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Biodiesel: The Renewable Oil Well

The Louisiana bayou is an endless expanse of still and glassy water dotted with numerous cypress trees and swamp grass. The rich biodiversity in these areas are the lifeblood of the people who reside within close proximity of them. Much of traditional Cajun cuisine, tourism, and other industries rely on what these ecosystems have to offer in regards to the different organisms they contain. For example, crawdads, shrimp, catfish, alligators, and frogs are a staple in Cajun cuisine. A dramatic reduction of these ingredients would almost certainly destroy the local food culture and much of the existing bayou-based industries—tourism and fishing. This, unfortunately, is exactly what is happening in Louisiana due to our insatiable thirst for oil. A fact unknown to many is that Louisiana is one the largest gas producing states in the nation. The large-scale infrastructure dedicated to this oil refinement process also happens to exist in close proximity to the crucially important bayous and neighborhoods that are located along the Mississippi River. This places many plants, animals, and humans in the way of harm. The pollution that is created by these petrochemical facilities eventually enters the waterways of the bayous which contaminates the aquatic organisms that the native people have come to rely on for food and other industries. If and when these plants or animals are ingested the contaminants that they harbor are deposited within our bodily tissues, and if this persists, the development of many illnesses, cancers, and, in some cases, pre-mature death ensues.

This reliance on fossil fuels is definitely not considered a viable solution for future inhabitants of the earth; not only due to the scarcity and finite nature of these resources, but also due to their adverse affects on human health and the well-being of other living organisms when exposed to them directly and even indirectly. As was mentioned, traces of oil and other fossil fuel contaminants can sometimes be found in the food you eat, the water you drink, and even the air you breathe. However, with the development of cleaner and renewable forms of alternative energy—such as biodiesel—we will sever our reliance from fossil fuels and the harmful carcinogens they contain, thereby creating a healthier environment for all.

What exactly is biodiesel? Why are petroleum-based fuels so bad for our health? Will biodiesel help us in our quest to finding a viable alternative energy sources without a drastic change in current infrastructure dedicated to the production of carbon-based fuel sources? The feature film, *FUEL*, answers these questions and many others. This documentary takes an in-depth view of the mission of Josh Tickell, the director and narrator of the movie. He was adversely affected by the petrochemical industry and decided to help spearhead the movement for the development and innovation of biofuels—a cleaner burning fuel now derived from cooking grease, animal fats, and vegetable oils—in order to find a safe alternative to carbon-based fuels.

When the movie begins, Josh Tickell describes the initial stages of his quest to promote biodiesel. He first discovered this type of alternative energy when he was studying on a European farm as part of a degree in sustainable living from The New College of Florida. During his work on these organic farms, he discovered that the machinery used for the farm's upkeep was powered by biodiesel manufactured from the

biomass of the crops that the farmer grew. After finishing his degree, he flew to the United States and began a project that would advertise the "biodiesel cause" to America. His idea was to purchase a regular diesel-powered Winnebago R.V. and tour the country propelled solely by used vegetable oil acquired from restaurants throughout the journey. His trip lasted from 1997 to 1999 and came to an abrupt end when Tickell learned that his mother had fallen desperately ill.

His mother, Deborah Dupre, at the time lived in Louisiana. This state also happens to be the largest gas producing state in the nation due to their numerous oil deposits and refining and processing centers. In fact, there are 150 petrochemical facilities within a 100-mile area along the Mississippi River between Baton Rouge and New Orleans (*FUEL*). The Environmental Protection Agency of Louisiana pronounces the air and soil surrounding these petrochemical facilities as the fallout area due the large concentrations of lethal chemicals that are present in these areas (qtd. in Environmental Protection Agency of Louisiana). The households that happen to be within these fallout areas have become subject to high levels of oil refinement byproducts that are correlated with the onset of many debilitating and, in some cases, life-threatening diseases—e.g. asthma, bronchitis, and cancer (*FUEL*).

These chemicals are released during the gas refinement process. Initially, crude oil is heated in distillation towers where oil vapors are released through the top of the tower and into the environment. According to the scientific data compiled by Dr. Cheryl L. Waldner and Dr. Edward G. Clark, experts in the field of environmental and occupational health, the vapor extruded into the atmosphere contains a mixture of highly dangerous chemical agents including, hydrogen sulfide, sulfur dioxide and volatile

organic compounds (VOCs) (6)[1]. Waldner and Clark have also found correlations between the different chemicals emitted by the petrochemical factories and the various diseases that are prominent when chronically exposed. Close contact with high levels of hydrogen sulfide and sulfur dioxide are commonly connected with symptoms that include increased incidence of respiratory infections, bronchial hypersensitivity, coughing and wheezing, negative effects on airway resistance and lung function, permanent neurobehavioral impairment, and increases in the incidence of diseases of the nervous system and sense organs (7). The inhalation of VOCs, such as benzene and toluene, is associated with respiratory tract irritation, central nervous system dysfunction and the suppression of bone marrow function (inhibits cell-mediated and humoral immune responses). (Waldner 7)

The chemical agents emitted from the distillation towers are not the only byproducts of the crude oil refinement process. In addition, solid toxic waste must be discarded. According to Tickell, the oil companies in Louisiana have been dumping the remaining hazardous waste in waterways and on patches of land for the past seventy years. As a result of the continued dumping, the local biota in the river and land systems—such as small animals, fish, and plants—have also been affected. The continued pollution of these environments causes highly detrimental side effects to the local ecosystem and, in some cases, destroys the life that inhabits the area.

According to the Oregon State University's toxicology database, these chemicals enter the various plants and animals by means of bioaccumulation and biomagnification.

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[1] The research work conducted by Dr. Waldner and Dr. Clark, was done primarily to test the effects of the oil and gas industry on the birthrates of cattle in Canada. However, within their abstract they also included the effects of these chemicals on humans.

The process of bioaccumulation is defined as an increase in the concentration of a chemical in a biological organism over time, compared to the chemical's concentration in the environment (Oregon State University). Biomagnification is a process that results in the accumulation of a chemical in an organism at higher levels than are found in its food. It occurs when a chemical becomes more and more concentrated as it moves up through a food chain—the dietary linkages between single-celled plants and increasingly larger animal species (Oregon State University). The interplay between the processes of biomagnification and bioaccumulation result in abnormally high concentrations of contaminants within the environment's intricate food web. This can lead to various diseases, syndromes, deformities, and in some cases, death (*FUEL*).

As a result, of the large concentration of health abnormalities, the petrochemical facility areas along the Mississippi River are known as "Cancer Alley" due to the large amount of health abnormalities that are experienced within this region. Barbara Koeppel, an investigative reporter for *The Nation*, describes Cancer Alley as place where:

> People living nearest the factories and waste dumps are sick and dying. Clusters of asthma, stillbirths (a full-term baby that dies at or within 1 hour of birth), miscarriages, neurological diseases and cancers have mushroomed. And residents have long claimed that the waste has poisoned domestic animals, wildlife and fish. (16)

The article also refers to the case study of eight-year-old Caleb Thomas. Caleb and his family lived in Gonzales, Louisiana, which sits in the wake of five petrochemical plants and several hazardous waste dumps. On his second birthday, Caleb's parents made a gruesome discovery. Caleb had contracted rhabdomyosarcoma, a rare childhood cancer

that afflicts one in a million children a year (16). Koeppel also adds in her article, "But in Gonzales, cancer is no rarity. Two other boys were also diagnosed with rhabdomyosarcoma, bringing to three the total who fell ill within fourteen months" (16). The claim regarding the rarity of this cancer can be validated with the scientific findings collected by the Greenebaum Cancer Center of the University of Maryland. This institution states that as of 2009 there are on average 240 cases of children being afflicted with this disease each year (Greenebaum Cancer Center). This figure coincides with the claim made by *The Nation* according to the latest population data provide by the U.S. Census Bureau, who say that the United States is home to 310,532,637 people (U.S. Census Bureau).

Koeppel also indicates that four other similar instances occurred forty miles away in Zachary. In 1999, five more children in or near Gonzales had developed leukemia (16). Koeppel also concludes that:

> Six children, who lived within three miles of an oil and chemical waste dump that operated in the sixties and seventies, developed neuroblastomas, deadly cancers of the central nervous system—a rate 120-200 times higher than the norm (17).

In addition to various types of cancers, residents of the parishes surrounding the petrochemical facilities have high rates of asthma and the development of other respiratory diseases (Koeppel 17). Imagine how the lives of these children could have been spared if those oil companies would have been refining and processing biodiesel without the addition of harmful additives into the surrounding area.

According to the 2000 Toxics Release Inventory (TRI) published annually by the

U.S. Environmental Protection Agency, Louisiana is nationally ranked third for total releases within the state, second throughout the nation for total onsite releases, and first for the total amount of production related waste managed. The total amount of waste produced by all of the petrochemical facilities in Louisiana is 9,416,598,055 pounds (Toxics Release Inventory 1). In other words, the waste generated at these alarming rates puts many of the surrounding communities in extreme danger due to the oil companies' inability to properly dispose these large amounts of toxic effluence. This build up of hazardous material eventually ends up in the surrounding ecosystem.

This is not the only "Cancer Alley" that exists. Wherever oil is processed there are usually a high volume of cases of localized incidences of cancer. For example, cancer rates are higher than normal in Westville, New Jersey; Vicksburg, Mississippi; Robinson, Illinois; and Torrance, California among others (*FUEL*).

In addition to the negative impacts experienced by humans, the long-term exposure to these petrochemical facilities affects our livestock as well. The team of Canadian researchers, led by Dr. Cheryl L. Waldner and Dr. Edward G. Clark, began an investigation to determine the association between exposure to emissions from the oil and gas industry and the pathology of the immune, nervous, and respiratory systems, and skeletal and cardiac muscle in beef calves. The experimental group for the study consisted of 203 herds (29,713 cows) of cattle in the areas of Saskatchewan, Alberta, and northeastern British Columbia. The cow pastures studied were at least 1.6 km away from an oil and gas facility/facilities. After the study concluded, researchers reported that 1,531 calves out of 29,970 total births were aborted, stillborn (a full-term calf that died at or within 1 hour of birth, or a full-term calf that was found dead, had not been observed

alive, and was obviously recently born), or dead more than 1 hour after birth (6). Postmortem examinations of the calve tissues revealed startling results. In regards to the immune system of the calves, forty-nine percent of the tissue examinations reported lympholysis—destruction of the lymph cells (21). Lesions (an abnormal change in the structure of an organ due to disease) to the nervous system occurred in five percent of the brain and spinal cord tissues examined (31). The most common lesions in the skeletal and cardiac muscle tissues examined were degeneration (loss of muscular tissue) and necrosis (premature death of cells and living tissue) and occurred in more than twenty-five percent of the samples obtained (23).

These results show that the exposure to various chemical agents—such as hydrogen sulfide, sulfur dioxide, and volatile organic compounds—associated with the combustion of crude oil in petrochemical facilities, are presumably detrimental to the immune system and the skeletal and cardiac muscle tissue of baby calves. Accordingly, if the newborn calves endure the ingestion of these contaminants and survive until they are ready to be slaughtered, their meat that is sent to the grocery stores is likely to harbor these pollutants and will biomagnify within our tissues when consumed. Over time, if the consumption of these tainted products continues, those continually exposed will be at a greater risk of contracting the diseases associated with the chemicals found in the meat.

After discovering the existence of "Cancer Alley" and the harmful effects of our reliance on oil, Tickell also realizes that long-term, and even momentary exposure to these chemicals can have a detrimental impact on anyone's health. When Josh Tickell finished tending to his mother, he once again began his public outreach mission to teach people about the potentials of biodiesel. sIn *FUEL*, Tickell presents the advantages of

biodiesel as a form of renewable, alternative energy. In regards to carbon dioxide (CO_2) emissions, gasoline and regular crude oil-based diesel emit twenty pounds per gram when burned, while biodiesel creates two to four pounds of CO_2 per gram of fuel (*FUEL*). That is an eighty to ninety percent offset in the release of carbon dioxide. Josh Tickell also states that, as compared to the combustion of regular diesel, biodiesel reduces the output of soot, airborne particulates, and volatile organic compounds.

Many of the claims made by the film, in regards to the advantageous health implications of using biofuel, can be validated by the published scientific findings of Dr. Mustafa Balat, an expert in the field of biodiesel research from the Sila Science Universite in Turkey. In his study, he examines the fuel characteristics and the use of biodiesel as a transportation fuel. Dr. Balat's findings indicate that:

> The use of biodiesel decreases the solid carbon fraction of particulate matter (since the oxygen in biodiesel enables more complete combustion to CO_2) [and] pure biodiesel is essentially sulfur free and results in a total reduction of sulfur dioxide (SO_2) emissions as well sulfate aerosols in particulate matter. (861)

As was mentioned earlier, the reduction of sulfur particulate greatly decreases the occurrence of ailments afflicting the respiratory system. Therefore, a switch to the mass production of biodiesel, for instance, would greatly reduce a fuel refinery worker's propensity of contracting ailments that are closely associated with exposure to carbon-based fuels.

Another study, by Dr. Robert L. McCormick, a researcher at the National Renewable Energy Laboratory, was conducted to test the impact of biodiesel on pollutant

emissions and public health. By comparing the emission compositions of regular petroleum-based diesel, B20 diesel (a blend of twenty percent pure biodiesel and eighty percent oil-based diesel), and pure biodiesel, the environmental health benefits were clear. Biodiesel blends of twenty percent produce reductions of fifteen percent or higher in emissions of particulate matter, carbon monoxide, total hydrocarbons, and a group of toxic compounds including vapor-phase hydrocarbons, aldehydes, ketones, and selected semi-volatile and particle-phase PAH and NPAH (McCormick 1033). In other words, there is a considerable reduction in the amount of carcinogens and other harmful chemicals that are released from the combustion of biodiesel as compared to regular, oil-based biodiesel. The absence of these contaminants will promote a healthier environment and less of a likelihood of contracting ailments associated with carbon-based fuel byproducts.

The byproducts reduced by the use of B20 diesel are the primary contributors to ground-level ozone (smog). Ground-level ozone is correlated with incidences of airway irritation, coughing, wheezing and other breathing difficulties, respiratory tissue inflammation, aggravation of asthma, increased susceptibility to respiratory illnesses like pneumonia and bronchitis, and permanent lung damage with repeated exposures (Ground-level ozone).

Also, the use of pure biodiesel reduces the harmful chemicals from exhaust emissions even further, in some cases up to a forty-two percent decrease as compared to petroleum-based diesel (McCormick 1037). As you can see, not only is biodiesel a viable, renewable energy resource, but also it is a leader in the race to reduce harmful pollutants as byproducts of combustion.

In summation, the scientific evidence presented and the resulting public awareness regarding the benefits of biodiesel have added momentum to the biofuel movement. *FUEL* documents the growing participation of government agencies, businesses, celebrities, and others. With this growing awareness, many benefits, besides those concerned with health issues, have also been discovered. For example, *FUEL* uncovered an in invaluable energy relic from the presidency of Jimmy Carter (1977-1981). This artifact was a project proposed in the Department of Energy's Aquatic Species Program, which examined the feasibility of a new form of biodiesel derived from algae that was fed with wastewater. This government project concluded that ALL of America's fuel needs could be grown using only fifteen percent of the Sonoran Desert in Arizona (18,000 square miles) and only cost $25 million over twenty years (qtd. In Aquatic Species Program). Keep in mind that this idea was proposed almost 30 years ago! This came from a president who managed to reduce America's energy usage by twenty five percent during his term in office (*FUEL*). Not only is biodiesel more feasible to produce in regards to the space needed, its obvious health benefits, and the lower cost of production, but it also yields more energy. For every 1 unit of energy—BTU—placed into the production of petroleum, it yields only 0.8 BTU per unit of oil (*FUEL*). In other words, the production of petroleum is energy negative. On the other hand, for every 1 unit of energy (BTU) placed into the production of biodiesel, it yields 3 BTUs per unit of biodiesel (*FUEL*). With all of the time and money invested towards the research into the benefits of biodiesel, why don't we make the switch? Well, many consumers and businesses have answered the calling for change. According to The National Biodiesel Board, a national trade association representing the biodiesel industry, the amount of

biodiesel consumed in 2009 was approximately 700 million gallons. Also, the current production capacity for the 173 companies that are involved with biodiesel is 2.29 billion gallons per year (U.S. Biodiesel Production Capacity). Notice the large disparity between the amount of biodiesel consumed and the production capacity. This gap can only be filled with your help. This vision for the mass-consumption of biodiesel can become a reality if, for instance, consumers who are interested in a healthier tomorrow contact their local gas stations and demand biodiesel. Also, become politically active and explain to your congressman how biodiesel will promote a healthier environment in your area. We have the power to make a difference and together we can make the world a better place.

Work Cited

Balat, Mustafa. "Fuel Characteristics and the use of Biodiesel as a Transportation Fuel." *Energy Sources Part A: Recovery, Utilization & Environmental Effects* 28.9 (2006): 855-64. *Academic Search Complete*. Web. 12 October 2010.

Extension Toxicology Network. "Bioaccumulation." *Toxicology Information Briefs.* Oregon State University, compiler, Sept. 1993. Web. 9 Oct. 2010.

Extension Toxicology Network. "Biomagnification." *Toxicology Information Briefs.* Oregon State University, compiler, Sept. 1993. Web. 12 Oct. 2010.

Greenebaum Cancer Center. *What is Rhabdomyosarcoma?*. University of Maryland, 21 Sept. 2009. Web. 21 Oct. 2010.

Koeppel, Barbara. "Cancer Alley, Louisiana." *Nation* 269.15 (1999): 16-24. *Academic Search Complete*. Web. 12 October 2010.

McCormick, Robert L. "The Impact of Biodiesel on Pollutant Emissions and Public Health." *Inhalation toxicology* 19.12 (2007): 1033-9. *Academic Search Complete*. Web. 12 October 2010.

FUEL. Josh Tickell. Narr. Josh Tickell. Cinema Libre Studio, 2008. Web.

"U.S. Biodiesel Production Capacity." *Biodiesel.org*. The National Biodiesel Board, 22 June 2010. Web. 24 Oct. 2010.

U.S. Environmental Protection Agency. "Louisiana." *Toxics Release Inventory*. U.S. Environmental Protection Agency, 2000. N. pag. *epa.gov*. Web. 9 Oct. 2010.

United States. U.S. Census Bureau. *U.S. POPClock Projection*. 12 Oct. 2010. Web. 22 Oct. 2010.

United States. U.S. Environmental Protection Agency. *Ground-level Ozone*. 7 Jan. 2010.

Web. 10 Oct. 2010.

Waldner, Cheryl L., and Edward G. Clark. "Association between Exposure to Emissions from the Oil and Gas Industry and Pathology of the Immune, Nervous, and Respiratory Systems, and Skeletal and Cardiac Muscle in Beef Calves." *Archives of Environmental & Occupational Health* 64.1 (2009): 6-27. *Academic Search Complete*. Web. 12 October 2010.