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Striving for Greenhouse Gas Mitigation and Energy Independence in Pennsylvania

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As the waves of protests and revolution sweep across North Africa and Southwest Asia, energy independence must become a priority for federal and state governments. Although oil still flows from these regions, we have already seen the impact the current uncertainty and instability are playing with the world oil markets. Based on U.S. Energy Information Administration data, at the time of this writing the price per barrel of crude oil was $95.70.[1] Over the past nine months, the price has fluctuated drastically by approximately $33.00 per barrel.[2] As gasoline and fuel oil prices begin to

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[1] CUSHING, OK CRUDE OIL FUTURE CONTRACT 1, U.S. ENERGY INFO. ADMIN., http://www.eia.gov/dnav/pet/hist/LeafHandler.asx?n=PET&s=RCLC1&f=D (last visited July 29, 2011).

[2] *Analysis of Light Crude Oil Prices on the New York Mercantile Exchange Over a One Year period*, CNNMONEY.COM (Sept. 19, 2011), http://money.cnn.com/data/commodities.

surge in Pennsylvania and across the nation, it should now be apparent that collectively, we have not done enough to ensure that we have access to enough alternative resources such as biofuels, solar and hydrogen technologies. The development of alternative energies are intrinsically linked to greenhouse gases ("GHG") and climate change, which are now widely accepted as real issues that must be dealt with in our lifetimes.[3] The GHG emission mitigation policies we establish now will determine the quality of life for future generations. If we choose to continue making only minor greenhouse gases emission mitigation policies, we will guarantee that adverse effects of global climate change will come to pass and the price of fuels generated from crude oil will climb to a point that will cripple Pennsylvania and the nation.

It has been proven that GHG emissions have a substantial impact on climate change.[4] The type of fuel that we use determines how much GHG emissions are produced. The influence of GHG emissions on climate change has caused a general global warming, which has begun to melt the arctic poles and significantly change weather patterns worldwide. GHG emissions have also contributed to an increase in respiratory problems and other significant medical issues.[5] Given that many GHG emissions take decades or more to degrade in the atmosphere, mitigation must begin now. Therefore, GHG emission mitigation policies must change so that lower levels of

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[3] *See* CLIMATE CHANGE 2007: SYNTHESIS REPORT, SUMMARY FOR POLICYMAKERS, INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (2007), http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf, http://epa.gov/climatechange/downloads/Climate_Change_Science_Facts.pdf.

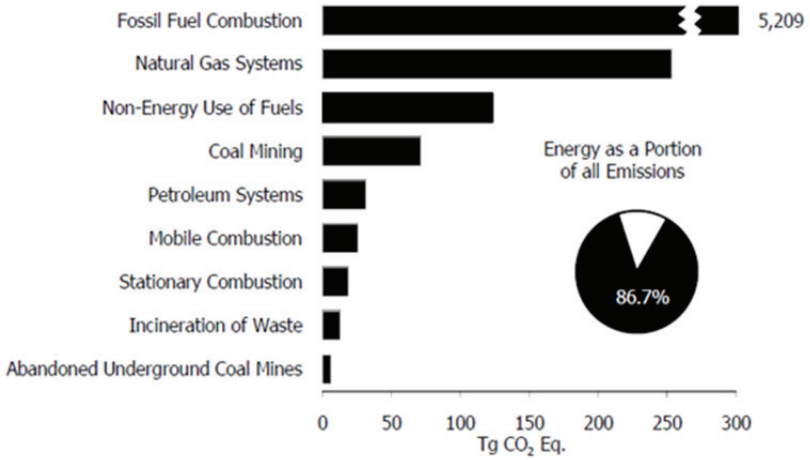
[4] HERVE LE TREUT ET AL., HISTORICAL OVERVIEW OF CLIMATE CHANGE 97, *in* CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS. CONTRIBUTION OF WORKING GROUP I TO THE FOURTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (S. Solomon et al. eds., 2007), *available at* http://www.ipcc.ch/pdf/assessment-report/ar4/ wg1/ar4-wg1-chapter1.pdf.

[5] JOHN WALSH, DECADAL CHANGES AND LONG-TERM TRENDS IN THE ARCTIC ATMOSPHERE, NOAA Artic Theme Page, http://www.arctic.noaa.gov/essay_walsh.html.

emissions are emitted by all, thereby mitigating the growing adverse effects of climate change.[6]

One of the major contributors to GHG emissions is the continued use of petroleum-based fuels.[7] As reported in the 2011 U.S. Greenhouse Gas Inventory Draft Report, published by the Environmental Protection Agency ("EPA"), the United States contributed 5.209 billion metric tons of Carbon Dioxide ("CO_2") emissions from petroleum-based fuels in 2009.[8] This is an increase of 470.6 million tons of CO_2 emissions from the 1990 baseline year.[9]

Looking at historical data in Figures 1 and 2, it is quite clear that more must be done with urgency. The most significant contributor to increased CO_2 emissions is the combustion of fossil fuels as shown below.



[6] WORLD HEALTH ORGANIZATION—CLIMATE CHANGE AND HUMAN HEALTH: RISKS & RESPONSES (A.J. McMichael et al. eds., 2003, ISBN 92 4 156248 X), *available at* http://www.who.int/globalchange/publications/climchange.pdf.

[7] GLOBAL GREENHOUSE GAS DATA, ENVTL. PROT. AGENCY, http://www.epa.gov/climatechange/emissions/globalghg.html.

[8] ENVTL. PROT. AGENCY, EPA 430-R-11-005, DRAFT INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990–2009, at 2–9 (Apr. 15, 2011), *available at* http://www.epa.gov/climatechange/emissions/ downloads11/US-GHG-Inventory-2011-Complete_Report.pdf.

[9] *Id.*

Figure 1: 2009 Energy Sector Greenhouse Gas Sources in Tg (Teragrams) CO_2[10]

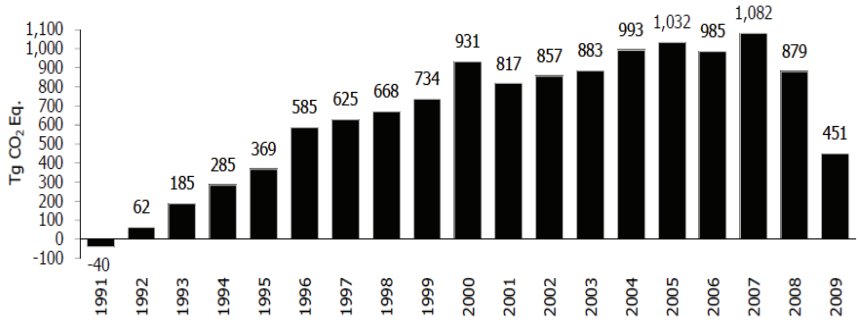


Figure 2: Cumulative Change in Annual U.S. Greenhouse Gas Emissions Relative to 1990[11]

As we search for alternative fuels that will emit little or no GHGs, we should use our legal system to develop policies that encourage the technologies that have been determined to generate positive, real, and sustainable GHG mitigating effects and abandon the technologies that provide little or no sustainable GHG reductions.

One fuel that has shown promise in greatly reducing greenhouse gas emissions is biomass-based diesel, also known as biodiesel. To determine if biodiesel could be used as an alternative energy source to increase energy independence and reduce GHGs, this article explains in Part I what biodiesel is and how it is made. Part II discusses whether it is economically feasible and advantageous to produce biodiesel in Pennsylvania to meet diesel fuel demands. Part III explains how the use of biodiesel will be beneficial in reducing GHG emissions. Part IV presents the various federal and state mandates and incentives as they pertain to the production of biodiesel. Part V explains why the current state and federal regulations fall short in utilizing biodiesel to decrease GHGs and increase energy independence. Finally, Part

[10] *Id.* at 2–30.

[11] *Id.* at 2–29.

VI proposes a few courses of action regarding biodiesel production and integration for the Commonwealth to consider as we strive to become more energy independent and reduce GHG emissions.

I. BIOMASS-BASED DIESEL BASICS (BIODIESEL)

Biodiesel is a diesel fuel substitute for use in combustion ignition engines.[12] According to the Energy Independence and Security Act of 2007 ("EISA"), biomass-based diesel (biodiesel)[13] is a diesel fuel substitute produced from nonpetroleum renewable resources that meets the registration requirements for fuels and fuel additives established by the EPA."[14] When classified as biodiesel, the fuel should have lifecycle GHG emissions that are "at least fifty percent less than the baseline lifecycle greenhouse gas emissions."[15] EISA defines the average lifecycle GHG emissions as:

> [T]he aggregate quantity of GHG emissions . . . related to the full fuel lifecycle, including all stages of fuel and feedstock production and distribution, from feedstock generation or extraction through the distribution and delivery and use of the finished fuel to the ultimate consumer, where the mass value for all GHGs are adjusted to account for their relative global warming potential.[16]

Therefore, when determining the GHG emissions of biodiesel, the complete life cycle must be considered. This includes the production of the feedstock to make the fuel all the way to the end use.

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[12] NAT'L RENEWABLE ENERGY LABORATORY, NREL/TP-540-43672, BIODIESEL HANDLING AND USE GUIDE 6 (4th ed. rev. 2009), *available at* http://www.nrel.gov/vehiclesandfuels/pdfs/43672.pdf [hereinafter BIODIESEL HANDLING AND USE GUIDE].

[13] Energy Independence and Security Act of 2007, 121 Stat. 1492 (2007); 42 U.S.C. § 7545 (2011).

[14] Energy Policy Act of 1992 § 312(f); 42 U.S.C. § 13220 (2006).

[15] 42 U.S.C. § 7545 (2006).

[16] 42 U.S.C. § 7545(o)(1)(H) (2006).

A. ADVANTAGES OF BIODIESEL

Biodiesel is produced through a refinement process called transesterification. Transesterification involves using an alcohol, usually methanol combined with a catalyst,[17] to produce glycerin and a substance made of mono-alkyl esters of long-chain fatty acids commonly called biodiesel.[18] Once the process is complete, the alcohol is reclaimed for further production and the resulting end products are glycerin and biodiesel, which are separated from each other and stored.[19] According to Greg Lardy Ph.D.,[20] in his report to the Western Organization of Resources Council ("WORC"), there are positive co-benefits of biodiesel production when a seed feedstock is used to generate fuel, in that valuable byproducts are created.[21] One of these byproducts is the oilseed, crushed into the form of livestock feed meal, ready to be used by ranchers and farmers.[22]

The byproducts generated from biodiesel production produce two additional streams of revenue, livestock meal and glycerin.[23] With the ability to sell all three, the producers have an excellent opportunity to become

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[17] *See* NATIONAL BIODIESEL BOARD, BIODIESEL PRODUCTION, http://www.biodiesel.org/pdf_files/fuelfactsheets/production.pdf (last visited Sept. 21, 2011).

[18] *Id.*

[19] *Id.*

[20] Dr. Greg Lardy is a Professor and Department Head, Department of Animal Sciences, North Dakota State University. He has spoke at over 550 local, area, state, national, and international meetings regarding cattle nutrition and feed management including the use of byproducts. He received his Ph.D. in Animal Science, Ruminant Nutrition from the University of Nebraska in 1997.

[21] *See generally* Greg Lardy, *Biodiesel Benefits for Cattle Producers: Feeding Byproducts of Biodiesel Production*, WESTERN ORGANIZATIONS OF RESOURCES COUNCILS 16, 20 (2008), *available at* http://www.worc.org/userfiles/file/Biodiesel%20Benefits%20Report.pdf.

[22] *Id.*

[23] *See* John Duncan, *Costs of Biodiesel Production, Energy Efficiency and Conservation Authority* 10 (2003), *available at* http://www.globalbioenergy.org/uploads/media/0305_Duncan_-_Cost-of-biodiesel-production.pdf.

profitable.[24] When using soy or some other seed, the seed is crushed to extract the oil.[25] After the oil is extracted, the crushed seeds are sold for feed meal.[26] Each planted acre of soybean yields approximately 45 to 50 bushels, and according to Ben Wootton, President of Keystone Biofuels, one bushel of soybeans makes approximately one gallon of soybean oil.[27] In turn, one gallon of soybean oil makes approximately .95 gallons of biodiesel.[28] The oil is then introduced into the transesterification process. When the process is complete, the primary product is biodiesel. Therefore, one acre of land is capable of producing at least 42 gallons of biodiesel. The most common feedstock sources of oil for biodiesel production are derived from animal fats[29] and oils from soybeans, cottonseed, sunflowers, canola, and peanuts.[30] Since the plants provide the oil though the intake of sunlight and air, and continue to do so, year after year, these oils are considered renewable.[31] Additionally, animal fats are produced from the intake of plants and other animals and are considered renewable.[32] Figure 3, listed below, provides a simplified view of the biodiesel transesterification process.

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[24] *Id.*; Interview with Charles Cross, President, United Oils Co. in Pittsburgh, Pa. (Mar. 4, 2009) (on file with author).

[25] Email from Ben Wootton, President, Keystone Biofuels (Mar. 31, 2009, 12:25 EST) (on file with author).

[26] *Id.*

[27] *Id.*

[28] *Id.*

[29] *See* Energy Policy Act of 1992 § 312(f); 42 U.S.C. § 13220 (2006).

[30] NAT'L GOVERNOR'S ASS'N, SECURING A CLEAN ENERGY FUTURE: GREENER FUELS, GREENER VEHICLES: A STATE RESOURCE GUIDE, *available at* http://www.nga.org/files/live/sites/NGA/files/pdf/0802GREENERFUELS.PDF;jsessionid=6E1B605878362D4005AD37CD8FDF1199.

[31] BIODIESEL HANDLING AND USE GUIDE, *supra* note 12.

[32] *Id.*

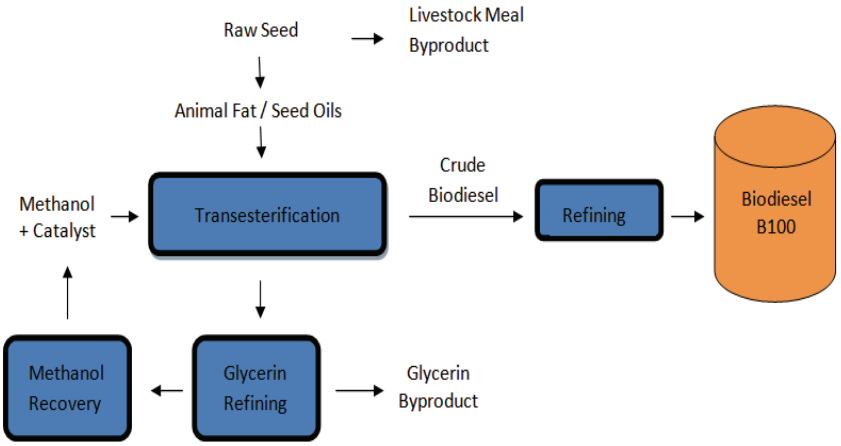

Figure 3: The Transesterification Process[33]

Another byproduct produced is glycerin, which is sold to many industries for a variety of uses.[34] Glycerin is used to make beauty products such as hand lotions and moisturizing soaps. It is used to make nitroglycerin and by food processing companies as a preservative, by pharmaceutical companies in making medication, and by biofuel companies to make ethanol, another promising biofuel.[35] The current market however has seen a surplus in glycerin and therefore potential revenue has decreased.[36] Conversely, according to a new study, conducted by Ramon Gonzalez[37] and Syed Shams

[33] *See id.* at fig. 1.

[34] Duncan, *supra* note 23, at 10.

[35] Syed Shams Yazdani & Ramon Gonzalez, *Anaerobic Fermentation of Glycerol: A Path to Economic Viability for the Biofuels Industry*, 18 CURRENT OPINION IN BIOTECHNOLOGY 213–19 (2007), *available at* http://envsus610.110mb.com/glycerol1.pdf.

[36] From interview with Ben Wooton.

[37] Dr. Ramon Gonzalez is an Associate Professor in Chemical Engineering at Rice University.

Yazdani,[38] there is a way to use this excess glycerin that will increase its value for biodiesel producers and may help the biofuels industry in general. Gonzalez and Yazdani have found that when glycerin is combined with a known strain of *Escherichia coli*, a anaerobic fermentation process is created that converts the glycerin into the biofuel ethanol,[39] which is an additive for gasoline engines and is used in place of gasoline in other countries.[40] Currently, Glycos Biotechnologies, Inc., based in Houston, Texas, is working with biodiesel producers to begin implementing these breakthroughs on a larger scale.[41] Once glycerin-to-ethanol production facilities are established, this will reduce the excess glycerin currently available and greatly increase this revenue stream for biodiesel producers.

When biodiesel is produced, the end product is known as pure biodiesel or B100, meaning that the contents are 100% pure biodiesel as specified by the American Society for Testing and Materials ("ASTM").[42] Currently very few people use B100 because it is not on the market in many places. The blends more commonly used in Pennsylvania are B6, B10, and B20.[43] Each of these grades of biodiesel includes blends of 6%, 10%, or 20% of biodiesel, respectively, mixed with conventional petroleum grade diesel.[44]

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[38] Dr. Syed Shams Yazdani Is the Synthetic Biology and Biofuel Group leader at International Centre for Genetic Engineering and Biotechnology in New Delhi, India.

[39] *Id.*

[40] *See Ethanol Fuel in Brazil*, WIKIPEDIA, http://en.wikipedia.org/wiki/Ethanol_fuel_in_Brazil (last modified Sept. 26, 2011).

[41] *Glycos Biotechnologies Closes Series a Round of $5M; High-value Chemicals from Renewable Sources*, GREEN CAR CONGRESS (Apr. 17, 2009), http://www.greencarcongress.com/2009/04/glycosbio-20090417.html.

[42] NAT'L BIODIESEL BOARD, SPECIFICATION FOR BIODIESEL *(B100)—ASTM 6751-11A*, http://www.biodiesel.org/pdf_files/fuelfactsheets/B100_Specification.pdf (last visited Oct. 1, 2011).

[43] NAT'L BIODIESEL BOARD, SPECIFICATION FOR BIODIESEL BLENDS B6-B20 ASTM 7467-10, http://www.biodiesel.org/pdf_files/fuelfactsheets/B20_Specification.pdf (last visited Oct. 1, 2011).

[44] *Id.*

B. DISADVANTAGES OF BIODIESEL

Biodiesel also acts as an excellent cleaning agent.[45] It is therefore recommended that when switching an automobile or other diesel burning engine to fuel containing more than a B20 blend, maintenance should be performed on a periodic basis until all deposits, from the use of diesel, in the fuel system have been removed. Periodically changing the fuel filter is advised to help mitigate more serious issues.[46] For new vehicles and other diesel burning sources, the immediate use of biodiesel from B2 all the way up to B100 can be used with no adverse effects. The only restriction at this time is that most manufactures of diesel burning equipment and vehicles will not honor their warranty if certain percentages of biodiesel are used. It is advisable for consumers to check with their equipment manufacture to determine the maximum percentage of biodiesel allowable to ensure their warranty will be honored. The equipment and vehicle manufacturers believe that if this type of fuel used harms an engine, liability should be found in the suppliers of the fuel. Even though this is their general stance, many manufacturers have begun to research the use of biodiesel in their products.[47]

Another negative characteristic of biodiesel is that it has a high clouding point. According to the National Biodiesel Board, "The [c]loud point of a fluid is the temperature at which dissolved solids are no longer completely soluble, precipitating as a second phase giving the fluid a cloudy appearance. This term is relevant to several applications with different consequences."[48] In the fuel industry, cloud point refers to the temperature below which waxes

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[45] ANTHONY RADICH, BIODIESEL PERFORMANCE, COSTS, AND USE, ENERGY INFO. ADMIN., http://www.eia.gov/oiaf/analysispaper/biodiesel/, http://www.eia.doe.gov/oiaf/analysispaper/biodiesel/pdf/biodiesel.pdf, http://www.biodiesel.org/pdf_files/fuelfactsheets/bdusage.PDF (last updated June 8, 2004).

[46] *Id.*

[47] OEM INFORMATION/STANDARDS & WARRANTIES, NAT'L BIODIESEL BD., http://www.biodiesel.org/resources/oems/default.shtm (last visited Sept. 22, 2011).

[48] COLD FLOW IMPACTS, NAT'L BIODIESEL BD., http://www.biodiesel.org/pdf_files/fuelfactsheets/Cold%20Flow.PDF (last visited Sept. 22, 2011).

in the fuel form a cloudy appearance.[49] "The presence of solidified waxes thickens the oil and clogs fuel filters and injectors in engines. The wax also accumulates on cold surfaces and forms an emulsion with water."[50]

There is however already equipment in place and in use during extreme cold months in Pennsylvania for low and ultra-low sulfur diesels. Low sulfur diesel has a cloud point of -9° F. Currently the industry uses fuel pump, fuel line, and filter heater equipment to mitigate the cloud forming of diesel. This current technology can easily be used to achieve the same benefits only at warmer temperatures than currently used for diesel.[51] Therefore even though this characteristic of biodiesel causes it to seem less viable, with current technologies, this can be properly mitigated.

II. THE ECONOMIC FEASIBILITY OF PRODUCING BIODIESEL TO MEET THE DIESEL FUEL DEMANDS OF PENNSYLVANIA

In July 2008, Pennsylvania Governor Edward G. Rendell signed new legislation into law with the goal of increasing in-state biofuel production to reduce our dependency on imported oil and mitigate security risks from a sudden shortage of supply.[52] Although there is state law requiring the use of biodiesel, after certain biodiesel production benchmarks are achieved, the big question is whether in-state production of biodiesel is feasible. In other words, when the time comes that biodiesel must be blended with diesel, can

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[49] *Id.*

[50] *Id.*

[51] COLD FLOW BLENDING CONSORTIUM, BIODIESEL COLD WEATHER STUDY, NAT'L BIODIESEL BD., http://www.biodiesel.org/resources/reportsdatabase/reports/gen/20050728_gen-354.pdf (last visited Sept. 22, 2011) (soy biodiesel cloud point is 35 degrees Fahrenheit).

[52] Press Release, Office of the Governor of Pa., Governor Rendell Signs Biofuels Development and Incentives Acts to Strengthen National Security, Spur Economic Development (July 10, 2008), *available at* http://www.portal.state.pa.us/portal/server.pt?open=512&objID=2999&PageID=431162&mode=2&contentid=http://pubcontent.state.pa.us/publishedcontent/publish/global/news_releases/governor_s_office/news_releases/governor_rendell_signs_biofuels_development_and_incentives_acts_to_strengthen_national_security__spur_economic_development.html.

enough biodiesel be produced by suppliers to meet that demand and sustain such levels of production over time and at what cost to Pennsylvanians? In order to evaluate the feasibility of biodiesel as a replacement fuel in Pennsylvania, consideration must be given to the current supply and consumption of diesel fuel oil and the current production of biodiesel and feedstock supply needs.

Dr. Lardy purports that feed meal produced after the transesterification process using soybeans is still high in nutrients. This feed meal is an excellent protein supplement for swine, poultry and beef cattle due to its low fiber and high quality amino acid profile.[53] Because this feed meal is still usable for the livestock industry, the use of the original feedstock (i.e. soybeans) to create biodiesel does not create a shortage of available food as suggested by the food for fuel advocates.[54] Since the feed meal continues to be available, this does not create a deficit in available livestock feed meal.

To understand if biodiesel can be used as a replacement fuel in Pennsylvania, the current supply and consumption of diesel fuel oil must be considered. As of 2009, crude oil production in Pennsylvania totaled 3.540 million barrels (42 gallon capacity).[55] According to the EIA, the total stock of distillate fuel oil as of 2009 amounted to 5.925 million barrels (42 gallon capacity).[56] The consumption of diesel fuel oil in Pennsylvania as of 2008 was 64.132 million barrels (42 gallon capacity).[57] Due to the lack of availability of consumption levels for 2009, if we assume that consumption

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[53] Lardy, *supra* note 21, at 16.

[54] From interview with Ben Wooton.

[55] Petroleum & Other Liquids, U.S. Energy Information Administration website, http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s= MCRFPPA1&f=M.

[56] *Id.*

[57] *Id.*

stayed at least at 2008 levels in 2009, 58.207 million barrels (42 gallon capacity) of diesel fuel oil was imported to the state to meet demand.[58]

Additionally, the current production of biodiesel and feedstock supplies needs to be evaluated. Looking at in-state production of biodiesel, currently, there are eight fully operational and licensed production facilities located in Pennsylvania.[59] According to the Energy Information Administration, Pennsylvania Biodiesel producers have the capacity to generate 1.357 million barrels (42 gallon capacity) of pure Biodiesel as of December 2009.[60]

According to Charles Cross, President of United Oil Co. in Pittsburgh, Pennsylvania, there are many external factors that greatly affect the ability to produce biodiesel in Pennsylvania.[61] The cost of feedstock fluctuates dramatically, thereby affecting a producer's ability to keep cost down on a gallon of fuel.[62] A secondary issue affecting the production or availability of fuel is a lack of infrastructure in the distribution network for feedstock.[63] Presently, only a few companies are capable of blending biodiesel into mixtures with diesel in all B6 and higher ranges. This makes it increasingly difficult to distribute blended biodiesel on a larger scale.

In a report jointly submitted by the United States Department of Energy and the United States Department of Agriculture ("USDA"), there is currently

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[58] ENERGY INFORMATION ADMINISTRATION TABLE PT1. ENERGY PRODUCTION IN PHYSICAL UNITS, PENNSYLVANIA, 1960–2009, http://www.eia.gov/state/seds/sep_prod/pdf/PT1_PA.pdf 3541 thousand gallons x 1000 = 3.541 million barrels.

[59] NBB Member Plants, NAT'L BIODIESEL BD., http://www.biodiesel.org/buying biodiesel/plants/biomaps/biomaps.shtm#app=d088&ffc-selectedIndex=0&9707-selectedIndex=1&3702-selectedIndex=0 (use state selection scroll box, select "Pennsylvania" and click enter) (last visited Sept. 22, 2011).

[60] U.S. ENERGY INFO. ADMIN., DOE/EIA 0642 (2009/12), MONTHLY BIODIESEL PRODUCTION REPORT (Oct. 2010), *available at* http://www.eia.gov/cneaf/solar.renewables/page/biodiesel/biodiesel.pdf (last visited Sept. 22, 2011).

[61] Interview with Charles Cross, President, United Oils Co., in Pittsburgh, Pa. (Mar. 4, 2009) (on file with author).

[62] *Id.*

[63] *Id.*

enough agriculture land nationwide to create at least sixteen percent of the biofuels consumed each year.[64] The USDA Pennsylvania Office of the National Agricultural Statistics Service reports that in 2007, approximately 425,000 acres were used to produce soybeans in Pennsylvania.[65] If all the soybeans in the state that are grown were used to make biodiesel, 17,850,000 million gallons could be created. Since this is not enough to supply existing biodiesel production facilities, the majority of soybeans for biodiesel supply would have to be imported into the state or other feedstocks would have to be considered.

Dr. Lardy states there are other feedstocks that could be considered to generate biodiesel that have higher oil content than soybeans and would be a good substitute to make biodiesel and feed meal.[66] These alternative feedstocks include sunflower, canola, and safflower.[67]

At this time, complete in-state production of all materials needed for biodiesel production does not seem feasible due to the reality that most of the feedstocks needed for biodiesel production would have to be imported. There is hope that sunflower production may increase in Pennsylvania and this may help reduce our importing dependency. A Berks County farmer has devoted 10 acres to the production of sunflowers.[68] He estimates that from his harvest, he will be able to create 1,000 gallons of oil to be used to make fuel for his

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[64] BIOMASS AS FEEDSTOCK FOR A BIOENERGY AND BYPRODUCTS INDUSTRY: THE TECHNICAL FEASIBILITY OF A BILLION-TON ANNUAL SUPPLY, U.S. DEPT. OF ENERGY & U.S. DEPT. OF AGRICULTURE (Apr. 2005), http://feedstockreview.ornl.gov/pdf/billion_ton_vision.pdf (last visited Sept. 22, 2011).

[65] ACERAGE, USDA, NAT'L AGRIC. STATISTICS SERVICE, June 29, 2007, at 14; QUICK STATS, USDA, NAT'L AGRIC. STATISTICS SERVICE (2007), http://quickstats.nass.usda.gov/#030F8589-F00F-3500-AD6A-78A52638D9BF (In query enter: Program: Survey; Sector: Crops; Group: Field Crops; Commodity: Soybeans; Category: Area Harvested; Geographic Region: State; State: PA; Year: 2007).

[66] Lardy, *supra* note 21, at 8–9.

[67] *Id.*

[68] Darrin Youker, *Eastern Pa. Farmer Harnesses the Sun (flower)*, YDR.COM, http://ydr.inyork.com/ydr/greenfull/ci_10297272 (last updated: 08/25/2008 08:45:41 AM EDT).

farm equipment.[69] The statistical data on GHG emissions from sunflower seed oil would still need to be considered to determine if this would provide an overall reduction. If it would, this may be another potential approach to having a diverse feedstock mix in generating biodiesel as this would increase the available oil that could be produced per acre and would provide for more in-state production of the total biodiesel process.[70]

III. THE USE OF BIODIESEL WILL REDUCE GREENHOUSE GAS EMISSIONS AND WILL INCREASE AIR QUALITY

If used as a replacement fuel for petroleum diesel, biodiesel provides significant GHG emission and ambient air quality benefits. To understand why reductions of GHG emissions are important, a brief look at each emission and its effect on human health and climate change is provided below. These emissions include CO_2, CO, NO_X, VOC, CH_4, SO_X, $PM_{2.5}$, and PM_{10}.

A. CARBON DIOXIDE—CO_2

According to the EPA, CO_2 is emitted naturally through the carbon cycle and through human activities including, but not limited to, the burning of fossil fuels.[71] Natural sources of CO_2 occur within the carbon cycle where "billions of tons of atmospheric CO_2 are removed from the atmosphere [though 'sinks,' such as] oceans and growing plants." CO_2 is also emitted back into the atmosphere by 'sources,'[72] which include the natural release of CO_2 and man-made processes that generate CO_2 release. When in balance, the total carbon dioxide emissions and removals from the entire carbon cycle are

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[69] *Id.*

[70] *See id.* See also email with Ben Wootton, *supra* note 25 (1 acre produces appox. 42 gallons of soybean oil which equals about 40–42 gallons of biodiesel. 1 acre produces appox. 100 gallons of sunflower oil which equals about 98–100 gallons of biodiesel).

[71] EPA—CLIMATE CHANGE—GREENHOUSE GAS EMISSIONS—CARBON DIOXIDE (*available at* http://www.epa.gov/climatechange/emissions/co2.html) [hereinafter EMISSIONS, CARBON DIOXIDE].

[72] *Id.*

roughly equal.[73] Since the Industrial Revolution in the 1700s, human activities, such as the burning of oil, coal and gas, and deforestation, has increased CO_2 concentrations in the atmosphere.[74] In 2005, global atmospheric concentrations of CO_2 were 35% higher than they were before the Industrial Revolution.[75] The increase in CO_2 has caused many scientists concern that this increase is enhancing the global warming effect and will lead to adverse climate change.[76] When looking at a fuel substitute to reduce or replace fossil fuels, CO_2 emissions of the fuel substitute must be considered to determine emissions are actually being reduced.

B. CARBON MONOXIDE—CO

According to the EPA, carbon monoxide is "an odorless, colorless and toxic gas."[77] The main sources of CO include leaky and improperly vented combustible heat sources in the home and automobile exhaust.[78] Although the EPA does not consider CO a direct GHG, it has recognized that CO does have an indirect effect that increases CH_4 and CO_2, so any increase in CO will affect the overall increase or decrease in the previously noted GHGs.[79] The EPA warns that "[s]ince it is impossible to see, taste or smell the toxic fumes, CO can kill you before you are aware it is in your home. At lower levels of exposure, CO causes mild effects that are often mistaken for the flu.

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[73] CLIMATE CHANGE—GREENHOUSE GAS EMISSIONS, NATURAL SOURCES AND SINKS OF CARBON DIOXIDE, ENVTL. PROT. AGENCY, http://www.epa.gov/climatechange/emissions/co2_natural.html (last updated Apr. 14, 2011).

[74] *Id.*

[75] EMISSIONS, CARBON DIOXIDE, *supra* note 71.

[76] CLIMATE CHANGE, BASIC INFORMATION, ENVTL. PROT. AGENCY, http://www.epa.gov/climatechange/basicinfo.html (last updated Apr. 14, 2011).

[77] Indoor Air—An Introduction to Indoor Air Quality (IAQ)—Carbon Monoxide (CO), ENVTL. PROT. AGENCY, http://www.epa.gov/iaq/co.html.

[78] *Id.*

[79] INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990–2009, U.S. Environmental Protection Agency, p. 1–6, *available at* http://www.epa.gov/climatechange/emissions/downloads11/US-GHG-Inventory-2011-Complete_Report.pdf.

These symptoms include headaches, dizziness, disorientation, nausea and fatigue."[80]

C. NITROGEN OXIDES—NO_X

NO_X is the generic term for a group of highly reactive gases (NO, NO_2, N_2O, N_2O_3, N_2O_4, N_2O_5), all of which contain nitrogen and oxygen in varying amounts. Many of the nitrogen oxides are colorless and odorless. Although many different NO_x emissions can indirectly cause an increase in CH_4, at this time the EPA considers only N_2O a GHG.[81] As reported by the EPA, for 2009 there was a decrease in N_2O by 6.22% from the base year 1990.[82] NO_X is a major contributor to respiratory disease, acid rain, water quality degradation and ground level smog.[83] Additionally, although there is a smaller amount of N_2O in the atmosphere as compared to CO_2, N_2O is 300 times more powerful than CO_2 at trapping heat in the atmosphere.[84]

D. VOLATILE ORGANIC COMPOUNDS—VOC

Volatile organic compounds ("VOCs") are emitted as gases from certain solids or liquids.[85] VOCs include a variety of chemicals, which may have

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[80] EPA, INDOOR AIR QUALITY, AN INTRODUCTION TO INDOOR AIR QUALITY, CARBON MONOXIDE (CO), http://www.epa.gov/iaq/co.html# Sources_of_Carbon_Monoxide.

[81] GREENHOUSE GAS EMISSIONS, Greenhouse Gas Overview, ENVTL. PROT. AGENCY, http://epa.gov/climatechange/emissions/index.html.

[82] ENVTL. PROT. AGENCY, DRAFT INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990–2009, at Page ES-5, Apr. 15, 2011, http://www.epa.gov/climate change/emissions/downloads11/US-GHG-Inventory-2011-Complete_Report.pdf.

[83] U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES, Public Health Agency for Toxic Substances & Diseases Registry—Toxic Substances Portal—Nitrogen Oxides—ToxFAQs™ for Nitrogen Oxides Page 2, http://www.atsdr.cdc.gov/toxfaqs/ tfacts175.pdf.

[84] ENVTL. PROT. AGENCY, DRAFT INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990–2009, at Page ES-10, Apr. 15, 2011, http://www.epa.gov/climate change/emissions/downloads11/US-GHG-Inventory-2011-Complete_Report.pdf.

[85] AN INTRODUCTION TO INDOOR AIR QUALITY, ORGANIC GASES: VOLATILE ORGANIC COMPOUNDS (*VOCs*), ENVTL. PROT. AGENCY, http://www.epa.gov/iaq/ voc.html (last

short-term adverse health effects, long-term adverse health effects, or both.[86] Concentrations of many VOCs are consistently higher indoors (up to ten times higher) than outdoors.[87] VOCs are emitted by a wide array of products numbering in the thousands. A major outdoor source of VOCs is transportation.[88]

E. NON-CH_4 VOLATILE ORGANIC COMPOUNDS—NMVOC

Non-Methane Volatile organic compounds ("NMVOCs") are emitted as gases from solids and liquids.[89] VOCs include a variety of chemicals, which may have both short-term and long-term adverse health effects and indirectly affect the formation and destruction of other GHGs.[90] The EPA reported that in 2009 NMVOCs decreased by 66.34% as compared to the base year 1990.[91] One reason for this decrease is that NMVOCs have a very short life-cycle and usually are regionally concentrated.[92] According to the EPA "[c]oncentrations of many VOCs are consistently higher indoors (up to ten times higher) than

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visited Oct. 5, 2011). CONTROLLING POLLUTANTS AND SOURCES IAQ DESIGN TOOLS FOR SCHOOLS, ENVTL PROT. AGENCY, http://www.epa.gov/iaq/schooldesign/controlling.html (last visited Oct. 1, 2011).

[86] *Id.*

[87] *Id.*

[88] *Id.*

[89] EPA—AN INTRODUCTION TO INDOOR AIR QUALITY (IAQ) VOLATILE ORGANIC COMPOUNDS (VOCS), http://www.epa.gov/iaq/voc.html [hereinafter VOCs].

[90] ENVTL. PROT. AGENCY, DRAFT INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990–2009, at Page ES-2, Apr. 15, 2011, http://www.epa.gov/climatechange/emissions/downloads11/US-GHG-Inventory-2011-Complete_Report.pdf.

[91] *Id.*

[92] ENVTL. PROT. AGENCY, DRAFT INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990–2009, at Page 1-6, Apr. 15, 2011, http://www.epa.gov/climatechange/emissions/downloads11/US-GHG-Inventory-2011-Complete_Report.pdf.

outdoors."[93] Futhermore, the EPA states "VOCs are emitted by a wide array of products numbering in the thousands."[94]

F. METHANE—CH_4

Methane is produced by natural sources and anthropogenic activities and human related activities such as farming, ranching, and the production and use of fossil fuels.[95] Emissions from natural sources are largely determined by environmental variables such as temperature and precipitation.[96] Methane is about 21 times more powerful at warming the atmosphere than carbon dioxide (CO_2) by weight.[97] Thankfully, methane's chemical lifetime in the atmosphere is approximately 12 years.[98] According to the EPA, as of 2009, there has been a 1.69% increase of CH_4 as compared to the base year 1990.[99] The EPA has stated "[methane's] relatively short atmospheric lifetime, combined with its potency as a greenhouse gas, makes it an ideal candidate to help mitigate global warming over the near-term."[100]

G. SULFUR DIOXIDE—SO_X

Sulfur Dioxide is another indirect GHG that has an effect on the absorption of radiation and thereby affects the formation and destruction of

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[93] See VOCs, *supra* note 89.

[94] *Id.*

[95] ENVTL. PROT. AGENCY, DRAFT INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990–2009, at Page ES-6, Apr. 15, 2011, http://www.epa.gov/climatechange/emissions/downloads11/US-GHG-Inventory-2011-Complete_Report.pdf.

[96] *Id.* at 1-3.

[97] *Id.* at ES-3.

[98] *Id.* at 1-7 to 1-8.

[99] *Id.* at ES-5.

[100] EPA, METHANE, SCIENCE, http://www.epa.gov/methane/scientific.html.

other GHGs.[101] The EPA states that "[s]ulfur is found in all raw materials, including crude oil, coal, and ore which contains common metals like aluminum, copper, zinc, lead, and iron. SO_x gases are formed when fuel containing sulfur is burned, gasoline is extracted from oil, or metals are extracted from ore."[102] When SO_2 dissolves, it combines with water vapor to form acid, and interacts with other gases and particles in the air to form sulfates and other products that can be harmful to people and the environment.[103] SO_2 works in conjunction with VOCs to produce acid rain.[104]

H. PARTICULATE MATTER—$PM_{2.5}$ & PM_{10}

According to the EPA,

> PM represents a broad class of chemically and physically diverse substances. Particles can be described by size, formation mechanism, origin, chemical composition, atmospheric behavior and method of measurement. The concentration of particles in the air varies across space and time, and is related to the source of the particles and the transformations that occur in the atmosphere.[105]

$PM_{2.5}$ is produced from combustion sources such as residential wood combustion, agricultural open burning, coal and oil fired power plants and industries, as well as dust particles from roads and fields.[106] Particles formed

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[101] ENVTL. PROT. AGENCY, DRAFT INVENTORY OF U.S. GREENHOUSE GAS EMISSIONS AND SINKS: 1990-2009, at Page 2-25, Apr. 15, 2011, http://www.epa.gov/climatechange/emissions/downloads11/US-GHG-Inventory-2011-Complete_Report.pdf.

[102] EPA—International Programs—Air Quality and Public Health, http://www.epa.gov/international/air/pollution.htm.

[103] *Id.*

[104] WORLD HEALTH ORGANIZATION—MEDIA CENTRE—AIR QUALITY AND HEALTH FACT SHEET N°313 UPDATED SEPTEMBER 2011, http://www.psr.org/environment-and-health/code-black/blog/epa-proposes-stringent-new.html.

[105] EPA, PARTICULATE MATTER, http://www.epa.gov/ncer/science/pm/ index.html.

[106] EPA—FINE PARTICLE (PM2.5) DESIGNATIONS—BASIC INFORMATION, http://www.epa.gov/pmdesignations/basicinfo.htm.

in the atmosphere are referred to by the EPA as "secondary" particles, and the majority of these particles are from gases from fuel combustion in automobiles, trucks, and power plants such as sulfur dioxide (SO_2) and nitrogen oxides (NO_x) released by anthropogenic and natural sources.[107] Health effects have been directly linked to $PM_{2.5}$, and exposure to such particles can affect the function of the lungs and heart.[108] The EPA has awarded $40 million to study the health effects of particulate matter.[109]

I. THE COMPLETE FUEL LIFECYCLE

When looking at the greenhouse gas emissions of a particular fuel source, it is standard practice to look at the emissions produced when used in vehicles as well as the complete fuel lifecycle. A National Renewable Energy Laboratory report states that "[u]nderstanding the benefit of biodiesel means understanding how its life cycle emissions compare to those of petroleum diesel."[110] The complete fuel lifecycle includes, GHG emissions produced from feedstock growth, extraction of seed oil, production of oil into fuel, distribution and combustion.[111] This complete fuel lifecycle is commonly known as the well-to-wheels analysis.[112]

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[107] *Id.*

[108] EPA—PARTICAL POLLUTION AND YOUR HEALTH—PAGE 1 OFFICE OF AIR AND RADIATION, www.epa.gov/airSeptember2003EPA-452/F-03-001 or http://www.epa .gov/oar/particlepollution/pdfs/pm-color.pdf.

[109] EPA NATIONAL CENTER FOR ENVIRONMENTAL RESEARCH, EPA AWARDS $40 MILLION IN GRANTS TO STUDY HEALTH EFFECTS OF PARTICULATE MATTER (2005), http://www.epa.gov/ncer/events/news/2005/ 11_17_05_feature.html.

[110] U.S. DEPT. AGRIC. & U.S. DEPT. OF ENERGY, NREL/SR-580-24089 UC CATEGORY 153, LIFE CYCLE INVENTORY OF BIODIESEL AND PETROLEUM DIESEL FOR USE IN AN URBAN BUS (1998), *available at* http://www.nrel.gov/docs/legosti/ fy98/24089.pdf [hereinafter USDA URBAN BUS].

[111] *Id.*

[112] MIT A WELL-TO-WHEELS LIFECYCLE ASSESSMENT OF USED VEGETABLE OIL BIODIESEL PRODUCED ON MIT CAMPUS 3, http://web.mit.edu/biodiesel/downloads/ BiodieselLCAReport.pdf.

According to Office of Transportation and Air Quality, the increased usage of alternative fuels can provide significant reductions in GHG emissions from petroleum-based fuels.[113] Additionally, the EPA reports biodiesel, when used as B100, provides a 40-90% reduction in GHG emissions when replacing diesel.[114] Biodiesel B20 provides a 10-20% reduction in GHG emissions as compared to diesel.[115]

Specifically, an EPA analysis of biodiesel impacts on exhaust emissions from diesel engines, published in October 2002, indicated as the amount of biodiesel blend was increased from zero percent to one hundred percent, all recorded emissions PM, CO, and HC decreased dramatically with the exception of NO.[116] As the blend of biodiesel was increased to one hundred percent, NO_x increased to ten percent above the baseline of a zero percent of biodiesel blended with diesel.[117] There is some cause for concern as this is a chief ingredient in ground-level smog, acid rain and global warming in general.[118] To reduce the amount of NO_x resulting from biodiesel, the EPA has authorized and funded several pilot programs to research techniques that

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[113] OFFICE OF TRANSP. & AIR QUALITY, ENVTL. PROT. AGENCY, EPA420-F-07-035 GREENHOUSE GAS IMPACTS OF EXPANDED RENEWABLE AND ALTERNATIVE FUELS USE 1–2 (Apr. 2007), *available at* http://nepis.epa.gov/Adobe/PDF/P100093S.PDF.

[114] OFFICE OF TRANSP. & AIR QUALITY, ENVTL. PROT. AGENCY, EPA420-F-06-007, A GLANCE AT CLEAN FREIGHT STRATEGIES 2 (2006), *available at* http://nepis.epa.gov/Adobe/PDF/P1004KVB.PDF.

[115] *Id.*

[116] EPA, ASSESSMENT AND STANDARDS DIVISION, OFFICE OF TRANSPORTATION AND AIR QUALITY, A COMPREHENSIVE ANALYSIS OF BIODIESEL IMPACTS ON EXHAUST EMISSIONS 74 (2002) [hereinafter A COMPREHENSIVE ANALYSIS OF BIODIESEL IMPACTS ON EXHAUST EMISSIONS] EPA420-P-02-001, *available at* http://epa.gov/otaq/models/analysis/biodsl/p02001.pdf.

[117] A COMPREHENSIVE ANALYSIS OF BIODIESEL IMPACTS ON EXHAUST EMISSIONS, *supra* note 116, at 69.

[118] OFFICE OF AIR QUALITY PLANNING AND STANDARDS, ENVTL. PROT. AGENCY, EPA456/F-98-005, HOW NITROGEN OXIDES AFFECT THE WAY WE LIVE AND BREATHE 2–3 (Sept. 1998), *available at* http://nepis.epa.gov/EPA/html/DLwait.htm?url=/Adobe/PDF/P10006ZO.PDF.

can be used to mitigate the increase in NO_x.[119] A 2004 EPA report has shown promising results by adding cetane[120] additive to biodiesel and reducing NO_x emissions significantly.[121] Even with the increase in NO_x, the potential benefit from total GHG emissions from biodiesel usage outweighs this drawback.

[119] SOLID WASTE AND EMERGENCY RESPONSE ENVTL. PROT. AGENCY, EPA 500-F--04-022, OSWER INNOVATIONS PILOT: REDUCING PRODUCTION COSTS AND NITROGEN OXIDE (NO_X) EMISSIONS FROM BIODIESEL 1–2 (June 2004), *available at* http://www.epa.gov/oswer/docs/iwg/fs_biodieseland_nox_final.pdf.

[120] Cetane—A colorless oily hydrocarbon C16H34 found in petroleum, Merriam-Webster dictionary, http://www.merriam-webster.com/dictionary/cetane. The amount of cetane, determines the cetane number which is a measure of the ignition value of a diesel fuel that represents the percentage by volume of cetane in a mixture of liquid methylnaphthalene that gives the same ignition lag as the oil being tested—called also cetane rating—compare octane number, http://www.merriam-webster.com/dictionary/cetane%20number.

[121] OFFICE OF TRANSPORTATION AND AIR QUALITY, ENVTL. PROT. AGENCY, EPA420-B-04-005PA, GUIDANCE ON QUANTIFYING NO_X BENEFITS FOR CETANE IMPROVEMENT PROGRAMS FOR USE IN SIPS AND TRANSPORTATION CONFORMITY 18–20 (June 2004), *available at* http://www.epa.gov/OTAQ/guidance/420b04005.pdf.

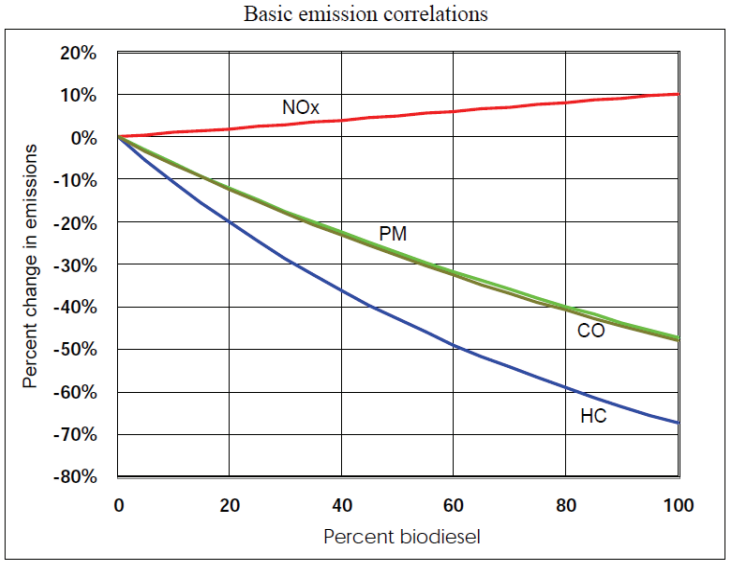

Figure 4: Exhaust Emissions Reduction when Biodiesel blend is increased to 100% (B100)[122]

Figure 4 above shows the results from the EPA study cited. When twenty percent biodiesel, or B20, is used the carbon monoxide emissions are reduced to fifteen percent below the baseline.[123] Overall, the study indicated while all blends of biodiesel greatly reduced GHG emissions, the amount achieved varied.[124] The data shows that dependent on the type of feedstock used, whether soybean or yellow grease, the resulting benefits from using the biodiesel will either increase or decrease slightly.[125] The study also shows

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[122] A COMPREHENSIVE ANALYSIS OF BIODIESEL IMPACTS ON EXHAUST EMISSIONS, *supra* note 116, at 37.

[123] ENERGY EFFICIENCY & RENEWABLE ENERGY, U.S. DEP'T OF ENERGY, DOE/GO-102008-2542 CLEAN CITIES FACT SHEET 2 (Apr. 2008), *available at* http://www.afdc.energy.gov/afdc/pdfs/42562.pdf.

[124] A COMPREHENSIVE ANALYSIS OF BIODIESEL IMPACTS ON EXHAUST EMISSIONS, *supra* note 116, at 37 fig. IV.A.1-1.

[125] A COMPREHENSIVE ANALYSIS OF BIODIESEL IMPACTS ON EXHAUST EMISSIONS, *supra* note 116, at 48 fig. IV.A.3-1.

that oil obtained from seeds generates improved reductions as compared to yellow grease and tallow.[126] In all cases, there were substantial GHG emission reductions as compared to petroleum diesel fuel oil.[127] One constraint of this study is that the results were limited to emissions generated when biodiesel was used in combustion ignition engines and did not take into account the complete well-to-wheels analysis.

A more comprehensive study on the complete lifecycle of biodiesel GHG emissions conducted by the United States Department of Energy ("DOE") and the Department of Agriculture ("USDA") concluded that biodiesel could provide substantial reductions.[128] The study found that B20 biodiesel provided a 15.66% net CO_2 reduction and the reduction increases to 78.45% when using B100 as compared to petroleum diesel.[129] The study reported reductions in all areas with the exception of NO_x, which increased as compared to petroleum diesel by 13% when using B100.[130] When soybean feedstock was used, the DOE/USDA study reported that CO_2 was reduced 78%, CO was reduced by 35%, PM_{10} was reduced by 32%, total PM soot was reduced by 83.6%, SO_x was reduced by 8%, methane (CH_4) was reduced by 3%, HC was reduced by 37%, wastewater was reduced by 79%, and hazardous solid waste was reduced by 96%.[131]

Conducting an independent analysis using software developed by the Argonne National Laboratory called the Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (otherwise known as GREET)

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[126] A COMPREHENSIVE ANALYSIS OF BIODIESEL IMPACTS ON EXHAUST EMISSIONS, *supra* note 116, at iii, 29–30, 73.

[127] *Id.* at 41–42.

[128] USDA URBAN BUS, *supra* note 110, at ii (explaining the Dep't of Energy and U.S. Dep't of Agric. collected and constructed their own lifecycle model with help from Ecobalance, Inc. and the Colorado Institute for Fuels and High Altitude Engine Research (CIFER) at the Colorado School of Mine).

[129] *Id.* at 21.

[130] *Id.* at 256.

[131] *Id.* at 18–34.

Model,[132] I found biodiesel provides substantial reductions in GHG emissions when the percentage of biodiesel used is increased.[133] Using the well-to-wheels analysis, the amount of total GHG emissions was reduced from 25.14 lbs/gal to 21.38 lbs/gal when using B20. Finally, when using B100, total GHG emissions were reduced to 5.90 lbs/gal. Looking at the CO_2 emissions from petroleum diesel, B20, and B100, the emissions are 24.28 lbs/gal, 20.47 lbs/gal, and 4.62 lbs/gal, respectively. Figure 5 below shows the corresponding reductions.

[132] "To fully evaluate energy and emission impacts of advanced vehicle technologies and new transportation fuels, the fuel cycle from wells to wheels and the vehicle cycle through material recovery and vehicle disposal need to be considered. Sponsored by the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy (EERE), Argonne has developed a full life-cycle model called GREET (Greenhouse gases, Regulated Emissions, and Energy use in Transportation). It allows researchers and analysts to evaluate various vehicle and fuel combinations on a full fuel-cycle/vehicle-cycle basis." *GREET Model: The Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation Model*, U.S. DEPARTMENT OF TRANSP., *available at* http://www.transportation.anl.gov/modeling_simulation/GREET/index.html.

[133] Basic constraints in the study—baseline year was 2010, target year was 2012. The energy mix was based on the NE mixture and assumed broad bases of input fuels to generate electricity. The basic combustion ignition direct injection (CIDI) engine was used. Grams/mmBTU was converted to pounds/gallon for ease of understanding for reader. Input and Output file on file with author [hereinafter Johnson GREET calculations].

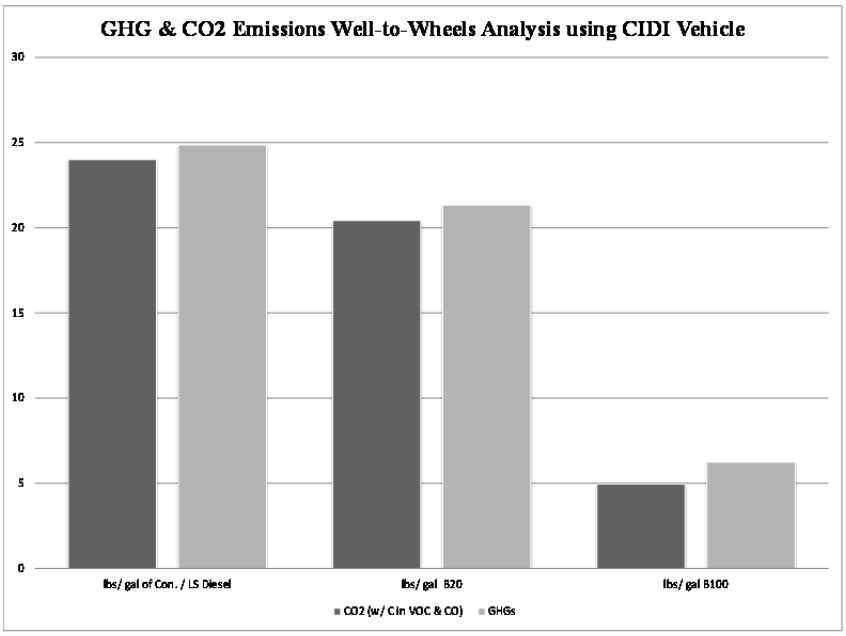

Figure 5: GHG & CO_2 emissions using well-to-wheel analysis created from Argonne Greet Model[134]

Looking at the other GHG emissions produced during the lifecycle of petroleum diesel and biodiesel, while some emissions decreased or stayed the same, most increase as biodiesel is increased. The emissions that increased as the percentage of biodiesel increases include total N_2O, NO_xs, CO, SO_xs, and $PM_{2.5}$. The emissions that decreased include CH_4 (methane) and total PM_{10}. Figure 6 below lists the results of per pound per gallon of petroleum diesel, B20 and B100.

[134] *Id.*

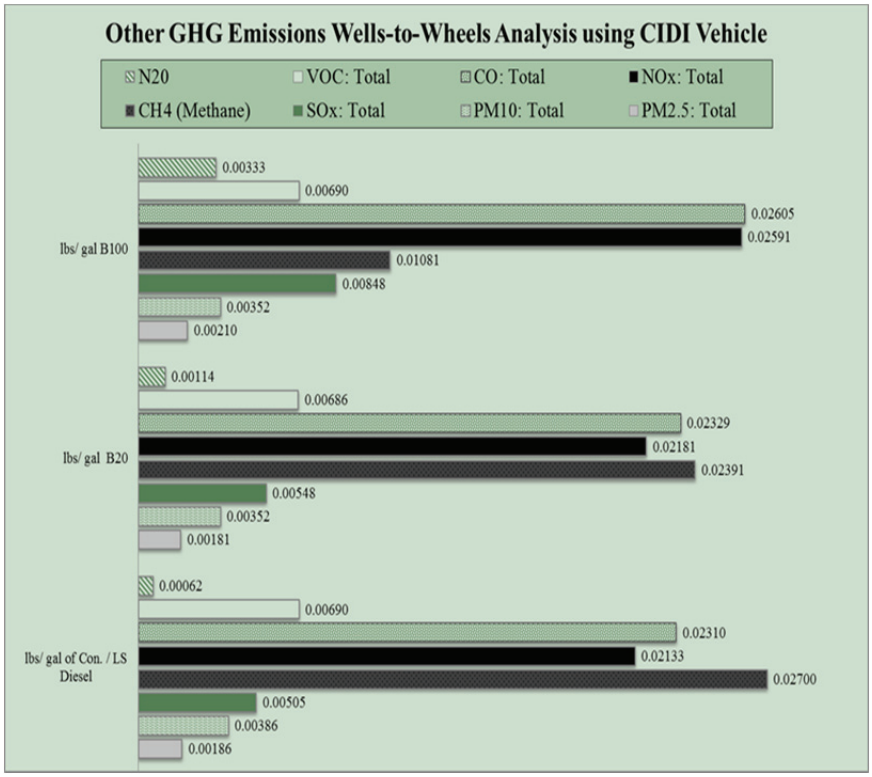

Figure 6: VOC, CO, NO_x, CH4, SO_x, PM10, & PM2.5 emissions using well-to-wheel analysis created from Argonne Greet Model[135]

Even though certain GHG emissions increased when using biodiesel, the drastic drop in methane and PM_{10} offers significant overall GHG emissions reductions as compared to petroleum diesel. Additionally, the increase in certain GHG emissions was so small that they are statistically insignificant. Overall, the Well-to-Wheels analysis shows that as the percentage of biodiesel increases, the GHG emissions that cause hazardous effects to health and environmental decreases.

[135] *Id.*

IV. CURRENT FEDERAL AND STATE LAWS AND THEIR EFFECT TO PROMOTE THE PRODUCTION OF BIODIESEL IN PENNSYLVANIA

A. FEDERAL MANDATES

It is important to look at what federal mandates have been enacted to determine what must be done in regard to biodiesel. Currently there is a federal statute and a corresponding regulation that addresses the required production of biodiesel in the United States. The federal statute's short title is the Energy Independence and Security Act of 2007 ("EISA")[136] and the federal regulation issued by the EPA is known as the Renewable Fuel Standard Program. Below is a review of what each federal mandate requires with regard to biodiesel.

B. ENERGY INDEPENDENCE AND SECURITY ACT OF 2007[137]

EISA was signed into law in 2007 by President George W. Bush.[138] One of the main objectives of EISA was to increase the supply of alternative fuel sources and become less dependent on foreign petroleum.[139] A way for the United States to be less dependent on foreign petroleum is by setting mandatory requirements that transportation fuel sold in the United States must contain a minimum of thirty-six billion gallons of renewable fuels by the year 2022.[140] This includes advanced and cellulosic biofuels (ethanol) and biomass-based diesel.[141]

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[136] 40 C.F.R. § 80.1100 et al. (2008).

[137] 121 Stat. 1492 (2007) (codified as amended at 42 U.S.C. § 7545(o)(2) (2006)).

[138] *Id.*

[139] *Id.* at Preamble ("To move the United States toward greater energy independence and security, to increase the production of clean renewable fuels, to protect consumers, to increase the efficiency of products, buildings, and vehicles, to promote research on and deploy greenhouse gas capture and storage options, and to improve the energy performance of the Federal Government, and for other purposes.").

[140] 40 U.S.C. § 7545(o)(2)(B)(i)(I) (2006).

[141] *Id.* at (IV).

EISA established the required volume for biodiesel for years 2009 through 2012 only.[142] The requirements for the listed years are as follows, 2009—0.5 billion gallons, 2010—0.65 billion gallons, 2011—0.80 billion gallons, and 2012—1.0 billion gallons.[143] Thereafter, the EPA will look thoroughly at the impact of biodiesel production, in coordination with the DOE and USDA, to determine the required volume in future years.[144] EISA mandates, however, that regardless of other factors, the minimum volume for biodiesel shall not be lower than the 2012 year mandate.[145]

Section 211(o) of the Clean Air Act ("CAA") requires the Administrator of the Environmental Protection Agency to annually determine a renewable fuel standard ("RFS"), which is applicable to refiners, importers and certain blenders of gasoline, and publish this standard in the Federal Register.[146] On the basis of this standard, each obligated party determines the volume of renewable fuel that it must ensure is consumed as motor vehicle fuel.[147] This standard is calculated as a percentage, by dividing the amount of renewable fuel that the CAA requires to be used in a given year by the amount of gasoline expected to be used during that year, including certain adjustments specified by the CAA.[148]

C. RENEWABLE FUEL STANDARDS PROGRAM

The national Renewable Fuel Standards Program ("RFS") was developed to increase the volume of renewable fuel that is blended into gasoline and other transportation fuels.[149] As required by the Energy Policy Act of 2005, the EPA finalized RFS Program regulations, effective

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[142] *Id.*

[143] *Id.*

[144] *Id.*

[145] 40 U.S.C. § 7545(o)(2)(B)(ii)–(v) (2006).

[146] *Id.* at (o)(2)(B)(i)(IV).

[147] *See generally id.*

[148] *See id.*

[149] 42 U.S.C. § 7545(o)(2) (2007).

September 1, 2007.[150] EISA increased and expanded this standard.[151] Under EISA, any party that produces fuel for use in the U.S., including refiners, importers, and blenders (other than oxygenate blenders), is considered an obligated party under the RFS Program.[152] Small refineries and refiners are also exempt from the program until 2011.[153] A small refinery is defined as one that processes fewer than 75,000 barrels of crude oil per day,[154] has a total crude capacity of less than 150,000 barrels per day, and employs fewer than 1,500 employees company-wide.

The EPA has formalized the rules for the Renewable Fuels Standard for 2009 in the Federal Register in November of 2008.[155] In this notice the EPA published an RFS of 10.21% for 2009. This standard is intended to lead to the use of 11.1 billion gallons of renewable fuel in 2009, as required by the EISA of 2007."[156] The EPA expects "the 11.1 billion gallons of renewable fuel required in 2009 to include approximately 0.5 billion gallons of biodiesel and renewable diesel."[157] The EPA is required to issue the RFS for the upcoming year by November of the present year.[158] The RFS for each year is expected to correspond with the guidelines issued in EISA.[159]

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[150] 40 C.F.R. § 80.1104 (2008).

[151] See RENEWABLE FUEL STANDARD FOR 2009, 73 Fed. Reg. 70643-01 (EPA Nov. 21, 2008).

[152] 40 C.F.R. § 80.1100(c) (2008).

[153] 42 U.S.C. § 7545(o)(9)(A)(i) (2006 & Supp. I).

[154] 42 U.S.C. § 7545(o)(1)(K) (2006 & Supp. I).

[155] See RENEWABLE FUEL STANDARD FOR 2009, 73 Fed. Reg. 70643-70645 (Nov. 21, 2008).

[156] *Id.*

[157] *Id.*

[158] *Id.*

[159] *Id.*

D. FEDERAL INCENTIVE PROGRAMS

Currently, there are two federal programs that provide incentives for companies working with biodiesel.[160] There is the biodiesel income tax credit for consumers of biodiesel and the Food, Conservation and Energy Act of 2008 that provides funding for new biodiesel production facilities.[161] Below is a brief review of what each incentive provides to further biodiesel production in the United States.

1. BIODIESEL INCOME TAX CREDIT

A consumer that uses pure unblended biodiesel (B100) as an on-road fuel in their trade or business may be eligible for a nonrefundable income tax credit in the amount of $1.00 per gallon.[162] To claim the credit, a certificate from the biodiesel producer or importer must be supplied, identifying the product as biodiesel and that confirms that it is properly registered as a fuel with the U.S. EPA and that it meets the requirements of ASTM specification.[163]

2. FOOD, CONSERVATION AND ENERGY ACT OF 2008 ("FARM BILL")

The Food, Conservation and Energy Act of 2008 provides funding for commodity, rural development, and conservation and energy programs. The legislation authorizes grants and guaranteed backed loans for the construction of bio-refineries in the amount of $920,000,000.[164] In addition, the Farm Bill supports and ensures expanding production capabilities by providing

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[160] Biodiesel credit, 26 U.S.C. § 40A(B)(2) and Small agri-biodiesel producer credit, 26 U.S.C. § 40A(b)(4) (2008).

[161] *Id.*

[162] BIODIESEL AND RENEWABLE DIESEL USED AS FUEL, 26 U.S.C. § 40A(b)(2)(A) (2006 & Supp. II).

[163] *Id.* § 40A(b)(4).

[164] H.R. 2419, 110th Cong. § 9003(a) (2008) (codified as 7 U.S.C. § 8103(a), (c)(1)–(2), (h)(1)–(2) (2006 & Supp. II)).

$400,000,000 over the next four years for the construction of new bio-refineries and retrofitting existing bio-refineries to newest technologies.[165] The Farm Bill stipulates that ninety-five percent of the funding must be made to producers generating less than 150,000,000 gallons of biofuel per year.[166]

E. PENNSYLVANIA MANDATES

The year 2008 was very significant for Pennsylvania citizens because, for the first time, Pennsylvania recognized the need to reduce GHG emissions in the state. The Pennsylvania legislature enacted several statutes designed to reduce dependency on foreign petroleum and increase the use and production of renewable fuels and energy. One of the newly signed laws, the Biofuel Development and In-State Production Incentive Act, No. 78 of 2008, deals specifically with the in-state production of biofuels.[167] The Act provides a series of benchmarks that require increased blending of biodiesel with diesel as the in-state production of biodiesel increases. Below is a brief review of what the law requires.

1. BIOFUEL DEVELOPMENT AND IN-STATE PRODUCTION INCENTIVE ACT—ACT NO. 78, ENACTED JULY 10, 2008

On July 10, 2008, Governor Edward G. Rendell signed into law the Biofuel Development and In-State Production Incentive Act.[168] The Act mandates all diesel fuel sold or offered for transportation in the Commonwealth, contain a percentage of biodiesel one year after in-state production benchmarks have been achieved and sustained for three months.[169] The Pennsylvania Department of Agriculture, in coordination with the Pennsylvania Departments of Transportation ("PennDOT") and Environmental Protection ("DEP"), shall determine in-state production

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[165] *Id.* § 8105(b), (g)(1)(A)–(D).

[166] *Id.* § 8105(g)(3).

[167] 73 P.S. § 1650.1.

[168] Biofuel Development and In-State Production Incentive Act 78 of 2008 § 3(A)(1)–(4); 73 PA. CONS. STAT. § 1650.3(a)(1)–(4) (2008).

[169] *Id.*

capacity and will increase the mandatory blending requirements as capacity reaches the benchmarks established in Act 78.[170] Once the determination has been made to increase the blending requirements, the Department of Agriculture will publish the decision in the PA Bulletin and transmit the information to the majority and minority leaders of both state houses.[171]

The first benchmark of a 2% blend by volume is to be implemented when in-state production of biodiesel reaches 40,000,000 gallons and is sustainable for three months.[172] This first benchmark was achieved in September 2008 and as announced in January 2009.[173] The second benchmark of a 5% blend by volume is to be implemented when production reaches 100,000,000 gallons.[174] The third benchmark of a 10% blend by volume is to be implemented when production reaches 200,000,000 gallons.[175] The last benchmark of a 20% blend by volume is to be implemented when production reaches 400,000,000 gallons.[176] The mandate does not require biodiesel blending for aviation or home heating oil.[177]

F. PENNSYLVANIA INCENTIVES

1. ALTERNATIVE FUELS INCENTIVE FUND

This incentive fund is a broad based plan to provide grants to school districts, municipal authorities, political subdivisions, nonprofit entities, corporations, limited liability companies or partnerships incorporated or

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[170] *Id.*

[171] *Id.* § 1650.3(b).

[172] *Id.* § 1650.3(a)(1).

[173] BIODIESEL MAGAZINE, PENNSYLVANIA BIODIESEL MANDATE TO TAKE EFFECT, BY ERIN VOEGELE, JAN. 15, 2009, http://biodieselmagazine.com/articles/3178/pennsylvania-biodiesel-mandate-to-take-effect.

[174] *Id.* § 1650.3(a)(2).

[175] *Id.* § 1650.3(a)(3).

[176] *Id.* § 1650.3(a)(4).

[177] *Id.* § 1650(f).

registered in this Commonwealth to fund expenses related to retrofitting vehicles to operate on alternative fuels as either a bi-fuel or dedicated vehicle.[178] Additionally, the Act grants funds and rebates for the incremental cost of purchasing a new dedicated alternative fuel vehicle.[179]

A production incentive of 75 cents per gallon for biomass-based diesel produced in the Commonwealth began on July 1, 2008 and ended on June 30, 2011.[180] The biodiesel must be sold in the Commonwealth for commercial transportation purposes only.[181] An individually qualified biomass-based diesel producer shall not receive more than $1,900,000 in incentives in any one fiscal year.[182] All facilities under common ownership are considered to be a single facility.[183] A producer of biomass-based diesel in Pennsylvania must file for the production incentive on a monthly basis on a form furnished by the department.[184] The form requires the producer to submit proof of production of the biomass-based diesel and the number of gallons sold during the previous calendar month and such other information as the department deems appropriate.[185] A biomass-based diesel producer must also submit to DEP, a certificate of analysis from an accredited laboratory to the state for every 500,000 gallons of biomass-based diesel produced, showing that the biodiesel meets the ASTM Specification D6751 to ensure proper standards are maintained in accord with EPA requirements.[186] A qualified producer that receives an incentive under this program is not eligible to receive further incentive under 73 P.S. § 1647.3.[187] Therefore, if this incentive is utilized,

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[178] Alternative Fuels Incentive Act, 73 PA. CONS. STAT. § 1647.3(b)(1) (2008).

[179] *Id.* § 1647.3(b)(1)(B), 1647.3(d).

[180] *Id.* § 1647.3.1(a)(1).

[181] *Id.*

[182] *Id.*

[183] *Id.*

[184] *Id.*

[185] *Id.*

[186] *Id.* § 1647.3.1(a)(2).

[187] *Id.* § 1647.3.1(b).

any future state incentives cannot be used unless an exception would later be provided allowing the combination of incentives by producers.

V. CURRENT MANDATES AND INCENTIVES ARE NOT ENOUGH TO ACHIEVE THE MAXIMUM BENEFITS OF BIODIESEL IN COMMERCIAL AND RESIDENTIAL LIFE IN PENNSYLVANIA TO THEREBY REDUCE GREENHOUSE GAS EMISSIONS FROM DIESEL BURNING SOURCES AND INCREASE ENERGY INDEPENDENCE

The current interest by the U.S. Congress and Pennsylvania Legislature to increase the use of biodiesel as well as other biofuels in order to reduce our dependency on foreign petroleum as well as reduce greenhouse gas emissions is encouraging. But, the mandates and incentives enacted are not sufficient to realize the full potential of biodiesel. When determining the full potential of biodiesel, the current mandates and incentives must be weighed against the overall reduction in greenhouse gas emissions that will be realized under those requirements.

Looking at the mandates first, the current federal requirement, as stipulated by EISA, required only 0.5 billion gallons of biodiesel production nationwide for year 2009 and will increase by 150 million gallons each year until 2012.[188] During the year 2012, production must increase by 200 million gallons.[189] Even though this seems to be a large quantity, the 2009 mandate only accounts for about 1.9% of the total consumption of diesel fuel consumed in the United States as of year 2009.[190] On a positive note, total biodiesel production in the United States in 2009 was a little over 0.5 billion gallons.[191] Hence, the biodiesel industry has already exceeded the requirements of EISA. Moreover, according to the National Biodiesel Board, potential production capacity reached 2.69 billion gallons per year as of June

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[188] 42 U.S.C. § 7545(o)(2)(B)(i)(IV) (2011).

[189] 42 U.S.C. § 7545(o)(2)(B)(i)(IV) (2011) calendar year 2012—year 2011—1.0 billion gallons—.80 billion gallons = 200 million gallons.

[190] http://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=C290000001&f=A.

[191] http://www.eia.gov/cneaf/solar.renewables/page/biodiesel/biodiesel.pdf.

2009.[192] With the ability to produce more than twice the required 2012 production as mandated in EISA, the current law does little to encourage more growth in this sector.

Upon closer inspection of the Pennsylvania Biofuel Development and In-State Production Incentive Act, it is clear that Pennsylvania is attempting to encourage growth in the biofuel sector by requiring a percentage of biodiesel to be blended with diesel once certain criteria are met. Unfortunately, the mandates are only triggered as the industry grows to the required and work towards incremental benchmarks, but the benchmarks Pennsylvania has set are too low, too spread out, and based on a three month sustainable production level before the next increase in biodiesel blending requirements is mandated. Essentially, the legislation requires biodiesel production sites to double their current facilities' capacity or build twice the number of plants to reach each new benchmark.

Looking at both mandates together, the federal mandate has little effect on the current growth of the industry and the state mandate is highly unattainable in its current formulation. Furthermore, the federal mandate only requires a certain amount of biodiesel be produced each year. There are currently no federal statutes requiring a percentage of biodiesel to be blended with petroleum-based diesel. On a national scale, it is difficult to determine how much reduction in greenhouse gases is currently being achieved because state laws governing the percent of biodiesel to be blended with petroleum diesel vary greatly. At the state level, some states do not require the use of biodiesel at all, while other states, like Illinois, allow, but do not require biodiesel blended above eleven percent (B11) to be sold tax-free.[193] Additionally, because the Pennsylvania mandate requires blending only when certain benchmarks in production are reached, and allows a large gap between the benchmarks and increased percentage blending requirements, the law virtually ensures meaningful greenhouse gas emission reductions from the use of biodiesel in Pennsylvania will be many years away. The past federal

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[192] National Biodiesel Board—U.S. Biodiesel Production Capacity, http://www.biodiesel.org/pdf_files/fuelfactsheets/Production_Capacity.pdf.

[193] 35 ILCS 105/3-10 (2011)—tax free if over 10% on sales made between July 1, 2003 till December 31, 2013.

and current state per gallon credits for the production and usage of Biodiesel were likely the only real reason why production of biodiesel continued to rise until 2008. Since the economic downturn in 2008, production has continued to fall.

Combining both incentives together, Pennsylvania biodiesel producers were able to take a total of $1.75 credit for each gallon of biodiesel produced.[194] These credits helped bring the cost per gallon closer in line with diesel fuel prices, but left them still slightly higher. Unfortunately since the federal credit of $1.00 expired on December 31, 2009, a gallon of biodiesel became even more expensive and producer incentives were reduced to the state offered $0.75 credit.[195] The expiration of this incentive was mandated by law and did not account for other economic conditions such as the recent downturn of world economies or the current production of biodiesel. For the consumer, there is an incentive to use biodiesel with a $1.00 income tax credit for each gallon of pure B100 biodiesel used. However, at this time very few people can take advantage of this credit because the majority of manufacturers will not warrant engines that are damaged while using a blend of biodiesel higher than B20.

The Farm Bill is another federal incentive enacted to offer grants and loans for the construction of new biodiesel production plants.[196] As of 2009, 173 biodiesel production facilities were located in the United States.[197] One of the many features of the Farm Bill is to increase the number of new sites producing biodiesel.[198] With funding available from the Farm Bill, roughly 13 new facilities could be built, capable of generating about 45 million

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[194] Pennsylvania 1. Alternative Fuels Incentive Fund—$0.75 (see Alt. Fuels Incentive Act, *supra* note 178) + Federal 1. Biodiesel Income Tax Credit $1.00 (see Biodiesel Used as Fuel, *supra* note 162).

[195] Which expired on June 30, 2011—Pennsylvania 1. Alternative Fuels Incentive Fund—$0.75 (see Alt. Fuels Incentive Act, *supra* note 178).

[196] See H.R. 2419, *supra* note 164.

[197] NATIONAL BIODIESEL BOARD—U.S. BIODIESEL PRODUCTION CAPACITY, http://www.biodiesel.org/pdf_files/fuelfactsheets/Production_Capacity.pdf.

[198] See H.R. 2419, *supra* note 164.

gallons per year of biodiesel, at a cost of $67.5 million each.[199] This would increase the total number of plants nationally by 7.5% and would increase the total production capacity in the United States by 585,000,000 gallons.[200] The size of these facilities would be equivalent to Pennsylvania's largest producer, HeroBX, located in Erie, Pennsylvania, which has the capacity to generate 45 million gallons per year (Mgy) of biodiesel.[201] If all funding from the Farm Bill is used for larger capacity facilities (75–80 million gallons per year), about six new facilities could be built at a cost of $144 million for each facility.[202] This would increase the number of facilities by 3.5% and would increase the total gallons of biodiesel that could by produced by only 480,000,000 gallons per year.

Because all of the funding will not go to any one state, but will be spread out across the country, this will be a benefit to the national biodiesel production capacity, but will not do enough to help Pennsylvania with production. Unless Pennsylvania is fortunate enough to have new companies that receive the funding interested in building and producing biodiesel in the state, the funding will do little to help in-state production.

VI. PROPOSED LEGAL STEPS TO MAXIMIZE GHG EMISSION REDUCTIONS USING BIODIESEL IN PENNSYLVANIA

A. PROPOSED LEGAL MANDATES

The state should enact new legislation requiring a mandatory blending level of twenty percent to be effective in two years. This would allow the

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[199] 13 * $67.5 million = $877.5 million—under the farm bill—funding was authorized for $75 million + $245 million and an additional $150 million for years 2009 through 2012. Total $920 million available.

[200] 45 million gallons per year per plant x 13 plants = 585 million gallons more production capacity.

[201] http://www.herobx.com/HERO-BX-Profile/HERO-BX-Plant.php, plant capable of 136,000 gallons per day x 365 = 49,640,000 gallons possible each year.

[202] 6 new facilities x $144 = $865 million—under the farm bill—funding was authorized for $75 million + $245 million and an additional $150 million for years 2009 through 2012. Total $920 million available.

needed time to fund and build additional facilities and ensure there is time to retrofit existing equipment and allow manufacturers to adhere to the new requirements. The legislation should require only B20 to be sold in Pennsylvania for automobile use and for home fuel oil needs. This would be an increase from the current requirement of B2 blending that became effective in January 2010. Additionally, this would include home fuel oil consumption, which is exempt under current legislation.

By increasing the blending requirement to B20, 14 new 45 Mgy biodiesel production facilities would need to be constructed to meet the additional 589,814,400 gallons of biodiesel needed to blend into B20 fuel. With the additional facilities, the total Pennsylvania production capacity would increase to 650,714,400 gallons. Because the B20 standard would be mandatory, this would spur incentive from investors to offer capital for some of these new facilities. By changing to a B20 standard, the state would realize an approximately 16% or 11,234,746,943 lbs/gal (5,617,373 short tons) CO_2 reduction per year.[203] Additionally, this would reduce overall GHG emissions from diesel vehicles by 15% or 10,981,966,647.00 lbs/gallons (5,490,983 short tons) total GHGs per year.

The legislation should also mandate automobile and equipment manufacturers honor warranties when B20 or higher biodiesel is used starting with the 2011 model year. Since the state has a legitimate state interest in reducing GHG emissions and protecting its citizens from invalidation of automobile warranties, the legislature would use its inherent power to mandate such a requirement and would not be in danger of violating the dormant commerce clause ("DCC"). Since this piece of legislation would affect all automobile and equipment manufacturers selling goods in Pennsylvania, this could be seen as protectionist under the DCC. When determining whether legislation is in violation of the DCC, the Supreme Court looks to see if the statute has an incidental effect on interstate commerce. This includes a balancing test to determine whether the burden on

[203] *See* Jonathan Johnson, *Striving for Greenhouse Gas Mitigation in Pennsylvania: How Law and Biodiesel Can Play a Part*, *in* SELECTED WORKS (2010). Fuel consumption calculations based on 2007 levels and emission results for GREET model analysis performed by Jonathan Johnson in 2009.

commerce is clearly excessive relative to putative local benefits. The presumption is the statute will be upheld unless shown to be excessive.[204] In this case, the statute would not impose an excessive burden on manufacturers to meet the state requirements. Currently, many manufacturers honor their warranties to a certain percentage of biodiesel. Furthermore, the state has a very important interest in protecting the health and environment of Pennsylvania. Lastly, the statute would not be designed as a protectionist statute that would favor in-state manufacturers of goods.

Opposition to this increase to a B20 standard will argue that B20 and higher blends have a higher clouding point than diesel and due to the cold harsh winters in Pennsylvania, they will be unable to operate the necessary trucks and equipment. However, as discussed earlier,[205] technology is already used and available to the public to mitigate this issue.

B. PROPOSED LEGAL INCENTIVES

Since the B20 standard would be mandatory, this would affect all citizens. To alleviate the potential adverse economic impacts and incite a demand for changes, incentives would have to be provided. A simple search of biodiesel conversion kits, which would allow a vehicle built to run on diesel to efficiently use biodiesel, shows that the average cost is approximately $1,500 to $2,000.[206] The legislation should provide a state rebate of approximately $2,000 to $3,000 toward initial maintenance when modifying an existing vehicle to B20 compatibility or when the consumer purchases a new B20 compliant vehicle. This would include any necessary equipment to prevent clouding of the fuel during the cold winter months, which normally costs approximately $200 plus installation. Funding for this rebate is already available through the state Alternative Fuels Incentive Fund.[207] The Fund would need to be amended to include this specific

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[204] Pike v. Bruce Church, Inc., 397 U.S. 137, 142 (1970).

[205] Johnson, *supra* note 203, at 8–9.

[206] http://www.organicmechanic.com/Diesel-Conversion-Kit/; http://www.greasecar.com/products/greasecar-truck-kits; http://www.modernconversions.com.

[207] 73 PA. CONS. STAT. § 1647.3(b)(ii), (iv), (d) (2008).

purpose, but this should not be an issue as this addition is in accordance with the purpose of the fund.

C. PROPOSED BIODIESEL WORKING GROUP

The legislation should create a working group within thirty days of this legislation's effective date to study the impact on fueling stations and what would be required to renovate existing infrastructure. The working group should report its findings and recommendations to the legislature within eight months.

D. PROPOSED FUTURE STUDIES

Legislation should mandate a study to determine the feasibility of increasing the blend of biodiesel to higher percentages in the next few years. This study should look at emerging technologies that increase efficiency and reduce energy and GHG emissions. Ultimately the study should conduct a final determination on the ability to use glycerin to make ethanol on a larger scale. The participants of this study should include state agencies, state universities and businesses in the private sector. Grants should be awarded to conduct these studies.

VII. CONCLUSION

Looking at the cumulative effect of all federal and state biodiesel mandates and incentives, it is clear that no single approach is doing enough to bring about the maximum benefits possible. It is also clear that greenhouse gas emissions from diesel-burning sources will not be reduced unless something is done now. Based on the cost-benefit analysis of switching to biodiesel, the Pennsylvania legislature should take additional steps to achieve the maximum reduction in GHG emissions from diesel use. The state should impose new legislation requiring a mandatory blending of twenty percent biodiesel with regular petroleum diesel (B20) to be effective in two years. The legislation should require only B20 to be sold in Pennsylvania for both automobile use and home fuel oil needs.

Every year that Pennsylvania waits to increase the standards and incentives for biodiesel usage is another year of ever increasing GHG emissions, lost opportunity in mitigation, and increased difficulty in curbing further adverse climate change effects on the state. Every year of delay

decreases the chances of successful in-state biodiesel production facilities and stunts the growth of emerging technologies. By switching to B20 in two years, Pennsylvania will realize an immediate fifteen percent reduction in GHG emissions. This has the potential to increase the air quality and reduce harmful health-related issues. With the proposed legislation, Pennsylvania will be well on its way to becoming independent in its diesel fuel needs.