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From Gray to Green—Using Algal Biofuels to Change the Energy Landscape of Southwestern Pennsylvania

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INTRODUCTION

Since the dawn of the industrial age, southwestern Pennsylvania has been a leader in new energy production methods.[1] Pennsylvania led in coal production for more than 200 years, was responsible for half of the world's oil production through the early 1900s, and is currently probing ways to effectively utilize natural gas from the Marcellus Shale formation.[2] Amidst the shifting views on optimal energy sources, biofuel advocates are urging that they become top priority for a variety of environmental, economic, and social reasons. The undesirable reliance on non-renewable fossil fuels, the concerns over greenhouse gas emissions and global warming, along with the social desire to increase energy security by decreasing dependence on foreign oil, all bolster the desire to utilize alternative fuel sources.[3] With the assistance of state and local legislatures, southwestern Pennsylvania can lead the country in the production and utilization of the next leading energy source—algal biofuels.

Part I of this article describes the history of southwestern Pennsylvania's energy projects. Part II provides an overview of major alternative fuel sources and discusses why algal fuels stand out from other alternative energy sources as the best option. Part III describes recent federal and state incentives developed to assist in the development of these alternative fuels. Part IV describes why southwestern Pennsylvania is poised to lead the algal biofuels market. Lastly, Part V explains ways in which local and state legislatures can help make this goal a reality.

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[1] *Western Pennsylvania's Long History of Energy Production*, POPULAR PITTSBURGH, http://www.popularpittsburgh.com/pittsburgh-info/pittsburgh-history/pittsburghenergy.aspx (last visited Oct. 21, 2013) [hereinafter *History of Energy Production*].

[2] *Id.*

[3] *The Disadvantages of Oil*, FOSSIL FUEL RESOURCES, http://fossil-fuel.co.uk/oil/the-disadvantages-of-oil (last visited Oct. 21, 2013).

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I. HISTORY OF SOUTHWESTERN PENNSYLVANIA'S ENERGY LANDSCAPE

Major energy advancements in southwestern Pennsylvania over the past 300 years have involved the use of coal, oil, and natural gas from various sources. There are advantages and disadvantages to each of these sources.

A. Coal

Active bituminous coal mines have been in operation in Pennsylvania since the late 1700s.[4] The first coal mined in Pennsylvania was procured from Coal Hill in Mount Washington.[5] Over the last 200 years, more than ten billion tons of bituminous coal has been mined from twenty-one western Pennsylvania coal-mining counties.[6] This amount represents one-fourth of all coal mined in the country.[7] In fact, use of coal to heat homes and run the steel manufacturing was so significant that Pittsburgh was nicknamed "The Smoky City" and "Hell with the Lid Taken Off."[8]

Currently, coal provides "forty percent of all electricity and twenty-one percent of all energy in the United States (US)."[9] Proponents of coal usage as a primary energy source argue that it is the only source of obtainable energy that is sufficiently abundant and inexpensive enough to sustain our energy needs.[10] New "clean coal" approaches also enable the utilization of coal with less of a detrimental impact on the environment because these approaches involve stripping the carbon dioxide out of the coal.[11] Yet, history has shown that coal is no longer the primary energy source for a variety of reasons including: 1) it emits an enormous amount of carbon dioxide; 2) it is nonrenewable; 3) is the second highest emitter of methane,

[4] *History of Energy Production*, *supra* note 1.

[5] *Id.*

[6] *Id.*

[7] *Id.*

[8] Angela Gugliotta, "Hell with the Lid Taken Off": A Cultural History of Air Pollution—Pittsburgh (Dec. 15, 2004) (published Ph.D. dissertation, University of Notre Dame), http://etd.nd.edu/ETD-db/theses/available/etd-12152004-121352/unrestricted/gugliottaangela.pdf. *See also EIA's Energy in Brief: What are the Major Sources and Users of Energy in the US*, U.S. ENERGY INFORMATION ADMINISTRATION (Aug. 1, 2013), http://www.eia.gov/energy_in_brief/article/major_energy_sources_and_users.cfm [hereinafter *EIA's Energy in Brief*].

[9] RP Siegel, *Clean Coal: Pros and Cons*, TRIPLE PUNDIT (Apr. 9, 2012), http://www.triplepundit.com/2012/04/clean-coal-pros-cons/.

[10] *Id.*

[11] *Id.*

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a potent greenhouse gas; 4) during production coal releases more radiation than nuclear plants; 5) burning coal emits mercury and other heavy metals; and 6) "clean coal" is not "carbon free."[12] These reasons suggest that coal is not the ultimate answer to the energy needs of the United States.

B. Oil

Western Pennsylvania also has a long history of oil production.[13] In 1859, oil was struck in Titusville, resulting in a regional oil boom, which is reflected in town names such as "Oil City" and "Petroleum Center."[14] In fact, the Titusville area was responsible for nearly half of the world's oil production up until the Texas oil boom of the early 1900s.[15]

With thirty-six percent of all energy needs depending on oil, it is currently the primary energy source in the United States.[16] Oil also provides ninety-three percent of the energy used for transportation.[17] Numerous problems with oil exist, however, regarding supply, environmental concerns, and production issues.[18] Specifically, our nations' dependency on oil coupled with rising demand in other countries could lead to shortages in production.[19] Even though oil is relatively easy to store and transport and is cleaner and easier to burn than coal, it is non-renewable and generates greenhouse gases when burned.[20] Lastly, the risks associated with the continued expansion of oil production from conventional sources include: "political instability in the Middle East and North Africa, the resurgence of resource nationalism in Latin America, civil unrest in Nigeria, piracy off the African coast, transit vulnerability in the Caspian, energy subsidies in Asia, extreme weather around the world, and restricted access to resources in the United States."[21]

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[12] *Id.* (stating the Environmental Protection Agency ("EPA") estimates that coal contributes to thirty-one percent of all carbon dioxide (CO_2) emitted).

[13] *History of Energy Production*, *supra* note 1.

[14] *Id.*

[15] *Id.*

[16] *EIA's Energy in Brief*, *supra* note 8 (stating that energy needs are met by twenty-seven percent natural gas, eighteen percent coal, nine percent renewable energy, and eight percent nuclear electric power).

[17] *Id.*

[18] *Our Energy Sources, Oil*, THE NATIONAL ACADEMIES, http://needtoknow.nas.edu/energy/energy-sources/fossil-fuels/oil/ (last visited Oct. 21, 2013).

[19] *Id.*

[20] *The Disadvantages of Oil*, *supra* note 3.

[21] ENERGY TOMORROW, http://gaspricesexplained.org/ (last visited Oct. 25, 2013).

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Comparable to coal, the inherent problems of oil usage suggest that the United States should consider other energy sources to satisfy its needs.

C. Natural Gas

The recent discovery of the gigantic natural gas reserves of the Marcellus Shale formation is predicted to place Pennsylvania again at the forefront of energy production.[22] Governor Tom Corbett recently stated, "We are the Saudi Arabia of natural gas."[23] In 2012, the U.S. Energy Information Administration ("EIA") estimated that Pennsylvania's Marcellus Shale formations had 141 trillion cubic feet of recoverable gas.[24]

Natural gas is being hailed as the solution to current energy problems for a number of reasons. A delivery infrastructure for natural gas already exists, it is the cleanest of all fossil fuels, and it burns efficiently, is in abundant supply, and releases low levels of pollutants.[25] The disadvantages of natural gas include: 1) it is non-renewable; 2) it emits methane, a potent greenhouse gas; 3) it is explosive; and 4) it is not easily transported.[26] There are also a significant number of environmental risks associated with fracking,[27] which include water pollution, straining of nearby water sources through water intensive processes, air and noise pollution, and risks from naturally occurring radioactive materials that can be brought to the surface by drilling equipment and fluids.[28]

A common theme with all of these energy sources is that they are non-renewable and can be very costly, both in price per unit and in their effects on the environment. These issues have driven researchers to seek out alternative means of obtaining energy.

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[22] *History of Energy Production*, *supra* note 1.

[23] *Id.*

[24] *Annual Energy Outlook 2012*, U.S. ENERGY INFORMATION ADMINISTRATION (June 2012), http://www.eia.gov/forecasts/aeo/pdf/0383(2012).pdf.

[25] RP Siegel, *Natural Gas: Pros and Cons*, TRIPLE PUNDIT (Apr. 3, 2012), http://www.triplepundit.com/2012/04/natural-gas-pros-cons/.

[26] *Id.*

[27] *Hydraulic Fracturing Background Information*, EPA, http://water.epa.gov/type/groundwater/uic/class2/hydraulicfracturing/wells_hydrowhat.cfm (last updated May 9, 2012) (stating fracking or hydraulic fracturing is the forcing open of fissures in subterranean rocks by introducing liquid at high pressure to extract gas).

[28] *The Marcellus Shale-America's Next Super Giant*, CATSKILL MOUNTAINKEEPER, http://www.catskillmountainkeeper.org/our-programs/fracking/marcellus-shale/ (last visited Oct. 25, 2013).

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II. ALTERNATIVE FUELS: AN OVERVIEW

The Energy Policy Act of 1992 defines an "alternative fuel" as one of the following:

> Biodiesel; Natural gas and liquid fuels domestically produced from natural gas; Propane (liquefied petroleum gas); Electricity; Hydrogen; Blends of 85% or more of methanol, denatured ethanol, and other alcohols with gasoline or other fuels; Methanol, denatured ethanol, and other alcohols; Coal-derived, domestically produced liquid fuels; Fuels (other than alcohol) derived from biological materials; P-Series fuels.[29]

While many of these are advantageous over non-renewable energy sources, some of these sources are more promising than others. One promising alternative fuel that has garnered much press in the past few years is fuel that is derived from biological materials.

A. Plant Materials (Corn, Sugarcane, Wood, Grasses)

Corn ethanol has been touted as one of the most promising alternative fuels in the United States, largely due to its huge environmental perks.[30] Specifically, corn ethanol is a renewable resource that burns cleaner than gasoline, emitting twenty percent fewer heat-trapping gases.[31] Unfortunately a number of problems exist with corn usage, including: 1) competition between food and fuel for crops; 2) natural habitat destruction; 3) high water and nitrogen fertilizer usage; and 4) system inefficiencies.[32] Currently, environmental inspectors in Iowa are concerned with the breadth of the variety of air, water, and soil violations resulting from the

[29] *Alternative Fuels Data Center: Alternative Fuels and Advanced Vehicles*, U.S. DEPARTMENT OF ENERGY, http://www.afdc.energy.gov/fuels/index.html (last updated Jan. 17, 2013) [hereinafter *Fuels Data Center*].

[30] Perry Beeman, *Biofuel Plants Generate New Air, Water, Soil Problems for Iowa*, THE DES MOINES REGISTER (June 1, 2007), http://www.desmoinesregister.com/article/20070603/BUSINESS01/706030325/Biofuel-plants-generate-new-air-water-soil-problems-Iowa.

[31] *Id.* (stating that heat-trapping gases accumulate in the atmosphere and allow less energy or heat to escape into space, resulting in overheating).

[32] Heather Hunziker, *Finding Promise in Pond Scum: Algal Biofuels, Regulation, and the Potential for Environmental Problems*, 42 TEX. ENVTL. L.J. 59, 60–61 (Fall 2011) (stating that nitrogen fertilizer usage can create "dead zones" in coastal waters where the fertilizer accumulates from runoff).

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conversion of corn to ethanol.[33] There is also a concern that weather factors like heavy rains, flooding, and cooler temperatures could lead to lower yields and drive prices higher.[34] Additionally, there is a fear that increased demand of crops, especially corn, for biofuels will increase the price such that farmers and ranchers who use corn for animal feed will pay much more for the feed, causing the cost of meat to greatly increase.[35] An additional hurdle for corn, sugarcane, and other grasses is insufficient farmland available to handle a large increase in their demand.[36] These problems suggest that alternative fuel proponents should look for a different starting material.

B. Algae

1. Advantages

Recent research suggests that algae may be the answer for the starting material problem.[37] First, algae biomass can be processed into ethanol or other hydrocarbons, which can be processed into biodiesel, and the biomass can also be modified to produce valuable co-products.[38] These co-products include animal feed, fertilizers, bioplastics, and nutraceuticals.[39] Per unit area, algae has a higher productivity compared to other materials, it grows extremely fast, with its biomass doubling within a day, and it can grow on land incapable of producing crops.[40]

The use of algae for biofuels will benefit the environment.[41] The ability of algae to convert carbon dioxide into biomass can help balance greenhouse emissions and prevent global warming.[42] Since algae uses nitrogen and phosphorus compounds as nutrients, it can be used for biofuels production while

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[33] Beeman, *supra* note 30.

[34] *Ethanol's Forecast*, MIT TECH. REV., http://www.technologyreview.com/news/410263/ethanols-forecast/ (last visited Oct. 25, 2013).

[35] *See* Hunziker, *supra* note 32, at 60.

[36] *Id.* at 66.

[37] VIOLETA MAKAREVICIENE ET AL., BIODIESEL FUEL FROM MICROALGAE-PROMISING ALTERNATIVE FUEL FOR THE FUTURE: A REVIEW, REVIEW IN ENVIRONMENTAL SCIENCE AND BIOTECHNOLOGY 120 (2013).

[38] Hunziker, *supra* note 32, at 64.

[39] *Id.* at 65.

[40] MAKAREVICIENE ET AL., *supra* note 37.

[41] Hunziker, *supra* note 32, at 66.

[42] *Id.*

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simultaneously removing pollutants from wastewaters.[43] In fact, algae farms could be integrated with power plants and other stationary sources of emissions to capture and mitigate the carbon dioxide from fuel gas and other origins.[44] Algal biodiesel is one of the only avenues available for high volume re-use of carbon dioxide generated in power plants, but it could also be employed at cement and chemical plants, oil refineries, and petroleum-processing plants, all of which together represent over half of Americans' annual carbon dioxide emissions of more than six billion metric tons."[45]

Algal biofuel production, as discussed, also produces plentiful and useful co-products, which range from fertilizers to animal feed, coloring agents to cosmetics, biodegradable plastics to surfactants, and pharmaceuticals to health food supplements.[46] Several of these are high-value products are valued at $0.30–$1.00 per pound.[47] These products can assist in making algal biofuel production cost effective.[48] Hence, the sheer variety of fuels and co-products available from algae give it a significant advantage over other biofuel materials.

2. Disadvantages of Algal Biofuels and Future Work

While algal biofuels have a number of advantages over other fuel sources, some issues must be resolved. One fear is that non-native or genetically modified algae will somehow be released into the wild—either intentionally or through accidental discharge.[49] Even though closed systems may be used, total filtration may be extremely difficult due to algae's minute size.[50] Additionally, some strains can be transported in the air or on employees' skin and survive a variety of harsh conditions in their dormant stages.[51] Concerns regarding potential algae "escape" have multiple aspects, many of which are part of the larger debate about genetically

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[43] *Id.*

[44] *Id.* at 66.

[45] Hunziker, *supra* note 32, at 66.

[46] *Id.* at 67 (stating that one particularly popular health food supplement is vitamin-rich spirulina).

[47] *Id.*

[48] *Id.*

[49] *Id.* at 76 (discussing further how algal release into the wild raises two fears, one being "gene pollution" in which native plants are given modified traits from the algae, resulting in unforeseen and potentially undesirable effects, and the second being the possibility that the algae or affected native species could become invasive and destroy the natural habitat).

[50] Hunziker, *supra* note 32, at 76.

[51] *Id.* at 76.

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modified organisms ("GMOs") in general.[52] Other worries include: protecting algae from attack by fungi, rotifers, viruses, or other predators;[53] the large water requirement;[54] and the ability of fuels derived from algae to flow well at lower temperatures ("cold flow" problems).[55] Lastly, because the methodology of generating fuels is still in the development process, additional funds need to be invested into optimizing the methodology, determining the superior algal strain(s) to be used, defining the best growing system, and selecting the best co-products to produce.

III. LEGAL INCENTIVES FOR ALTERNATIVE FUELS

A. Federal Incentives

There are a few key federal incentives that have helped advance biofuels technologies. These include Advanced Energy Research Project Grants, Advanced Biofuel Production Payments, and Advanced Biofuel Production Grants and Loan Guarantees.[56] One concern with these incentives is that they are all subject to congressional appropriations.[57] With the uncertainty regarding the federal budget and how much money will be dedicated towards these federal incentives,[58] local biofuels companies need to look for additional assistance elsewhere. State and local legislatures could therefore greatly assist in the advancement of biofuels projects by developing additional incentives.

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[52] *Id.*

[53] Mike Janes, *Better Monitoring and Diagnostics Tackle Algae Biofuel Pond Crash Problem*, RENEWABLE ENERGY WORLD (Apr. 11, 2013), http://www.renewableenergyworld.com/rea/news/article/2013/04/better-monitoring-and-diagnostics-tackle-algae-biofuel-pond-crash-problem.

[54] Mose Buchele, *The Downside of Using Algae as a Biofuel*, NPR (Dec. 17, 2012), http://stateimpact.npr.org/texas/2012/12/17/the-downside-of-using-algae-as-a-biofuel/ (stating that the large water requirement would only apply to algae that are not grown in a salt-water environment).

[55] Tracey Schelmetic, *Biofuel from Algae Part One: The Pros and Cons of Pond Scum*, THOMASNET NEWS (Feb. 19, 2013), http://news.thomasnet.com/green_clean/2013/02/19/biofuel-from-algae-part-one-the-pros-and-cons-of-pond-scum/ (stating that "Cold flow" problems refer to the inability of many algal fuels to flow well at lower temperatures, likely because they contain relatively high amounts of saturated and polyunsaturated fatty acids).

[56] *Alternative Fuels Data Center: Federal Laws and Incentives*, U.S. DEPARTMENT OF ENERGY, http://www.afdc.energy.gov/fuels/index.html (last visited Oct. 25, 2013).

[57] *Id.*

[58] *See A Roadmap to the 2013 Federal Budget Debates*, NATIONAL WOMEN'S LAW CENTER (May 17, 2013), http://www.nwlc.org/resource/roadmap-2013-federal-budget-debates#Sequester for a roadmap of the 2013 federal budget debates, including a discussion of the appropriations bills and sequestration.

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B. Recent Pennsylvania State Incentives

In the past few years, the Pennsylvania legislature passed seven incentives to assist in the development and use of alternative fuels.[59] These include the Alternative Fuels Vehicle (AFV) Rebate Program, Natural Gas Vehicle (NGV) Grants, Small Business Advantage Grant Programs, the Small Business Pollution Prevention Assistance Account Loan Program, Alternative Fuel Development and Deployment Grants, the Pennsylvania Energy Harvest Grant, and an Idle Reduction Weight Exemption.[60] While these incentives are a step in the right direction, many of the incentives do not go far enough because they primarily assist technologies that are fully developed and ready to be implemented into existing vehicles. For example, the AFV program only provides rebates to consumers who purchase new plug-in hybrid, plug-in electric, natural gas, propane and hydrogen fuel cell vehicles.[61] The NGV grants provide funding to municipal and commercial fleets for the purchase or conversion of NGVs.[62] Unfortunately, algal biofuels production is not at the point where the public can effectively put it into use.[63] More work in terms of basic research and increased scale of production is required before these algal biofuels can be commercially available.

IV. SOUTHWESTERN PENNSYLVANIA IS POISED TO BE A LEADER IN THE BIOFUELS MARKET

A. The Support Infrastructure Is Available

Southwestern Pennsylvania is unique in that it already has an infrastructure that is supportive and capable of assisting algal biofuel companies with research and with scaling up production.[64] The regions' infrastructure includes interest groups such as Steel City Biofuels, "[a] new project of the Pennsylvania Resources Council that is building the awareness, policy, and infrastructure necessary for the

[59] *Alternative Fuels Data Center: Pennsylvania Laws and Incentives*, U.S. DEPARTMENT OF ENERGY, http://www.afdc.energy.gov/fuels/index.html (last visited Oct. 25, 2013).

[60] *Id.*

[61] *Alternative Fuels Data Center: Alternative Fuel Vehicle (AFV) and Hybrid Electric Vehicle (HEV) Funding*, U.S. DEPARTMENT OF ENERGY, http://www.afdc.energy.gov/fuels/index.html (last visited Oct. 25, 2013).

[62] *Alternative Fuels Data Center: Natural Gas Vehicle (NGV) Grants*, U.S. DEPARTMENT OF ENERGY, http://www.afdc.energy.gov/fuels/index.html (last visited Oct. 25, 2013).

[63] Schelmetic, *supra* note 55.

[64] *About Us*, STEEL CITY BIOFUELS, http://www.omnibydesign.com/steelcity/aboutus.html (last visited Oct. 25, 2013).

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widespread production and use of biofuels in South Western PA."[65] This foundation is a diverse network of "partnerships linking individuals, farmers, schools, non-profits, community organizations, businesses, and governmental agencies" to pursue their mission of finding clean, renewable, and local alternatives to petroleum fuels.[66] The University of Pittsburgh and Carnegie Mellon University are both well-known research institutions that have researchers already working on the development of biofuels; they can provide potential expertise assistance and/or collaboration.[67] Since no single business entity has become the dominant force in the algal biofuels market, there remains a great opportunity for start-ups or smaller companies to establish themselves as leaders in this market. Southwestern Pennsylvania provides a great environment for this. Pittsburgh has been repeatedly recognized as having a great start-up environment due to its many start-up accelerators or incubators, well-known research universities, and inexpensive costs of doing business.[68]

B. Some Local Businesses Are Already Making Efforts to Translate Research into Marketable Products

Having seen the promise in southwestern Pennsylvania, some businesses are already attempting to make algal biofuel production a reality here.[69] U.S. Alternative Fuels, a company based out of Johnstown, Pennsylvania, hopes to soon operate on a commercial scale to make crude oil from algae.[70] Importantly, they will utilize our area's unique environmental landscape, thereby producing fuel while also cleaning the environment.[71]

Specifically, U.S. Alternative Fuels hopes to tackle the problem of Abandoned Mine Discharge ("AMD"), one of many environmental problems caused by coal mining and production.[72] Although Pennsylvania has a rich

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[65] *Id.*

[66] *Id.*

[67] *About U.S. Alternative Fuels Corporation*, US ALTERNATIVE FUELS CORP., http://amd2energy.com/about-us (last visited Oct. 25, 2013); *Biofuels*, EPA, http://www.epa.gov/nrmrl/std/biofuels.html (last updated Oct. 22, 2012).

[68] *Pittsburgh Waves in the Atlantic*, STARTUPTOWN (Sept. 28, 2012), http://www.startuptown.org/the-atlantic-in-pittsburgh/.

[69] Randy Griffith, *Firm Says It's Making Crude Oil from Algae*, THE TRIBUNE-DEMOCRAT (Oct. 20, 2012), http://tribune-democrat.com/local/x699457777/Firm-says-it-s-making-crude-oil-from-algae.

[70] *Id.*

[71] *Id.*

[72] *About U.S. Alternative Fuels Corporation*, *supra* note 67.

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economic and cultural legacy associated with coal mining, this unfortunately means that Pennsylvania must also deal with abandoned mines, which often leak acid, heavy metals, and other pollution into nearby waters.[73] It is estimated that more than 4,000 miles of Pennsylvania streams are effectively "dead" because of AMD.[74] Many others are too polluted to support human needs for safe drinking water or family activities.[75] U.S. Alternative Fuels recognized that the discharge from these sites might offer an even better algal growth environment.[76] These sites already contain high levels of carbon dioxide, which normally must be separately added during biofuel production, and contain heavy metals that can be used to produce other products.[77] By working with these sites, U.S. Alternative Fuels hopes to "[transform] a serious environmental issue into an energy solution."[78]

Another company developing algal fuels in Pennsylvania is Solazyme, who has recently developed several facilities in Riverside, Pennsylvania.[79] Solazyme received a $21.8 million federal grant in December 2009 to build its first integrated biorefinery for commercial scale production of algal biofuel.[80] In September 2010, the Navy ordered 150,000 gallons of ship and jet fuel from Solazyme.[81] On October 22, 2010, the U.S. Navy conducted a full-power demonstration of pre-tested algae-based ship fuel supplied by Solazyme.[82] More work must be done to expand their operations, cut down the costs of processing the fuels, and to explore the production of other co-products.[83] Nevertheless, it is exciting to see the progress of algal biofuel development in the region.

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[73] *Abandoned Mine Drainage*, THE FOUNDATION FOR PENNSYLVANIA WATERSHEDS, http://www.pennsylvaniawatersheds.org/?page_id=12 (last visited Oct. 25, 2013).

[74] *Id.* (stating these "dead" streams are uninhabited by fish or insects and often are too polluted to be used for drinking water or family activities).

[75] *Id.*

[76] *About U.S. Alternative Fuels Corporation*, *supra* note 67.

[77] Griffith, *supra* note 69.

[78] *Id.*

[79] Stephen Graff, *Solazyme Developing Cheaper Algae Biofuels, Brings Jobs to Pennsylvania*, DEPARTMENT OF ENERGY (Aug. 6, 2010), http://energy.gov/articles/solazyme-developing-cheaper-algae-biofuels-brings-jobs-pennsylvania.

[80] Hunziker, *supra* note 32, at 68.

[81] *Id.*

[82] *Id.*

[83] Jim Lane, *Solazyme: A 5-Minute Guide*, ALTERNATIVE ENERGY STOCKS (Oct. 28, 2012), www.altenergystocks.com/archives/2012/10/solazyme_a_5minute_guide_1.html.

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V. MOVING FORWARD: SUGGESTIONS FOR PENNSYLVANIA STATE AND LOCAL LEGISLATURES

There are many ways in which state and local legislatures can assist in the creation and building of the algal biofuels industry.[84] One method would be using state money to set up a matching grants pilot program for financial assistance. This method worked well in Connecticut, where the state legislature set up a matching grants program to help small manufacturers, many of which were in the aerospace industry, switch into the medical products market.[85] Pennsylvania could follow Connecticut's lead and other states' leads, by starting a program that provides on-site financial expertise and guidance to new manufacturers, thereby helping them manage cash flow and finances.[86] Pennsylvania could also establish a loan program to subsidize conventional bank loans, or encourage the utilization of community development loan funds to encourage biofuel start-ups to utilize foundations and philanthropic organizations.

While there is still concern about the strength of the economy and local government bodies are hesitant to fund new projects, an important point that Pennsylvania legislatures should keep in mind is the long-term benefits that will come from supporting these biofuel projects. Besides bringing in more money and providing jobs in the area, Pennsylvania will eventually be able to tax biofuels, which is a very powerful motivator to invest in this industry. The National Biodiesel Board estimates that for every 100 million gallons of biodiesel produced from algae, 16,455 jobs will be created and $1.461 billion will be added to the GDP.[87] Hence, the long-term benefits of funding algal biofuels projects should convince legislatures to support this work.

The continuing surge in fuel costs is a problem no one can ignore. As of October 25, 2013 the average price for regular gasoline in Pennsylvania was $3.36 per gallon.[88] The U.S. Energy Information Administration reported that gas expenditures during 2012 reached $2,912, or about four percent of the average

[84] Elizabeth Olson, *What States and Cities Are Doing to Help Small Businesses*, N.Y. TIMES (Mar. 3, 2010), http://www.nytimes.com/2010/03/04/business/smallbusiness/04help.html?_r=1&.

[85] *Id.*

[86] *Id.*

[87] *About U.S. Alternative Fuels Corporation*, *supra* note 67.

[88] *Average Prices By State*, CAL. GAS PRICES (Oct. 25, 2013), http://www.californiagasprices.com/Prices_Nationally.aspx.

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United States household's income before taxes.[89] This figure is one of the highest estimated percentages of household income spent on gasoline in nearly three decades.[90] Though gasoline consumption has decreased in recent years, the rise in average gasoline prices has led to even higher overall gasoline expenditures.[91] Industry leaders expect that prices will continue to rise.[92] Therefore, Pennsylvania local and state legislatures are urged to address this pressing issue. Legislatures are specifically encouraged to: (1) establish a matching grants program to provide additional financial assistance to those individuals or organizations that have already received federal grants to develop algal biofuels; (2) implement a program that provides financial expertise and guidance to new manufacturers; (3) enact a loan program to subsidize conventional bank loans; (4) increase state funding for non-profits or provide tax incentives to organizations whose focus is on biofuel development.

CONCLUSION

Southwestern Pennsylvania has been, is, and should continue to be at the forefront of the emerging energy field. Through the years the region has lead the nation in the production of coal and oil, and the region is a current leader in the development of energy from natural gas.[93] Nevertheless, these energy sources are non-renewable and can exact a huge price on both consumers and on the environment.[94] During the search to find alternative means of obtaining energy, algal biofuels have emerged as a very attractive and promising renewable energy option. The products that can be derived from algae include: ethanol; methane, butane, or other hydrocarbons; biodiesel; gasoline, jet fuel; various co-products such as animal feed, fertilizers, bioplastics, and nutraceuticals. Algae are attractive due to their higher oil production, their fast growth, and the ability for them to be grown on land unsuitable for crop production. They have the potential to balance greenhouse emissions and prevent global warming. Unfortunately, algal biofuels also present some concerns, because they are not yet commercially available and

[89] Sharon Epperson, *Consumers Taking Financial Hit From Rising Fuel Prices*, CNBC (Feb. 4, 2013), http://www.cnbc.com/id/100431822.

[90] *Id.*

[91] *Id.*

[92] Jennifer Dlouhy, *Lawmakers Debate Cause of Rising Gas Prices*, FUEL FIX (July 16, 2013), http://fuelfix.com/blog/2013/07/16/senate-committee-debates-gasoline-prices/.

[93] *History of Energy Production*, *supra* note 1.

[94] *See The Disadvantages of Oil*, *supra* note 3; *see also* Siegel, *supra* note 9; Siegel, *supra* note 25.

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issues with GMOs, the large water requirement, "cold flow" problems, and scaling up methodologies need to be addressed. Nevertheless, southwestern Pennsylvania is positioned to make algal biofuels commercially available. The community support infrastructure is available and local researchers and businesses are currently making great strides in the field. Local and state legislatures are encouraged to heed some or all of the suggestions described above. In this way, the region can truly transform from the gray images depicted at the dawn of the industrial age to the green of the twenty-first century.

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