take a Trip from Diesel to Veggie Oil*, L.A. TIMES, Aug. 5, 2006, at E1.

23. See U.S. Dep't of Energy, *supra* note 15 ("[T]here is . . . interest in the direct use of vegetable oils as straight or raw vegetable oil . . . or of waste oils from cooking and other processes"); see, e.g., Potter, *supra* note 5 (discussing one vegetable oil consumer who scavenges for vegetable oil fuel from "waste cans and grease trays tossed away by restaurants").

24. See, e.g., Herman, *supra* note 22 (noting how the exhaust from a car that uses vegetable oil as fuel smells like tempura).

25. It is unlikely that vegetable oil can replace the nation's oil supply because it is derived from the same biological feedstock as biodiesel and ethanol, which themselves cannot alone replace the nation's supply of oil. See *supra* notes 19-20 and accompanying text.

(CAA).²⁶ Ameliorating these standards to include vegetable oil as part of a strategy aimed at diversifying the nation's fuel supply could substantially alleviate the United States' dependence on petroleum while reducing negative environmental impacts, increasing security, and improving the domestic economy.²⁷

This Comment advocates the use of straight vegetable oil as a renewable alternative fuel source to petroleum diesel. Part II provides a brief background on the historical development of the diesel engine, followed by a discussion on the development of renewable fuel sources. Part III discusses the EPA's federal emissions standards and testing requirements authorized by the CAA. These standards currently prohibit the use of straight vegetable oil as an alternative fuel as well as the aftermarket modification of existing vehicles.²⁸ Part IV proposes amending the CAA to create a renewable fuel policy directed at diversifying the United States' oil supply to the greatest extent possible. This strategy would include the use of straight vegetable oil. Part V reasons that as part of a comprehensive strategy aimed at diversifying the nation's oil supply, straight vegetable oil

26. California Center for Sustainable Energy, *Biodiesel* (2007), <http://www.sdenergy.org/ContentPage.asp?ContentID=320&SectionID=316&SectionTarget=316> [hereinafter Center for Sustainable Energy] ("Raw vegetable oil does not meet biodiesel fuel specifications, it is not registered with the EPA, and it is not a legal motor fuel."). Although not within the scope of this paper, it should be noted that, in addition to federal emissions requirements, motor vehicles may be required to comply with emissions standards promulgated by certain States. *See* 42 U.S.C. § 7543(b)(1) (1994) (providing a waiver of federal preemption of emissions regulations to states that have adopted satisfactory emissions standards prior to March 30, 1966).

27. *See* Spaulding, *supra* note 4, at 279 ("Using renewable fuels will not only improve the environment, but will also help the United States combat the serious problems of energy security and the plight of rural Americans."); *see generally* Kate M. Joyce, *U.S. Energy Policy Since September 2001*, 15 *FORDHAM ENVTL. L. REV.* 31 (2004) (arguing that diversifying the United States' sources of energy is one way to reduce dependence on imported oil and help the environment); *see also* Potter, *supra* note 5 (noting that the consumption of vegetable oil does not require the deployment of troops to protect foreign petroleum interests).

28. *See supra* note 26 and accompanying text; *see also* 42 U.S.C. § 7545 (2000) (mandating the registration of all fuel and fuel additives before they can be sold, offered for sale, or introduced into commerce); 40 C.F.R. § 85.504(a)(1) (2006) (stating that the conversion of a post-1993 model year vehicle must be "certified as if it were a new vehicle or engine.").

would reduce the negative human health and environmental impacts associated with petroleum, increase energy security, and improve the domestic economy. Part VI concludes that these benefits advocate the use of straight vegetable oil in the new fuel economy.

II. BACKGROUND

Rudolf Diesel anticipated the potential of vegetable oil to fuel automobiles as early as 1912, when he prophetically stated:

The use of vegetable oil for engine fuels may seem insignificant today, but such oils may become, in the course of time, as important as petroleum and the coal-tar products of the present time. . . . Motive power can still be produced from the heat of the sun, always available, even when the natural stores of solid and liquid fuels are completely exhausted.²⁹

The means to make this vision a reality was designed twenty years earlier by the same man. In 1892, Diesel received a patent for his namesake invention—the diesel engine.³⁰ Diesel designed his compression-ignition engine to be efficient³¹ and flexible in its ability to burn a variety of fuels.³² In contrast to the spark-ignition (or gasoline) engine, which requires spark plugs to ignite vaporized gasoline, the diesel engine compresses air to such an extent that it ignites the fuel on its own without any ignition from spark plugs.³³

29. See PAHL, *supra* note 1, at 23 (quoting Rudolf Diesel in an April 13, 1912 speech in St. Louis, Missouri).

30. Luc C. Duchesne, *Is Biodiesel Really Good for the North?*, NORTHERN ONTARIO BUSINESS, Apr. 1, 2006, available at <http://www.northernontariobusiness.com/industry/transportation/04-06-biofuel.asp>.

31. See MORTON GROSSER, DIESEL: THE MAN AND THE ENGINE 4-5 (1978) (stating that efficiency “was one of Rudolf Diesel’s guiding principles” and that Diesel was dissatisfied with the relatively low efficiency of the steam engine).

32. See PAHL, *supra* note 1, at 18. In 1893, Diesel published the “Theory and Construction of a Rational Heat Engine to Replace the Steam Engine and Contemporary Combustion Engine.” *Id.* In the paper, he described his theory that compressing air at high pressures would create such extreme temperatures that an engine could ignite virtually any fuel injected into its cylinder. *Id.*

33. *Id.* at 62 (noting that the temperature inside the cylinder of a diesel engine reaches approximately 1000°F); Allen, *supra* note 12; see TICKELL, BIODIESEL

Internal compression makes the diesel engine capable of operating on a variety of fuels, whereas the spark-ignition engine requires an extremely volatile fuel for combustion.³⁴

At the 1900 World's Fair in Paris, Diesel demonstrated the flexibility of his engine to operate on a variety of fuels by running a smaller prototype on peanut oil.³⁵ Although Diesel conceived his engine to run on a number of different fuels,³⁶ the diesel engine eventually adopted a byproduct of petroleum, which is presently referred to as diesel fuel.³⁷ This byproduct was created during the gasoline-making process at a time in which it was both cheap and plentiful.³⁸ Consequently, the energy-producing potential of vegetable oil was all but forgotten.³⁹

AMERICA, *supra* note 5, at 60 (discussing how Diesel's inspiration for the concept of compression ignition originated with early Southeast Asian peoples' Malayan fire piston). The Malaysians created fire by placing a small piece of tinder in a hollow bamboo shoot that was sealed at one end. A fitted wooden rod was then forced into the bamboo shoot, compressing and heating the air inside the bamboo shoot to such an extent that it ignited the tinder. *Id.*

34. Allen, *supra* note 12.

35. Gerhard Knothe, *Historical Perspectives on Vegetable Oil-Based Diesel Fuels*, INFORM, Nov. 2001, at 1103; Center for Sustainable Energy, *supra* note 26.

36. PAHL, *supra* note 1, at 26 (stating that "Diesel had originally intended that his engine would be able to run on a variety of fuels, including whale oil, hemp oil, [coal dust] and kerosene"); Center for Sustainable Energy, *supra* note 26; *see also* TICKELL, BIODIESEL AMERICA, *supra* note 5, at 156 (stating that Diesel experimented with peanut oil).

37. Potter, *supra* note 5.

38. *Id.* Vegetable oil cannot form a combustible gas in a gasoline engine because it is not volatile enough. Duchesne, *supra* note 30. Rudolf Diesel's engine resolved this issue because it does not require a spark plug; "the compression of the fuel sets off combustion." *Id.*

39. Potter, *supra* note 5 (stating that, "until the past decade, vegetable oil fell out of mainstream use"); *see also* Knothe, *supra* note 35, at 1105 (purporting that, during World War II, vegetable oils were used as emergency fuels and for other purposes). For example, the Japanese battleship Yamato used soybean oil as a bunker fuel. *Id.* Following World War II, a mixture of certain vegetable oils and conventional diesel (the predecessor to biodiesel) was briefly studied at The Ohio State University. *Id.*

A. Renewed Interest in Vegetable-Based Fuels in the Wake of the 1973-1979 Oil Shocks

In October 1973, the Organization of Petroleum Exporting Countries (OPEC), represented by Middle-Eastern nations owning 36% of the world's oil,⁴⁰ initiated an oil embargo against the United States and much of Western Europe in response to their support of Israel during the Yom Kippur War.⁴¹ The embargo inflated energy prices⁴² and sent the United States and much of Europe into an economic recession.⁴³ In the United States alone, the price of gas increased by more than 40% and long lines at gas stations became commonplace.⁴⁴ In response, the United States was forced to increase domestic production of oil, which had peaked just three years earlier,⁴⁵ and further diminished the domestic supply.⁴⁶

40. TICKELL, FROM THE FRYER, *supra* note 2, at 11. The OPEC nations include: Saudi Arabia, Indonesia, Algeria, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, the United Arab Emirates, and Venezuela. TICKELL, BIODIESEL AMERICA, *supra* note 5, at 48-49.

41. DANIEL YERGIN, THE PRIZE: THE EPIC QUEST FOR OIL, MONEY AND POWER 607 (1991) (stating that, on October 17, 1973, OPEC agreed to an embargo, initially cutting production by 5%). On October 19, following President Richard Nixon's proposal to send \$2.2 billion in military aid to Israel, Libya embargoed all shipments of oil to the United States. *Id.* at 608. Saudi Arabia and the other OPEC nations soon followed. *Id.* See also PAHL, *supra* note 1, at 27.

42. PAHL, *supra* note 1, at 27.

43. *Id.* at 28. Because of its limited domestic supply of petroleum, Western Europe was especially affected. *Id.*

44. YERGIN, *supra* note 41, at 616-17. "These gas lines became the most visible symbol of the embargo and America's most direct experience of it." *Id.* at 617; see also TICKELL, BIODIESEL AMERICA, *supra* note 5, at 33 ("Lines at many American gas stations stretched for miles."); Andrew C. Udin, *Slaying Goliath: The Extraterritorial Application of U.S. Antitrust Law to OPEC*, 50 AM. U. L. REV. 1321, 1322 (2001). The estimated total cost of the United States' dependence on oil is approximately \$7 trillion over a thirty-year period extending back from 2000. C. Boyden Gray & Andrew R. Varcoe, *Octane, Clean Air and Renewable Fuels: A Modest Step Toward Energy Independence*, 10 TEX. REV. L. & POL. 9, 10 & n.3 (2006).

45. TICKELL, BIODIESEL AMERICA, *supra* note 5, at 32.

46. TICKELL, FROM THE FRYER, *supra* note 2, at 11; see also PAHL, *supra* note 1, at 28. "In response to the crisis, the U.S. Congress approved the construction of the trans-Alaskan oil pipeline (completed in 1977 at a cost of \$8 billion), which was designed to supply 2 million barrels of oil a day." *Id.*

In 1979, the Iranian Revolution triggered another global energy crisis.⁴⁷ In the wake of nationwide protests, the United States-backed Shah of Iran was ousted,⁴⁸ and the exiled Ayatollah Khomeini rose to power.⁴⁹ Ayatollah Khomeini was hostile towards the United States and the oil supply was again restricted.⁵⁰ Soon after, the cost of petroleum “spiraled out of control” and threatened the economic independence of the United States.⁵¹

Collectively referred to as the “oil shocks,” the 1973 oil embargo and 1979 Iranian Revolution revealed the vulnerability of the world’s dependence on Middle-Eastern oil.⁵² The United States Department of Energy (DOE) estimates that the oil shocks, and consequent disruptions of the nation’s oil supply, have cost the United States an estimated \$3.4 trillion over the last thirty years.⁵³

In the United States and Europe, the economic damage caused by the oil shocks renewed interest in the development of alternative fuels—namely, fuel derived from agricultural products.⁵⁴ Western Europe, which was particularly harmed by the energy crises,⁵⁵ “began experimenting with vegetable oils as a potential energy source.”⁵⁶ For example, researchers at the Austrian Federal Institute for Agricultural Engineering experimented with various vegetable oils in diesel engines.⁵⁷ After initial tests failed because vegetable oil was too thick to operate modern engines,⁵⁸ the researchers used a process called “transestrification” to remove a chemical compound called glycerin

47. PAHL, *supra* note 1, at 28.

48. *Id.*

49. TICKELL, BIODIESEL AMERICA, *supra* note 5, at 35.

50. *See id.*

51. *Id.*

52. *See* Iafolla, *supra* note 22.

53. TICKELL, BIODIESEL AMERICA, *supra* note 5, at 48.

54. Knothe, *supra* note 35, at 1103 (stating that “the energy crises of the 1970s and early 1980s generated renewed interest in alternative fuels”); Allan M. Richards, *Biomass Energy: An Agricultural Role in Pollution Control?*, 45 *DRAKE L. REV.* 143, 143-44 (1997).

55. PAHL, *supra* note 1, at 28.

56. *See, e.g.*, TICKELL, BIODIESEL AMERICA, *supra* note 5, at 156-57.

57. *Id.* *See generally* PAHL, *supra* note 1, at 29-36 (discussing the Austrian project).

58. *See* PAHL, *supra* note 1, at 42.

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from the vegetable oil to make it thinner.⁵⁹ The process chemically altered the vegetable oil into a byproduct called alkyl esters, or biodiesel.⁶⁰

Similarly, research on vegetable oil as a fuel source commenced at the United States Department of Agriculture (USDA) and at several American universities.⁶¹ In 1979, after similar failed attempts to use vegetable oil in diesel engines, researchers at the University of Idaho concluded that either the vegetable oil or the diesel engine would have to be modified if vegetable oil were to serve as an alternative fuel source.⁶² Initially, researchers used a 50-50 mix of pure vegetable oil and petroleum diesel, before subsequently adopting the transesterification process used to create biodiesel.⁶³ Despite these early strides in alternative fuel, they were eventually abandoned in favor of petroleum-based fuels because oil prices had stabilized⁶⁴ and the consensus at the time was that the production and distribution of agricultural-based fuels was much more costly than conventional diesel.⁶⁵

59. *Id.* at 31. Vegetable oil is a triglyceride composed of three fatty acid molecules, which are linked to a glycerin molecule. *Id.* Transesterification mixes vegetable oil with alcohol, which works as a catalyst that separates the glycerin molecule from the vegetable oil leaving two byproducts—alkyl esters, or biodiesel, and glycerin. *Id.*

60. *Id.* at 31-32. Biodiesel is also known as “fatty acid methyl ester” (FAME). U.S.D.A. FOREIGN AGRIC. SERV., GERMANY OILSEEDS AND PRODUCTS: BIOFUELS IN GERMANY—PROSPECTS AND LIMITATIONS, GM4048, at 7 (2004) [hereinafter GAIN REPORT].

61. Taneja, *supra* note 15, at 204 & n.8; *see, e.g.*, PAHL, *supra* note 1, at 156-57. Automotive pioneers Henry Ford and Charles Kettering pursued alcohol-based ethanol. Gray & Varcoe, *supra* note 44, at 15. However, the invention of leaded gasoline, the discovery of massive oil fields, and Prohibition, which made it illegal to distill alcohol even for use as fuel, quelled their pursuit. *Id.*

62. PAHL, *supra* note 1, at 38-39.

63. *Id.* at 39.

64. *See* Michael Snyder, *No ‘Corn Dot-Com Bust’ for Indiana Ethanol, Says Ag Secretary Miller*, MIDWESTBUSINESS.COM, Feb. 15, 2007, <http://www.midwestbusiness.com/printer/article.asp?newsletterID=16620> commenting that people lost interest in alternative fuels in the 1980s after oil prices stabilized); *see also* YERGIN, *supra* note 41, at 630-32, 714 (discussing the abandonment of the embargos and the stabilization of oil prices).

65. Taneja, *supra* note 15, at 204 n.8.

*B. The Continued Energy Crisis and the Pursuit
of a New Fuel Economy*

Today, even more than in the 1970s, the Middle East is situated to force the world into economic recession.⁶⁶ While the eleven OPEC nations control over 40% of the world's oil and three-quarters of the world's proven oil reserves,⁶⁷ the United States has come to rely on imported oil more than ever.⁶⁸ When the 1973 oil embargo occurred, the United States imported about 30% of its oil.⁶⁹ Presently, oil imports represent approximately 60% of the United States' oil supply—46.2% of which comes from OPEC nations.⁷⁰

In response to the unpredictability of the United States' long-term oil supply, there have been a number of legislative and regulatory initiatives promoting the research and development of renewable fuel sources.⁷¹ Foremost among these renewable fuels is hydrogen.⁷² President George W. Bush has called on the nation to make the gradual transition to hydrogen fuel.⁷³ To facilitate this transition, during the 2003 State of the Union Address, President Bush announced a \$1.2 billion initiative to develop a hydrogen infrastructure aimed at the production and distribution of hydrogen fuel cells.⁷⁴

66. See Ramish, *supra* note 3, at 238-39 (stating that experts believe that OPEC's power to tighten supply and keep oil prices high will only increase); see also Udin, *supra* note 44, at 1323 (stating that OPEC has used its control over a significant portion of the world's oil supply to inflate oil prices); Joyce, *supra* note 27, at 33 (2004) (“[O]il security is threatened by the ability of the oil exporting countries to exploit their market power, raising oil prices and causing macroeconomic disruptions”).

67. TICKELL, *BIODIESEL AMERICA*, *supra* note 5, at 48-49; Udin, *supra* note 44, at 1328.

68. See TICKELL, *FROM THE FRYER*, *supra* note 2, at 13.

69. Jobe, *supra* note 17, at 7.

70. *Id.*; Ramish, *supra* note 3, at 238 (“In the first half of 2005, the U.S. imported 46.2% of its oil from OPEC countries, amounting to more than 5.6 million barrels per day.”).

71. See *supra* notes 15-16 and accompanying text.

72. See Allen, *supra* note 12 (“Department of Energy (DOE) policy calls for eventually making a transition to a hydrogen-based economy.”).

73. See *id.*

74. Wise, *supra* note 16, at 83 (describing the project as a “coast-to-coast

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Unfortunately, while hydrogen has the potential to be a limitless source of energy because it is the most abundant element on the planet,⁷⁵ whether it will ever be commercially viable as a replacement to petroleum fuel is questionable.⁷⁶ Despite spending almost \$720 million on the first phase of the President's hydrogen initiative, the hydrogen infrastructure remains far away.⁷⁷ In addition to production being prohibitively costly and energy intensive,⁷⁸ current production methods require fossil fuels that still need to be imported, thus reducing some of the benefit of hydrogen fuel technology.⁷⁹ Consequently, the United States has had to take intermediate steps to reduce the consumption of petroleum oil.⁸⁰

In the interim, the two alternative renewable fuels that have generated the most attention are ethanol, an alternative to gasoline,⁸¹ and biodiesel, an alternative to petroleum diesel, which is compatible with diesel engines.⁸² Because the United States' fuel economy is primarily powered by gasoline engines, ethanol, which is primarily made from corn,⁸³ has been the most popular renewable fuel source.⁸⁴

network of facilities that would produce and distribute the hydrogen for powering hundreds of millions of fuel cell vehicles”).

75. Allen, *supra* note 12.

76. Ramish, *supra* note 3, at 242. *See generally* Wise, *supra* note 16, at 83-87 (discussing the viability of a hydrogen fuel economy).

77. Wise, *supra* note 16, at 83.

78. Allen, *supra* note 12 (stating that “producing hydrogen is expensive and energy consuming”). Most hydrogen is made from petroleum. *Id.* Hydrogen can also be made by a process called electrolysis, a process that runs currents of electricity through water to separate the oxygen and hydrogen. *Id.* However, electrolysis “takes about 17 kwh of electricity, which costs about \$1.70, to make 100 cu. ft. of hydrogen. That amount would power a fuel cell vehicle for about 20 miles.” *Id.*; *see also* Wise, *supra* note 16, at 84 (“At present, 95 percent of America’s hydrogen is produced from natural gas. . . . Over the next 10 or 20 years, fossil fuels most likely will continue to be the main feedstock for the hydrogen economy.”).

79. Ramish, *supra* note 3, at 242 (stating that creating hydrogen fuel cells may require importing natural gas from OPEC countries).

80. *See id.*

81. *See* Allen, *supra* note 12 (stating that ethanol is the “king of the challengers to petroleum”).

82. *See* TICKELL, BIODIESEL AMERICA, *supra* note 5, at 104 (stating that biodiesel, which is compatible with the diesel engine, is “the fastest growing fuel in America today” according to the DOE).

83. Hoffman, *supra* note 15 (stating that, in the United States, 97% of ethanol

As previously discussed, biodiesel is a renewable fuel source, which is derived from vegetable oil that has been thinned through the transesterification process.⁸⁵

Despite the potential of ethanol and biodiesel as renewable fuels, in order for either to replace the United States' current petroleum consumption, the agricultural sector would need to dedicate a disproportionate amount of farmland to growing "feedstock."⁸⁶ Committing such a significant portion of the nation's farmland to energy crops would severely impair the nation's ability to produce food.⁸⁷ Accordingly, biodiesel and ethanol have not been widely considered as replacements, but rather as additives to existing petroleum-based fuels.⁸⁸

In this regard, the marketing and regulation of biodiesel and ethanol remains centered on petroleum blends.⁸⁹ Ethanol can be

is made from the starch inside of corn kernels); *see generally* Adam Lashinsky & Nelson D. Schwartz, *How to Beat the High Cost of Gasoline. Forever!*, FORTUNE, Jan. 24, 2006, available at http://money.cnn.com/magazines/fortune/fortune_archive/2006/02/06/8367959/index.htm (discussing the success of Brazil's ethanol economy, which uses sugar cane as its source for ethanol).

84. *See* Allen, *supra* note 12 (stating that ethanol "is already found blended with gasoline at pumps across the country, and production is continuing to ramp up"). Nevertheless, ethanol will not replace gasoline "overnight." Lashinsky & Schwartz, *supra* note 83 (stating that only 587 of the United States 170,000 gas stations serve E85 ethanol); *see also* Amanda Paulson, *Where Corn Is King, a New Fuel is Prince*, CHRISTIAN SCIENCE MONITOR, July 19, 2006 (stating that ethanol has been heavily invested in by Wall Street executives, venture capitalists, and even Bill Gates). Additionally, three major "automakers have pledged to double their production of flex-fuel vehicles—which can run on either gasoline or ethanol—by 2010." *Id.*

85. Center for Sustainable Energy, *supra* note 26.

86. *See* Allen, *supra* note 12 (estimating that approximately 71% of the nation's 938 million acres of farmland would need to grow the feedstock in order to replace gasoline with ethanol). "Feedstock" is raw agricultural material used to produce biofuels. GAIN REPORT, *supra* note 60, at 3.

87. *See* GAIN REPORT, *supra* note 60, at 13.

88. *See* Allen, *supra* note 12 (stating that "ethanol alone won't kick our fossil fuel dependence—unless we want to replace our oil imports with food imports"); *see infra* notes 89-93 and accompanying text (providing various examples of how biofuels have been added to petroleum-based fuels).

89. *See* Iafolla, *supra* note 22 (noting Lovecraft founder's skepticism that "biodiesel at the pump [will be] 20 percent biodiesel and 80 percent regular diesel"); Allen, *supra* note 12 ("E85 is a blend of 85 percent ethanol and 15 percent

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blended with gasoline in varying quantities.⁹⁰ E85, a blend of 85% ethanol and 15% gasoline, is the most common blend of ethanol.⁹¹ Biodiesel can be blended with diesel in any quantity.⁹² Although 100% pure biodiesel (called B100) can operate in most standard diesel engines, B2 (a blend of 2% biodiesel and 98% petroleum diesel) and B5 (a blend of 5% biodiesel and 95% petroleum diesel) are currently the most common biodiesel blends on the market.⁹³ While ethanol and biodiesel blends demonstrate progress, they are inadequate to displace the nation's reliance on petroleum—particularly when considering that both consist mostly of petroleum. In order to effectively wean itself off petroleum, the United States must look to a variety of different sources for its energy—including straight vegetable oil.

C. Straight Vegetable Oil

When Rudolf Diesel demonstrated his engine running on peanut oil, it was not modified in any way.⁹⁴ In the one hundred years since, Diesel's invention has been fine-tuned to run on petroleum diesel.⁹⁵ With some modification, however, modern diesel engines can run on a variety of different fuels.⁹⁶ In the spirit of Rudolf Diesel's original engine, a growing number of motorists are illegally⁹⁷ modifying

gasoline.”).

90. See GAIN REPORT, *supra* note 60, at 3.

91. Lashinsky & Schwartz, *supra* note 83; see also Allen, *supra* note 12 (stating that E85 is available in 36 states).

92. See CAL. ENERGY COMM'N, BIODIESEL AS A TRANSPORTATION FUEL, Publ'n No. CEC-600-2005-028-FS (2006), available at <http://www.energy.ca.gov/2005publications/CEC-600-2005-028/CEC-600-2005-028-FS.PDF> [hereinafter CAL. ENERGY COMM'N].

93. *Id.*; Scott Hughes, Dir. of Gov't Affairs, Nat'l Biodiesel Bd., Update at the FTA Motor Fuel Tax Section Annual Meeting in Boston: Biodiesel & Straight Vegetable Oil (Oct. 5, 2004).

94. TICKELL, BIODIESEL AMERICA, *supra* note 5, at 66.

95. PAHL, *supra* note 1, at 26.

96. Jennifer Gunther, “Veggie” on Her License Plate, ANITA BORG INSTITUTE FOR WOMEN AND TECHNOLOGY, <http://anitaborg.org/news/archive/veggie> (last visited Sept. 13, 2007).

97. Center for Sustainable Energy, *supra* note 26 (“Raw vegetable oil does not meet biodiesel fuel specifications, it is not registered with the EPA, and it is not a legal motor fuel.”).

automobiles to run on straight vegetable oil (SVO).⁹⁸ Vegetable oil, as the name suggests, is fatty oil derived from vegetables (and some fruits)⁹⁹ and is predominantly used for human consumption.¹⁰⁰ However, vegetable oil also has energy-producing potential.¹⁰¹

As a preliminary matter, straight vegetable oil should not be confused with biodiesel, which, as previously noted, is a derivative of vegetable oil.¹⁰² In contrast to biodiesel, vegetable oil is used in diesel engines directly, without first reducing its viscosity through the transesterification process.¹⁰³ Because vegetable oil is naturally thicker than biodiesel, modern diesel engines require some engine and fuel system modifications to operate on it.¹⁰⁴

Although “biodiesel and petroleum diesel have similar specifications, pure vegetable oil differs substantially in viscosity and

98. See Iafolla, *supra* note 22 (reporting on the trend to convert 1980s-era diesel-fueled Mercedes-Benz sedans to run on vegetable oil); see also Herman, *supra* note 22 (stating that Lovecraft Biofuels, a shop in Silver Lake, specializes in converting cars to run on vegetable oil).

99. WEBSTER’S NEW COLLEGIATE DICTIONARY 1287 (1981).

100. THE WORLD BOOK ENCYCLOPEDIA 312 (1989) (“Vegetable oils are used mainly in producing or cooking many kinds of food Vegetable oils consist almost entirely of fat, an essential part of a healthy diet.”).

101. See *supra* note 29 and accompanying text. See generally FAIR, ADVANCED COMBUSTION RESEARCH FOR ENERGY FROM VEGETABLE OILS (ACREVO): FINAL REPORT, FAIR-CT95-0627 (2001), available at http://www.senternovem.nl/mmfiles/27769_tcm24-124184.pdf [hereinafter FAIR REPORT] (discussing the results of a scientific study that compares vegetable oil to fuel oil and diesel as an energy source).

102. Center for Sustainable Energy, *supra* note 26 (stating that biodiesel is produced from renewable resources such as vegetable oil and animal fats).

103. See Iafolla, *supra* note 22 (stating that “[b]iodiesel is basically vegetable oil that has been thinned out via a chemical process”).

104. GAIN REPORT, *supra* note 60, at 19; see also PEDER JENSEN, UNMODIFIED VEGETABLE OIL AS AN AUTOMOTIVE FUEL (2005), <http://www.jrc.es/home/report/english/articles/vol74/TRA1E746.htm> (stating that most diesel engines on the market today can be converted to straight vegetable operation, including advanced turbocharged direct injection (“TDI”) versions as well as other special diesel engines). The majority of vehicles running on SVO are converted from standard vehicles, but conversion equipment kits are available for many common engine models. See, e.g., Iafolla, *supra* note 22 (stating that “Lovecraft will modify any diesel engine, but his business focuses almost exclusively on Reagan-era Mercedes-Benzes”).

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burning parameters.”¹⁰⁵ Vegetable oil is approximately eight times thicker than petroleum diesel.¹⁰⁶ However, when it is preheated to 150°C, it has the same viscosity and roughly equivalent performance as petroleum diesel.¹⁰⁷ The high viscosity of vegetable oil must be reduced to avoid incomplete combustion, which may cause the accumulation of carbon deposits and the poor atomization of the fuel.¹⁰⁸ In turn, these consequences may result in poor performance, higher exhaust emissions, and may ultimately reduce the lifespan of the engine.¹⁰⁹ Viscosity and poor combustion are compounded in cold temperatures.¹¹⁰ When vegetable oil gets too cold, it solidifies or gels and can clog fuel lines and filters.¹¹¹

Aftermarket conversion systems have been designed to deal with these problems. These modifications vary with regards to cost and sophistication—ranging from \$700 to well over \$1,500—depending on whether they are completed with do-it-yourself kits for the

105. See GAIN REPORT, *supra* note 60, at 19; see also U.S. Dep’t of Energy, *supra* note 15.

106. The Big Green Bus, Quick Breakdown: Vegetable Oil Versus Biodiesel, <http://thebiggreenbus.org/06/fuelcomp.htm> (last visited Nov. 1, 2007) [hereinafter Big Green Bus].

107. FAIR REPORT, *supra* note 101. Vegetable oil has slightly reduced fuel efficiency and power compared to petroleum diesel. *See id.* (“Due to their physical differences as compared to Diesel fuel (especially a significantly higher viscosity), there are problems such as poor atomization and cooking temperatures in long-term test.”).

108. *See id.*; Iafolla, *supra* note 22 (“[P]ure vegetable oil’s high viscosity and boiling point can cause carbon build-up in the engine, contaminate the lubrication in the crankcase and interfere with and wear out fuel pumps and injectors.”); U.S. Dep’t of Energy, *supra* note 15 (explaining that carbon buildup occurs over a long period of time).

109. See TICKELL, BIODIESEL AMERICA, *supra* note 5, at 177-78. SVO voids manufacturer’s warranties due to concerns that the relatively high viscosity of vegetable oil can cause premature engine wear. *Id.* However, given that the majority of SVO enthusiasts are modifying 80s-era vehicles, any issues related to manufacturers’ warranties are moot.

110. See Duchesne, *supra* note 30 (“In cold temperatures, vegetable oil becomes so viscous that it plugs the fuel filter.”).

111. See John Roach, *Vegetable Oil: The New Fuel?*, NATIONAL GEOGRAPHIC NEWS, Apr. 22, 2003, available at http://news.nationalgeographic.com/news/2003/04/0422_030422_veggiefuels.html (stating that vegetable oil also tends to break apart when it gets too hot).

mechanically-inclined, or by a professional mechanic.¹¹² The typical conversion entails the addition of a parallel fuel line and an independent fuel tank for the straight vegetable oil.¹¹³ The stock fuel tank contains petroleum diesel, which is used to start and stop the vehicle's engine.¹¹⁴ As the engine runs, it heats the vegetable oil contained in the independent fuel tank.¹¹⁵ Once the motor reaches 175°F, the driver uses a switch mounted on the dashboard to toggle to the aftermarket fuel line containing straight vegetable oil.¹¹⁶ Prior to turning off the automobile, the driver toggles back to the petroleum diesel in order to remove excess vegetable oil from the motor.¹¹⁷ There are two obvious drawbacks to this system: the inconvenience of toggling between fuels and continued dependence on petroleum to operate the vehicle.

To remedy these drawbacks, a single-tank system has been designed that enables diesel engines to burn straight vegetable oil without any petroleum diesel or biodiesel.¹¹⁸ Rather than requiring a parallel fuel line for petroleum diesel, an electric heating device is used to preheat the oil and reduce its viscosity.¹¹⁹ The single-tank engine functions just like an automobile fueled exclusively with

112. See Allen, *supra* note 12 (stating that Charles Anderson, owner of Greasel Conversions, has sold over 4500 do-it-yourself conversion kits at prices starting at \$800); Potter, *supra* note 5 (stating that do-it-yourself kits range from \$800 to \$1000, and professional installations usually cost between \$1600 and \$2000); Herman, *supra* note 22 (stating that the Los Angeles-based AT Lovecraft Biofuels will convert a vehicle for a little as \$700).

113. PAHL, *supra* note 1, at 205-06; Iafolla, *supra* note 22.

114. PAHL, *supra* note 1, at 206; Iafolla, *supra* note 22.

115. See PAHL, *supra* note 1, at 206; Iafolla, *supra* note 22.

116. See Herman, *supra* note 22 (stating that Friedman's technology differs from many other systems which require driver-operated switches to control the flow of vegetable oil).

117. PAHL, *supra* note 1, at 206.

118. See, e.g., Herman, *supra* note 22 (stating that Friedman, founder of Lovecraft Biofuels, has developed a one-tank system that not only allows cars to run on SVO and waste vegetable oil, but also any combination of diesel and biodiesel). Friedman's one-tank system requires "no diesel fuel for starting and no driver-operated switches to control the flow of vegetable oil." *Id.*

119. See, e.g., REUK.co.uk, Vegetable Oil Fuel Heaters: Inline Fuel Heaters for Vegetable Oil Conversions, <http://www.reuk.co.uk/Vegetable-Oil-Fuel-Heaters.htm> (last visited Nov. 1, 2007) (advertising inline fuel heaters).

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petroleum diesel; that is, it does not require the driver to toggle between petroleum diesel and vegetable oil.¹²⁰

Furthermore, technology continues to evolve in an effort to make straight vegetable oil a more viable alternative. Promising biotech developments have the potential to improve the commercial viability of vegetable oil both as an alternative fuel and as a supplement to petroleum diesel.¹²¹ For instance, recent advances from the United States Department of Agriculture (DOA) have resulted in the successful chemical modification of the structure of vegetable oil to make it more resistant to temperature changes.¹²²

In addition to the necessary engine modifications, there are practical concerns associated with the use of straight vegetable oil, which make it far less convenient than traditional diesel and biodiesel fuel.¹²³ Currently, the infrastructure is not in place for the mass consumption of vegetable oil.¹²⁴ In all likelihood, using straight vegetable oil will never be as convenient as purchasing fuel at a local

120. See Iafolla, *supra* note 22.

121. See Roach, *supra* note 111 (discussing how researchers are developing technologies to improve vegetable oil as a fuel source).

122. *Vegetable-Based Fuels Steam Ahead*, WIRED NEWS, Mar. 24, 2003, <http://www.wired.com/science/discoveries/news/2003/03/58185> [hereinafter *Steam Ahead*]. The article elaborates on the DOA's progress on its soybean oil:

A team of researchers led by Atanu Adhvaryu at the U.S. Agriculture Department has increased the temperature durability and shelf life of soybean oil by reducing the amount of double bonding in the molecule. . . . Researchers are continuing to modify the vegetable oil molecule, and they said it could be four years before the fluid is tested in a real engine.

Id. The DOA's progress is further discussed in the following excerpt:

The NCAUR researchers say their chemically modified soybean oil is a simple, cost-effective method for enhancing the temperature stability and lubricity of vegetable oil, while retaining its basic chemistry. . . . The result is an inedible vegetable oil product that is more stable at both hot and cold temperatures, which is a key requirement for using it as a stand-alone engine oil, industrial fluid, and specialty grease. In addition, the chemical modification also improves the oil's lubricity.

Roach, *supra* note 111.

123. See, e.g., Potter, *supra* note 5 (commenting that using straight vegetable oil requires the additional steps of filtering the vegetable oil and pre-heating the fuel).

124. See JENSEN, *supra* note 104 (stating that the distribution system for straight vegetable oil is not as developed as the system for petroleum products).

gas station. Nevertheless, vegetable oil can be purchased from any grocery store or in bulk quantities from discount retailers for as low as \$2.20 per gallon—a cost that is quite economical given that petroleum prices can exceed \$3.00 per gallon.¹²⁵ Many vegetable oil consumers, hoping to get their fuel for free, will scavenge for used cooking oil from restaurants (which are often more than willing to part with it).¹²⁶ Burning waste vegetable oil collected from restaurants requires the additional step of filtering the fuel to remove impurities.¹²⁷

While the technical and practical difficulties associated with straight vegetable oil create an imposing barrier to its marketability and widespread acceptance, these concerns are overshadowed by the current illegality of straight vegetable oil conversions under the CAA. However, for the drivers of the estimated 200,000 vegetable oil-powered motor vehicles on the road today,¹²⁸ the difficulties associated with straight vegetable oil are either inconsequential or a source of pride for vegetable oil enthusiasts.¹²⁹ Moreover, as will be discussed in Part V, any difficulties are overshadowed by the considerable benefits of straight vegetable oil as a fuel.

III. THE CLEAN AIR ACT: REGULATORY AUTHORITY FOR FEDERAL EMISSIONS STANDARDS

A. History

In July 1970, President Richard M. Nixon consolidated a number of federal research, monitoring, and enforcement activities into one federal agency, the EPA, to establish and to enforce national

125. Herman, *supra* note 22 (stating that boxes of vegetable oil can be purchased at wholesale retailers like Costco for between \$2.20 and \$2.70 per gallon).

126. Steve Hargreaves, *Can Vegetable-Oil Cars Save The World?*, CNNMONEY.COM, July 24, 2006, http://money.cnn.com/2006/07/21/news/economy/vegetable_cars/index.htm (stating that restaurants usually have to pay to get rid of used cooking oil, so proprietors are often willing to part with it for free).

127. Potter, *supra* note 5.

128. *Id.*

129. *See id.*

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environmental standards.¹³⁰ In particular, these standards sought “to achieve the prevention and control of air pollution.”¹³¹

The agency’s authority to regulate emissions is based on the CAA of 1970,¹³² which directs the EPA to regulate pollutants that endanger the public health and the environment.¹³³ As originally enacted, the CAA focused primarily on automobile manufacturers because automobiles were regarded as the primary source of air pollutants in the United States.¹³⁴ The CAA required the EPA to establish and enforce strict national air quality standards on the manufacturers of passenger cars, trucks, and heavy-duty vehicles.¹³⁵ Accordingly, “[f]or the first twenty years after the CAA was enacted, the auto industry generally bore the brunt of the regulatory burden.”¹³⁶

Although the original CAA brought about significant improvements to the nation’s air quality by regulating vehicles, it failed to adequately address the air pollution that came from fuel itself.¹³⁷ In 1990, recognizing that more stringent regulation on fuel

130. Jack Lewis, *The Birth of the EPA*, EPA JOURNAL, Nov. 1985, available at <http://www.epa.gov/history/topics/epa/15c.htm> (stating that the EPA was pieced together from several existing programs, including the National Air Pollution Control Administration, the bureaus of Water Hygiene and Solid Waste Management, and parts of the Bureau of Radiological Health).

131. 42 U.S.C. § 7401(b)(2) (2000).

132. See Clean Air Act, 42 U.S.C. §§ 7401-7671 (2000).

133. 42 U.S.C. § 7401(b)(1) (2000) (stating that one purpose of the subchapter is “to protect and enhance the quality of the Nation’s air resources so as to promote the public health and welfare and the productive capacity of its population”); Gray & Varcoe, *supra* note 44, at 23 (noting that one of the EPA’s first actions was to phase out lead from gasoline because it damaged catalytic converters designed to reduce pollutants and also because lead itself was harmful to humans).

134. See Lewis, *supra* note 130.

135. See generally 42 U.S.C. § 7525 (2000); see also EPA, THE PLAIN ENGLISH GUIDE TO THE CLEAN AIR ACT: MOBILE SOURCES (CARS, TRUCKS, BUSES, OFF-ROAD VEHICLES, PLANES, ETC.), <http://www.4uth.gov.ua/usa/english/laws/majorlaw/caa/pegcaa04.htm> (last visited Sept. 22, 2007) [hereinafter MOBILE SOURCES].

136. Gray & Varcoe, *supra* note 44, at 23.

137. See MOBILE SOURCES, *supra* note 135 (stating that, despite the progress in the amount of pollution from cars since the 1960s, “[m]otor vehicles [still] release more than 50 percent of the hazardous air pollutants”); Joyce, *supra* note 27, at 47 (“There have been dramatic reductions in the nationwide levels of some pollutants since the inception of the CAA in the 1970s, but there is still a need for

was necessary to further improve the nation's air quality, President George H. W. Bush signed extensive amendments to the CAA.¹³⁸ The amendments established a new regulatory scheme directed at the composition of motor vehicle fuel itself, rather than the manufacturers of automobiles alone.¹³⁹

B. EPA Approval: The Registration of Motor Vehicle Fuel and Fuel Additives, and the Prohibition Against Tampering

As amended, the CAA requires automobile manufacturers to develop cleaner cars and fuel producers to develop cleaner-burning fuels.¹⁴⁰ To achieve this objective, the EPA requires all fuels and fuel additives, motor vehicles, and aftermarket modifications to be registered with the EPA prior to being sold.¹⁴¹ Unfortunately, these requirements are prohibitively expensive, complicated, and time-consuming to the extent that they preclude the lawful operation of straight vegetable oil-fueled automobiles.

1. Fuel and Fuel Additive Registration

Under section 211(a) of the CAA,¹⁴² all motor vehicle fuels¹⁴³ and fuel additives¹⁴⁴ (collectively referred to as F/FAs) must be approved by the EPA prior to their introduction into the consumer

improvement.”).

138. Gray & Varcoe, *supra* note 44, at 14.

139. *Id.* (stating that the amendments charged the EPA with the responsibility of reducing pollution from motor vehicle fuels); *see also* MOBILE SOURCES, *supra* note 135 (discussing how the CAA “encourages development and sale of alternative fuels”).

140. MOBILE SOURCES, *supra* note 135.

141. *See infra* Part III.B.1-2.

142. *See* 40 C.F.R. § 79.1 (2006).

143. The EPA defines a motor vehicle fuel as “any material which is capable of releasing energy or power by combustion or other chemical or physical reaction.” 40 C.F.R. § 79.2(c) (2006).

144. A fuel additive is “any substance, other than one composed solely of carbon and/or hydrogen, that is intentionally added to a fuel named in the designation (including any added to a motor vehicle’s fuel system) and that is not intentionally removed prior to sale or use.” 40 C.F.R. § 79.2(e) (2006).

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marketplace.¹⁴⁵ In order to successfully register with the EPA, fuel manufacturers¹⁴⁶ are required to complete both the Tier 1 and Tier 2 Health Effects Testing Requirements, which are designed to calculate the harmful emissions and health effects resulting from the combustion of F/FAs.¹⁴⁷

Tier 1 requires manufacturers of F/FAs to provide the EPA with “the identity and concentration of certain emission products of such fuels or additives and any available information regarding the health and welfare effects of [their] emissions”¹⁴⁸ Particularly, Tier 1 requires manufacturers “to conduct tests to determine potential public health effects of [the] fuel” and “to furnish . . . other information as is reasonable and necessary” regarding the fuel’s emissions to the EPA Administrator.¹⁴⁹ The test data must include analysis of exhaust emissions, evaporative emissions, and compatibility with vehicle fuel systems.¹⁵⁰ Tier 2 testing requires toxicology studies to determine the

145. 40 C.F.R. § 79.4(a)(1) (2006) (“No manufacturer of any fuel designated under this part shall . . . sell, offer for sale, or introduce into commerce such fuel unless the Administrator has registered such fuel.”); 40 C.F.R. § 79.4(b)(1) (“No manufacturer of any fuel additive designated under this part shall . . . sell, offer for sale, or introduce into commerce such additive for use in any type of fuel designated under this part unless the Administrator has registered that additive for use in that type of fuel.”); *see also* Platinum GaSaver: Final Cancellation Order for a Fuel Additive Registration for Failure to Submit Test Data, 71 Fed. Reg. 25,840, 25,840 (May 2, 2006) [hereinafter Final Cancellation Order] (“Section 211(a) of the Clean Air Act . . . authorizes the Administrator of the Environmental Protection Agency . . . to designate and require the registration of fuels and fuel additives . . . prior to sale or introduction into commerce.”).

146. A “fuel manufacturer” is “any person who, for sale or introduction into commerce, produces, manufactures, or imports a fuel or causes or directs the alteration of the chemical composition of a bulk fuel, or the mixture of chemical compounds in a bulk fuel” 40 C.F.R. § 79.2(d) (2006).

147. Final Cancellation Order, *supra* note 145, at 25,840; TICKELL, BIODIESEL AMERICA, *supra* note 5, at 168; Iafolla, *supra* note 22 (stating that “EPA testing determines a fuel’s emissions and the health effects of those emissions”).

148. 40 C.F.R. § 79.52(a) (2006).

149. 42 U.S.C. § 7545(b)(2)(A)-(B) (2005).

150. *See generally* 40 C.F.R. § 79.52(b) (2006) (providing the testing requirements of Tier 1); *see also* Letter from Merrylin Zaw-Mon, Director, Certification and Compliance Division of the EPA’s Office of Transportation and Air Quality, to Manufacturer, at 19-22 (Feb. 3, 2006) (on file with the EPA) [hereinafter Letter from Merrylin Zaw-Mon to Manufacturer].

adverse human health effects of the F/FAs' emissions.¹⁵¹ Additionally, Tier 3 testing may also be required at the EPA's discretion if there are "remaining uncertainties as to the significance of observed health effects, welfare effects, and/or emissions exposures"¹⁵² These studies come at a rather significant expense to the petitioning party.¹⁵³

Due to this expense, biodiesel is the only alternative renewable fuel that has been approved by the EPA.¹⁵⁴ Testing was funded by the National Biodiesel Board,¹⁵⁵ a "national trade association representing the biodiesel industry as the coordinating body for research and development in the [United States]."¹⁵⁶ The total cost for both Tier 1 and Tier 2 testing exceeded \$2.2 million and took over four years to complete.¹⁵⁷

Although biodiesel is approved by the EPA, vegetable oil is not.¹⁵⁸ According to the EPA, no manufacturer or individual has ever attempted to certify vegetable oil as a fuel.¹⁵⁹ Because biodiesel and vegetable oil share similar chemical properties, they produce similarly

151. Final Cancellation Order, *supra* note 145, at 25,840.

152. 40 C.F.R. § 79.54(a)(1) (2006); Final Cancellation Order, *supra* note 145, at 25,840 ("Additional testing may be required under Tier 3 at EPA's discretion.").

153. See PAHL, *supra* note 1, at 192 (stating that the total cost for Tier I and II testing for biodiesel was over \$2.2 million); See also TICKELL, BIODIESEL AMERICA, *supra* note 5, at 179 (commenting that an engine manufacturer can expect to spend between \$3 to \$5 million on testing a new fuel).

154. PAHL, *supra* note 1, at 192. "In March 1998 biodiesel became the only alternative fuel in the nation to successfully complete the . . . required Tier [1] Health Effects testing . . ." *Id.* In May 2000, biodiesel completed the Tier 2 testing, making it the only alternative fuel approved by the EPA. *Id.*; see also CAL. ENERGY COMM'N, *supra* note 92 ("Biodiesel is the only alternative fuel to have fully completed the health effects testing requirements of the Clean Air Act.").

155. PAHL, *supra* note 1, at 192; Nat'l Biodiesel Bd., Health Effects Testing, http://www.biodiesel.org/pdf_files/fuelfactsheets/HealthEffectsTesting.PDF (last visited Sept. 23, 2007) (stating that the biodiesel industry financed the health effects testing program to set biodiesel apart from other alternative fuels and to increase consumer confidence in biodiesel).

156. Nat'l Biodiesel Bd., Who Are We?, <http://www.biodiesel.org/aboutnbb/whoarewe/> (last visited Nov. 1, 2007).

157. Nat'l Biodiesel Bd., *supra* note 155; PAHL, *supra* note 1, at 192.

158. Herman, *supra* note 22; Iafolla, *supra* note 22.

159. Matthew L. Wald, *A Petroleum Alternative, But U.S. Says It's Illegal*, N.Y. TIMES, July 23, 2006, § 12.

reduced emissions when compared to petroleum diesel.¹⁶⁰ However, lower emissions do not make vegetable oil legal. In order for vegetable oil to become a viable alternative fuel source, at a minimum, the two-tiered testing requirements must be satisfied.¹⁶¹ Unfortunately, as a result of the relatively small percentage of straight vegetable oil consumers in the market, it is unlikely that they will either individually or collectively have the means to undertake this testing.

2. *Tampering and the Registration of Aftermarket Conversions*

The EPA's prohibition against tampering represents another regulatory obstacle to the legal operation of straight vegetable oil-fueled vehicles. Because modern diesel engines require certain modifications in order to operate on straight vegetable oil, the cost of compliance with the CAA becomes even more expensive. Under section 206(a) of the CAA, all vehicle manufacturers are required to obtain emissions certification before their motor vehicles are sold.¹⁶² Converting a vehicle to operate on any fuel other than the one the manufacturer used to obtain its EPA emissions certification is considered tampering, which is proscribed under section 203(a)(3) of the CAA.¹⁶³

Aftermarket conversions are defined as "any combination of hardware, including but not limited to fuel storage and fuel metering hardware, which is installed on a [vehicle] with the effect of allowing the vehicle or engine to operate on a fuel other than the fuel which the vehicle or engine was originally certified to use."¹⁶⁴ Aftermarket conversion systems or kits can be certified under EPA regulations.¹⁶⁵

160. See Big Green Bus, *supra* note 106 (comparing the similar emissions characteristics of biodiesel and vegetable oil).

161. See *supra* notes 142-47 and accompanying text.

162. See Wald, *supra* note 159 ("The problem is that laws governing the Environmental Protection Agency require that motor vehicles be certified before they are sold . . .").

163. See 40 C.F.R. § 85.501(a) (2006); see also Letter from Merrylin Zaw-Mon to Manufacturer, *supra* note 150, at 3.

164. 40 C.F.R. § 85.502(c) (2006). Aftermarket components which do not affect the emissions performance of a converted vehicle or engine are exempted under the CAA. *Id.*

165. See 40 C.F.R. § 85.503(a) (2006); Letter from Merrylin Zaw-Mon to

However, these conversions must similarly go through the same testing requirements that are imposed on new vehicles, which include the costly Tier 1 testing requirements.¹⁶⁶

Compounding matters, the aftermarket conversion kits for straight vegetable oil are designed to enable diesel engines to operate on a fuel that is not yet approved by the EPA. Thus, the tiered testing of vegetable oil as an alternative fuel is, in and of itself, still necessary and required to certify any modifications.

IV. ACCOMMODATING STRAIGHT VEGETABLE OIL IN A NEW FUEL ECONOMY

Given that the United States consumes more petroleum and consequently produces “more harmful gases than any other country, it is imperative that it work[] domestically to reduce” its dependence on petroleum and decrease harmful emissions.¹⁶⁷ The United States could best reduce its consumption of petroleum by supporting a renewable fuel policy directed at diversifying the United States’ fuel supply to the greatest extent possible.¹⁶⁸

Europe, which consumes approximately three times more diesel fuel than gasoline, has been more responsive towards the fuel-producing potential of vegetable oil.¹⁶⁹ In 2003, the European Union

Manufacturer, *supra* note 150, at 3-4 (“Under EPA’s regulations, it is not tampering if you manufacture, distribute or install an aftermarket conversion system or kit that is certified in accordance with the EPA’s regulations.”).

166. See 40 C.F.R. §§ 85.504(a), 86.000-8 (2006).

167. Spaulding, *supra* note 4, at 291.

168. See generally Joyce, *supra* note 27 (arguing that diversifying the United States’ sources of energy is one way to reduce dependence on imported oil and help the environment).

169. Potter, *supra* note 5; see also Smolin, *supra* note 5, at 479 (“The United States lags behind Europe, South Africa, Brazil, and other countries that have adopted policies and are beginning to replace petroleum-based fuels with renewable fuels.”). In India, a recently proposed fuel policy aimed at reducing imported oil calls for the use of domestically-produced biofuels. *Draft Policy Moots Biofuels in Vehicles*, HINDUSTAN TIMES, May 1, 2006. The proposed legislation is designed to increase savings on foreign exchange, as well as promote energy security and environmental protection. *Id.* The legislation would mandate oil companies to purchase ethanol, biodiesel, or vegetable oil, and blend at least 5% of it into the petroleum, progressively increasing the blend to 20% depending on supply. *Id.* Moreover, the proposed legislation would require engine manufacturers to warranty

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(EU) adopted an alternative fuel policy aimed at diversifying its fuel supply by promoting the use of alternative biofuels such as ethanol, biodiesel, and notably straight vegetable oil.¹⁷⁰ EU Directive 2003/30/EC formally recognizes “pure vegetable oil from oil plants” as a biofuel alongside biodiesel and ethanol.¹⁷¹ A similar fuel policy in the United States recognizing straight vegetable oil as an alternative fuel and promoting its consumption would significantly contribute to diversification of the nation’s oil supply.

To this end, in some of the first legislation aimed at encouraging alternative fuels, the Biomass Energy and Alcohol Fuels Act of 1980,¹⁷² Congress declared that the United States’ dependence “on imported petroleum and natural gas must be reduced by all economically and environmentally feasible means.”¹⁷³ Despite this stated objective, Congress has yet to pass a statute promoting vegetable oil, and the EPA and DOE have consistently discouraged its use.¹⁷⁴

While the CAA has made dramatic improvements to the nation’s air quality,¹⁷⁵ it currently lacks the adaptability necessary to encourage a range of alternative fuels and fully diversify the United

the use of biofuels in their engines. *Id.* Finally, the legislation would allow the use of straight vegetable oil as fuel in transportation vehicles. *Id.*

170. See Council Directive 2003/30, 2003 O.J. (L 123) 42 (EC). The directive defines biofuel as “liquid or gaseous fuel for transport produced from biomass.” *Id.* at 44.

171. Council Directive 2003/30, *supra* note 170, at 43 (“Pure vegetable oil from plants produced through pressing, extraction or comparable procedures, crude or refined but chemically unmodified, can also be used as biofuel in specific cases”); see also GAIN REPORT, *supra* note 60, at 3 (listing vegetable oil as one of the ten biofuel types recognized by the EU).

172. See Biomass Energy and Alcohol Fuels Act, 42 U.S.C. §§ 8801-8871 (1994).

173. 42 U.S.C. § 8801(1) (1994); Richards, *supra* note 54, at 145.

174. Iafolla, *supra* note 22 (stating that, due to a “troubled track record, agencies like the U.S. Department of Energy, the California Air Resources Board and the California Energy Commission either passively ignore or actively argue against vegetable oil as a fuel”); see also Wald, *supra* note 159.

175. See John Hiski Ridge, *Deconstructing the Clean Air Act: Examining the Controversy Surrounding Massachusetts’s Adoption of the California Low Emission Vehicle Program*, 22 B.C. ENVTL. AFF. L. REV. 163, 171 (1995) (“The seven years following the 1970 Clean Air Act saw many advances in the protection of air quality and health.”).

States' fuel supply.¹⁷⁶ As previously noted, compliance with the statute is prohibitively costly and time-consuming, especially for small market manufacturers and consumers who desire to convert their vehicles legally.¹⁷⁷ If compliance is too prohibitive, it will discourage individuals and companies from pursuing alternative clean energy.

In order to promote renewable fuel sources to the greatest extent possible, Congress should follow the EU and formally recognize a number of atypical fuel sources, including vegetable oil. Additionally, Congress should direct the EPA to either exempt straight vegetable oil from the rigorous testing requirements of section 211 of the CAA or reduce the cost of compliance.

Under the CAA, the EPA is already directed to periodically revise its regulations to achieve the highest levels of emission reduction.¹⁷⁸ The EPA should adhere to this directive and exercise its authority to ease the burden of compliance for manufacturing and using alternative fuels such as straight vegetable oil. One possible way to ease compliance is to exempt straight vegetable oil from the tiered testing requirements. Unfortunately, a blanket exemption would permit the use of unregulated F/FAs and vehicle modifications without regard for the environment.¹⁷⁹

Preferably, the EPA could effectively reduce the cost of compliance by sharing the expense of testing or by establishing government-sponsored testing facilities, thereby eliminating the need for manufacturers to procure costly independent facilities. Additionally, by acknowledging straight vegetable oil as a fuel and sharing the expense of compliance, the EPA will be better suited to establish environmental standards for the quality of vegetable oils and conversion kits. A stated goal of the CAA is to encourage the

176. *See supra* Part III.B (discussing how compliance with the CAA is prohibitively expensive and time-consuming).

177. *See supra* notes 153-57 and accompanying text.

178. 42 U.S.C. §§ 7521(a)(1), (a)(3)(A)(i) (2002).

179. *See* Iafolla, *supra* note 22. Some SVO advocates argue that the existing standards are in place to perpetuate the oil industry by making it difficult for alternative fuel to either comply with, or afford, the testing and registration requirements. *See, e.g., id.* (quoting one advocate's declaration that the CAA is a "sham law to protect the oil industry").

development and sale of alternative fuels.¹⁸⁰ It is inconsistent with this goal to place a disproportionate amount of the expense of alternative fuel development and testing on manufacturers.

While the impact of straight vegetable oil on domestic oil consumption is currently negligible, displacement of a small percentage of the United States' transportation fuel supply would be a positive step towards reducing the substantial cost of our reliance on petroleum in terms of the environment, national security, and the domestic economy.¹⁸¹

V. THE BENEFITS OF STRAIGHT VEGETABLE OIL

Presently and for the foreseeable future, the use of straight vegetable oil will be limited to a small, niche market of consumers. While vegetable oil is not a viable alternative to petroleum diesel on a large scale, even a marginal reduction in petroleum consumption offers a number of benefits. The discernable benefits of a national fuel policy encouraging vegetable oil as a renewable fuel source include improving the global environment and human health, increasing domestic and foreign security by reducing our reliance on imported oil, and expanding the domestic economy.

A. *The Environment and Human Health*

Historically, environmental concerns did not drive the study of vegetable oil as an alternative fuel source, nor did it drive the study of renewable fuel sources in general.¹⁸² However, for the last forty years, “[t]he association between energy and the environment [has been] so strong that the nation’s environmental agenda has become indivisible from its energy policy.”¹⁸³ Mounting evidence of the negative human health and environmental effects associated with vehicle pollutants

180. See MOBILE SOURCES, *supra* note 135 (stating that “[t]he 1990 Clean Air Act encourages development and sale of alternative fuels such as alcohols, liquefied petroleum gas (LPG) and natural gas”).

181. See Spaulding, *supra* note 4, at 291.

182. Knothe, *supra* note 35, at 1105.

183. Joyce, *supra* note 27, at 32.

has contributed to the continuing need to replace petroleum with clean energy such as vegetable oil.¹⁸⁴

Unfortunately, there are limited scientific studies on the environmental effects of burning straight vegetable oil as a fuel.¹⁸⁵ However, the picture that emerges indicates that vegetable oil is an environmentally superior substitute to petroleum diesel because it reduces the aggregate amount of harmful pollutants from vehicle emissions.¹⁸⁶ Accordingly, for environmental reasons, including human health, the EPA should accommodate the use of straight vegetable oil as an alternative to petroleum diesel.

Harmful emissions from motor vehicles have declined dramatically since the enactment of the CAA.¹⁸⁷ Today, motor vehicles “produce[] 60 to 80 percent less pollution than cars in the 1960s.”¹⁸⁸ Nonetheless, motor vehicle emissions presently account for half of the hazardous pollutants found in the air.¹⁸⁹ The combustion of diesel fuel produces dangerous particle emissions of sulfur, nitrogen oxide (NO₂), and carbon.¹⁹⁰ Collectively, these pollutants are either known or suspected to cause serious illnesses, including cancer.¹⁹¹ In

184. Gray & Varcoe, *supra* note 44, at 35 (stating that hazardous air pollutants cause serious health effects, including cancer and birth defects); *see* Joyce, *supra* note 27 (stating that the environmental costs of America’s dependence on fossil fuels have risen exponentially).

185. Iafolla, *supra* note 22 (stating that emissions testing on vegetable oil is too limited to be definitive). *But see* FAIR REPORT, *supra* note 101 (stating that “[m]any studies have examined the performances and pollutants emissions of Diesel engines using vegetable oils”).

186. *See* FAIR REPORT, *supra* note 101 (stating that the “emission results of unburned hydrocarbons (HC), carbon monoxide (CO), nitric oxides (NO_x) and particulate matter confirm the advantages of [rape seed oil methyl ester] in comparison to Diesel fuel”).

187. *See* Lauren Parry, *Clean Air Rules of 2004: Motivation, Impacts, and Concerns*, 25 J. LAND RESOURCES & ENVTL. L. 367, 367 (2005) (stating that since the enactment of the CAA, air pollution has decreased 48%).

188. MOBILE SOURCES, *supra* note 135.

189. *Id.*; *see* Musto, *supra* note 14, at 152 (“The single most significant source of air pollution in the United States is the motor vehicle.”).

190. Taneja, *supra* note 15, at 214; Gray & Varcoe, *supra* note 44, at 41-42.

191. Gray & Varcoe, *supra* note 44, at 35 (stating that the CAA lists 188 hazardous air pollutants that are known or suspected to cause cancer and other serious health problems); *see* CAL. ENERGY COMM’N, *supra* note 92 (“All outdoor air pollution is estimated to pose one percent of our cancer risk.”).

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addition, the EPA has identified a direct correlation between the inhalation of diesel exhaust and serious respiratory illnesses.¹⁹²

In contrast to petroleum diesel, straight vegetable oil is non-carcinogenic and eliminates virtually all sulfur emissions.¹⁹³ Furthermore, the EPA has reported that straight vegetable oil reduces dangerous hydrocarbon and particle emissions.¹⁹⁴ European studies have similarly suggested that rapeseed oil produces 40% less particulate matter than petroleum diesel.¹⁹⁵ Although there is a tendency toward slightly higher nitrogen oxide emissions from vegetable oil,¹⁹⁶ any negative effects are offset by its other environmental benefits.

With regard to greenhouse gases, the transportation industry is recognized as a significant contributor.¹⁹⁷ Greenhouse gases trap heat in the atmosphere and are widely regarded as contributing to global warming.¹⁹⁸ Although many greenhouse gases occur naturally, human activities are responsible for an increasing amount of greenhouse gas emissions.¹⁹⁹ A number of greenhouse gases are produced by humans,

192. See TICKELL, *BIODIESEL AMERICA*, *supra* note 5, at 210-11. A joint study conducted by the California Air Resources Board (CARB), UCLA, and UC Riverside has attributed a 4% increase in the risk of cancer and a 6% increase in the risk of developing respiratory problems to children who ride diesel-fueled buses to school. *Id.* at 210.

193. See Gunther, *supra* note 96 (“[V]egetable oil reduces carcinogen emissions by 95% . . .”).

194. Robert Crowe, *UH Student Pushes Veggie Power—He Wants to ‘Spread the Word’ About Fryer Grease as an Alternative to Gasoline*, HOUS. CHRON., Mar. 22, 2006, at B1.

195. FAIR REPORT, *supra* note 101.

196. Crowe, *supra* note 194; Wald, *supra* note 159 (noting one research scientist’s opinion that “burning [vegetable] oil might increase production of nitrogen oxides, which lead to smog”).

197. See Spaulding, *supra* note 4, at 278.

198. *Id.* at 280; EPA, GREENHOUSE GAS EMISSIONS (2007), <http://www.epa.gov/climatechange/emissions/index.html> [hereinafter GREENHOUSE GAS EMISSIONS].

199. GREENHOUSE GAS EMISSIONS, *supra* note 198; EPA, STATE OF KNOWLEDGE (2006), <http://www.epa.gov/climatechange/science/stateofknowledge.html> (“Human activities are changing the composition of Earth’s atmosphere. Increasing levels of greenhouse gases like carbon dioxide . . . in the atmosphere since pre-industrial times are well-documented and understood. The atmospheric buildup of CO₂ and other greenhouse gases is largely the result of human activities

including methane (CH₄), NO₂, fluorinated gases, and most notably, carbon dioxide (CO₂).²⁰⁰ In addition to being credited as the world's largest consumer of oil, the United States also emits more CO₂ than any other nation.²⁰¹

Burning almost any fuel releases CO₂ into the atmosphere.²⁰² Both straight vegetable oil and petroleum diesel are carbon-based fuels with comparable CO₂ emissions.²⁰³ Nevertheless, vegetable oil substantially reduces overall carbon dioxide emissions because it operates on what has been characterized as a "closed-carbon" cycle.²⁰⁴ CO₂ released from carbon-based petroleum was extracted from beneath the Earth's surface where it had been buried for millions of years.²⁰⁵ By contrast, the plants used to produce vegetable oil absorb CO₂ as they grow, which almost completely offsets the CO₂ released into the air from burning vegetable oil as a fuel.²⁰⁶

such as the burning of fossil fuels."); Spaulding, *supra* note 4, at 278 (stating that the carbon gases emitted by the United States contribute significantly to the greenhouse effect).

200. GREENHOUSE GAS EMISSIONS, *supra* note 198.

201. Spaulding, *supra* note 4, at 278.

202. See GREENHOUSE GAS EMISSIONS, *supra* note 198 ("Carbon dioxide enters the atmosphere through the burning of fossil fuels (oil, natural gas, and coal), solid waste, [and] trees and wood products . . ."); see also Wald, *supra* note 159 (stating that burning biodiesel creates carbon dioxide); see generally EPA, EMISSION FACTS: AVERAGE CARBON DIOXIDE EMISSIONS RESULTING FROM GASOLINE AND DIESEL FUEL, EPA420-F-05-001 (2005), available at <http://www.epa.gov/otaq/climate/420f05001.htm> (stating that the EPA uses average carbon content values in fuel to estimate CO₂ emissions from mobile sources).

203. JENSEN, *supra* note 104 ("[T]ests show that the emission levels [from SVO] are similar to those of fossil diesel.").

204. See CAL. ENERGY COMM'N, *supra* note 92 (stating that a joint study conducted by the DOE and DOA concluded that biodiesel, which is derived from vegetable oil, reduces net CO₂ emissions because it operates on a closed carbon cycle).

205. See TICKELL, BIODIESEL AMERICA, *supra* note 5, at 18 (stating that "the majority of geologists agree that oil was formed by microscopic organic life forms that died millions of years ago," creating the organic sentiments underground that eventually became oil); see also Wald, *supra* note 159 (stating that crude oil comes from deep underground); GREENHOUSE GAS EMISSIONS, *supra* note 198 ("[CO₂] is . . . removed from the atmosphere (or 'sequestered') when it is absorbed by plants as part of the biological carbon cycle.").

206. PAHL, *supra* note 1, at 7; see also Wald, *supra* note 159 ("And while burning biodiesel does create carbon dioxide, harvesting the soybeans or other raw

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Air quality is only one environmental concern. In contrast to petroleum, vegetable oil is both nontoxic, as is evidenced by the fact that vegetable oil is primarily used for human consumption, and biodegradable.²⁰⁷ According to water hazard classifications, both biodiesel and petroleum are categorized as water hazards on par with crude oil.²⁰⁸ By comparison, vegetable oil is categorized as harmless to groundwater.²⁰⁹ Vegetable oil also biodegrades upwards of 98% as opposed to petroleum, which biodegrades anywhere from 20% to 40%.²¹⁰ Clearly, had the Exxon Valdez been carrying vegetable oil instead of petroleum crude oil, the results would have been far less catastrophic.²¹¹

Finally, using discarded cooking oil can accurately “be considered the most environmentally benign liquid fuel available because the primary ingredient is post-consumer waste product.”²¹² In the United States alone, the restaurant and hotel industries produce over three billion gallons of waste cooking oil per year.²¹³ This is the equivalent of 5% of the nation’s total petroleum diesel consumption of sixty billion gallons per year.²¹⁴ The majority of this cooking oil gets

materials leaves space for new soybeans to grow, and as they grow, they absorb carbon dioxide from the atmosphere.”); JENSEN, *supra* note 104 (“But if the absorption of CO₂ during plant growth is subtracted the picture changes dramatically.”).

207. Roach, *supra* note 111.

208. JENSEN, *supra* note 104.

209. *Id.*

210. Roach, *supra* note 111.

211. “On March 24, 1989, shortly after midnight, the oil tanker *Exxon Valdez* struck Bligh Reef in Prince William Sound, Alaska, spilling more than 11 million gallons of crude oil.” EPA, EXXON VALDEZ (2006), <http://www.epa.gov/oilspill/exxon.htm>. Knickerbocker, *supra* note 13 (stating that there is still environmental, economic, and legal fallout from the 1989 Exxon Valdez spill). *But see* Tony Fitzpatrick, *Vegetable Oil Spills Hurt Environment, Too*, WASHINGTON UNIVERSITY IN ST. LOUIS NEWS & INFORMATION, July 10, 2003, *available at* <http://news-info.wustl.edu/tips/page/normal/117.html> (stating that vegetable oil spills, while less toxic than petroleum, can still cause significant environmental damage).

212. Center for Sustainable Energy, *supra* note 26.

213. EPA, OSWER INNOVATIONS PILOT: REDUCING PRODUCTION COSTS AND NITROGEN OXIDE (NO_x) EMISSIONS FROM BIODIESEL (2004), *available at* <http://www.epa.gov/region09/waste/biodiesel/resources/UNR.pdf> [hereinafter “PILOT REPORT”].

214. TICKELL, BIODIESEL AMERICA, *supra* note 5, at 149.

disposed of in sewers and landfills.²¹⁵ Burning waste vegetable oil that might otherwise be disposed of in landfills will help reduce this waste and preserve the environment.²¹⁶

B. Energy Security and Agricultural Growth

Following the terrorist attacks of September 11, 2001, there has been increased interest in reducing the United States' dependence on foreign oil.²¹⁷ Presently, the United States consumes over a quarter of the world's oil, but produces only 9% of it.²¹⁸ To compensate for this disparity, the United States spends approximately \$97 billion each year to import oil.²¹⁹ Some commentators suggest that a considerable amount of this money is used to subsidize terrorism.²²⁰

Further, nearly half of this nation's trade deficit is attributable to oil imports.²²¹ At the United States' current rate of consumption, this figure will only increase as imported oil is predicted to account for 60% to 70% of the national trade deficit in the next ten to twenty years.²²² Moreover, it is estimated that by 2025, the Middle East will control half of the world's remaining oil, which will increase the cost of obtaining oil exponentially, both in terms of money and security.²²³ According to the DOE and Congressman Mac Thornberry, "the rise in expenditures on foreign oil corresponds to a decrease in domestic oil production and a loss in American jobs."²²⁴

215. PILOT REPORT, *supra* note 213.

216. Center for Sustainable Energy, *supra* note 26.

217. See Segal, *supra* note 8, at 79; Spaulding, *supra* note 4, at 293. It is worth noting that, "[s]ince September 11, 2001, attacks on energy targets aimed at disrupting world oil markets have increased." Ramish, *supra* note 3, at 241.

218. Ramish, *supra* note 3, at 240.

219. TICKELL, BIODIESEL AMERICA, *supra* note 5, at 49.

220. Ramish, *supra* note 3, at 241; see, e.g., Spaulding, *supra* note 4, at 293 (quoting the former Director of the [CIA], James Woolsey, as urging America to slow money to the Middle East because too much of it is used to purchase weapons and fund terrorism).

221. Spaulding, *supra* note 4, at 294.

222. *Id.*; Joyce, *supra* note 27, at 31 ("It is expected that by 2025, we will be importing 68 percent of the oil we use.").

223. TICKELL, FROM THE FRYER, *supra* note 2, at 13.

224. TICKELL, BIODIESEL AMERICA, *supra* note 5, at 51. Additionally, the DOE estimates that, for every \$1 billion in trade deficit, approximately 27,000 Americans

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While straight vegetable oil currently represents only a slight portion of the domestic fuel market,²²⁵ a national fuel policy legalizing straight vegetable oil will increase demand for domestic crops²²⁶ and simultaneously decrease demand for petroleum imports.²²⁷ Rudolf Diesel recognized the agricultural benefits of vegetable oil fuel consumption: “[t]he diesel engine can be fed with vegetable oils and would help considerably in the development of agriculture of the countries which use it.”²²⁸

A number of different crops can be used to produce vegetable oil, including soybeans, sunflowers, peanuts, and coconuts.²²⁹ However, production capabilities are limited by the availability of usable agricultural land and competition with other food-producing crops.²³⁰ One concern is that the increased consumption of crops for fuel could strain the nation’s food supply and result not only in higher food prices, but also in higher ethanol prices.²³¹ Interestingly, approximately sixty million acres of farmland is left uncultivated each year in the United States due to government programs.²³² The United States could use that acreage to grow vegetable oil-producing crops without affecting the food supply.²³³ While there may not be enough

lose their jobs. *Id.*

225. See Potter, *supra* note 5.

226. Spaulding, *supra* note 4, at 295.

227. *Id.* at 298.

228. PAHL, *supra* note 1, at 23. The idea to run Diesel’s prototype motor on peanut oil at the 1900 World’s Fair in Paris came from the French government. In the early 1900s, the French government recognized the potential for vegetable oil as a fuel source for primarily agrarian societies. France took a proactive role in testing the use of various vegetable oils as fuel, ultimately focusing on a vegetable oil derived from Arachide (peanuts), which grew in large quantities in its African colonies and could easily be cultivated. Knothe, *supra* note 35, at 1104.

229. See TICKELL, FROM THE FRYER, *supra* note 2, at 47-50. There are over 350 species of vegetable oil-producing plants. *Id.* at 47. Some of the vegetable oils employed as alternative fuel sources are soybean oil in the United States, rapeseed (canola) oil in Europe, and palm oil in tropical countries. *Id.* at 48-50.

230. See Paulson, *supra* note 84.

231. *Id.* (discussing the current and long-term consequences of increased ethanol consumption on United States agriculture).

232. TICKELL, FROM THE FRYER, *supra* note 2, at 41.

233. *Id.* (“[F]armers could earn billions of dollars by growing crops for biodiesel on land that is not currently used for food production.”).

domestic farmland to completely replace our petroleum consumption with vegetable oil,²³⁴ by employing a portion of the available domestic crops and supplementing those crops with post-consumer waste vegetable oil, the United States will be able to achieve the modest goal of diversifying its fuel supply, as well as satisfy any demand for straight vegetable oil.

In short, rather than finance hostile, oil-rich nations to supply this country with oil, the United States can instead direct that investment to the domestic economy.²³⁵ Rural areas of the United States have already felt the economic benefits of increased consumption of biodiesel and ethanol.²³⁶ By continuing to reduce our reliance on imported oil, the United States will increase domestic security, decrease our national trade deficit, and promote domestic agricultural economies while creating an influx of capital investment into rural America.²³⁷

VI. CONCLUSION

There is no other commodity on this planet like oil.²³⁸ It is “inextricably linked” to every aspect of our daily lives, touching on the production, consumption, and distribution of all products.²³⁹ “With such a strong reliance on a single source of energy, replacing that energy source requires an enormous amount of time and effort.”²⁴⁰

Despite promising legislation and initiatives supporting alternative energy sources, the United States’ fuel policy is inadequate to accommodate the nation’s growing dependency on oil. While

234. Kanellos, *supra* note 20.

235. *See* Taneja, *supra* note 15, at 202-03 (stating that Americans have a choice between paying another country to extract fuel for us, or paying our own country to grow our own fuel).

236. Spaulding, *supra* note 4, at 295; *see also* Paulson, *supra* note 84.

237. Spaulding, *supra* note 4, at 293-95; Gray & Varcoe, *supra* note 44, at 12 (“Fostering developing-world agricultural markets and reducing our petroleum dependence are two powerful ways of enhancing American security, both immediately and over the long term.”); Knothe, *supra* note 35, at 1105 (noting that energy security is a driving force for the use of vegetable-oil based fuels).

238. Jobe, *supra* note 17, at 3.

239. *Id.*

240. *Id.*

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biodiesel and ethanol have been the subject of much legislation, they are limited by the United States' agricultural production capacity.²⁴¹ Hydrogen technology, touted by politicians and doubted by many experts, is prohibitively expensive and may never be commercially viable.²⁴² Therefore, unless there is a dramatic shift in the United States' energy policy, conventional fossil fuels will continue to dominate the fuel market well into the foreseeable future.

It is becoming increasingly clear that there is no single solution to our dependence on oil.²⁴³ Indeed, the sources of our future energy supply will need to be more diffuse. The United States could best reduce its reliance on petroleum by supporting a renewable fuel policy aimed at diversifying the United States' fuel supply to the greatest extent possible. To this end, the CAA would be the ideal statutory vehicle to facilitate the diversification of the nation's fuel supply, provided that it is amended to ease the burden of compliance.

Straight vegetable oil is the most obvious beneficiary of a fuel policy aimed at diversification. Like biodiesel and ethanol, straight vegetable oil cannot completely replace petroleum. Nonetheless, straight vegetable oil would be an invaluable commodity in a new fuel economy—one that could collectively alleviate the United States' dependence on petroleum while reducing negative environmental impacts, increasing domestic security, and stimulating the domestic economy.

*Robert Scott Norman**

241. See *supra* notes 230-31 and accompanying text.

242. See Wise, *supra* note 16, at 83-84.

243. See Allen, *supra* note 12 (noting that, while no alternative fuel can single-handedly replace petroleum, "the proliferation of energy options and surge in research hold promise").

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