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Pig Manure, Recycling to Oil Pyrolysis & Energy Plant

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***Abstract* – As industrial productivity increases, the demand for energy with little affordable or easily accessible transferrable energy also increases. To date, mankind's energy sources are derived from solid, liquid, and gas sources. The correlation between energy consumption and industrial development creates a high dependency on fossil fuels [2]. Although alternative forms of energy are large in quantity, the modern-day marketplace remains dependent on fossil fuels as the readily available form of energy, despite economic and environmental hazards and risks to human health.**

This research paper discusses the opportunities and advantages of using new technologies to convert biomass to renewable energy. Using a Flow Process conversion system, Pars Bioscience proposes converting pig manure into diesel, methane, and electricity to meet the public interest of providing an economic and environmentally sustainable solution to landfill closures, population growth, rising waste removal costs and dependency on fossil fuels.

***Keywords* – Environmental Hazards and Risks to Human Health, Energy, Gas Sources, Fossil Fuels.**

I. Introduction

Fossil fuels increase CO_2 emissions, increase air pollution, are non-renewable sources of energy and contribute to environmental hazards including climate change. According to the Environmental Protection Agency, approximately 82% of CO_2 emissions in the United States were cause of human activities in 2013 by fossil fuels [20].

Flow Process conversion is directed at demonstrating the feasibility of using a novel process for the removal of CO_2 emissions in the atmosphere, caused by burning fossil fuels. Converting pig manure through a Flow Process conversion can reduce harmful emissions into the atmosphere and decrease the rate of climate change, one of the most serious national and global environmental and economical threats. Reducing dependency on fossil fuels will also lower CO_2 emissions in the atmosphere, also reducing the rate of climate change. Pars Bioscience proposes reducing dependency on fossil fuels by utilizing renewable energy technologies and converting pig waste into renewable energies.

Converting biomass and bio-waste to renewable energy provides an opportunity to increase human health and environmental benefits. As waste is collected from overflowing landfills, waste odor is decreased and gas emitted into the atmosphere is also reduced as it is collected to produce electricity [10].

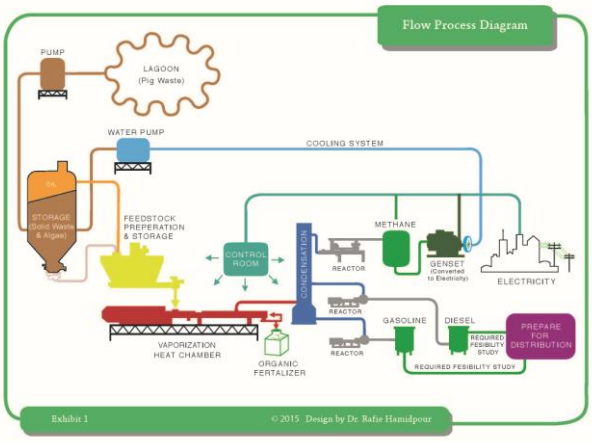
Advancing biofuels and bio-based products from animal manure to provide an economical and environmentally sustainable solution to current fossil fuel use will also reducing odor and lower the risk of biological disease and harmful bacteria emissions from pig manure.

II. Identification and Significance of the Problem

As industrial productivity increases, the demand for energy also increases. To date, mankind's energy sources are derived from solid, liquid, and gas sources. The correlation between energy consumption and industrial development creates a high dependency on fossil fuels [2]. Although alternative forms of energy are large in quantity, the modern-day marketplace remains dependent on fossil fuels as the readily available form of energy, despite economic and environmental hazards and risks to human health.

Electricity, gasoline and diesel use for transportation, and other industrial processes, are the top three sectors of largest energy use [19]. In developing countries, diesel consumption is in high demand due to growing transportation use. The energy consumption of these markets is largely dependent on fossil fuels. In 2011, almost 87% of fossil fuels were responsible for the world's energy production [18].

Biofuels have served as the alternative to expensive and harmful fossil fuels for decades. Generated from renewable resources, biofuels are environmentally friendly and economically sustainable. Biofuels also provide resolution to three major global threats: energy security; economic development in the modern marketplace and developing countries; and alleviating climate change, as noted by the Nuffield Council on Bioethics [5].



III. Discussion

Climate change poses one of the most serious environmental risks and is increased by CO_2 emissions in the atmosphere, caused by burning fossil fuels. Converting pig manure through a Flow Process conversion can reduce harmful emissions into the atmosphere and decrease the rate of climate change, one of the most serious national

and global environmental and economical threats. Reducing dependency on fossil fuels will also lower CO_2 emissions in the atmosphere, also reducing the rate of climate change. Pars Bioscience proposes reducing dependency on fossil fuels by utilizing renewable energy technologies, including energy from pig waste. The use of biomass will not emit CO_2 into the environment and biofuels can replace fossil fuels [10].

Fossil fuels increase CO_2 emissions, increase air pollution, are non-renewable sources of energy and contribute to environmental hazards including climate change, and negative effects on human health. According to the Environmental Protection Agency, approximately 82% of CO_2 emissions in the United States were cause of human activities in 2013 by fossil fuels [20]. The highest source of fossil fuel emissions were caused by electricity use, gasoline and diesel use, and fossil fuel combustion through industrial processes [6]. Electricity "is the largest single source of CO_2 emissions in the nation, accounting for about 37% of total U.S. CO_2 emissions and 31% of total U.S. greenhouse gas emissions 2013 [23]." The use of gasoline and diesel for transportation services including "highway vehicles, air travel, marine transportation, and rail" was the second largest source in 2013, "accounting for about 31% of total U.S. CO_2 emissions and 26% of total U.S. greenhouse gas emissions [20]." A variety of industrial activity, such as "production of metals such as iron and steel, and the production of chemicals," resulted in approximately 15% of total U.S. CO_2 emissions and 12% of greenhouse gas emissions in the United States [20].

Flow Process conversion (Exhibit 1) will also reduce pig manure odor and serve as a form of odor control for neighboring communities. While policies exist state-to-state to regulate "hazardous substances from animal waste [4]," two of the primary manure management collection methods, lagoons and pits or tanks [4], have different effects on the components of manure, either reducing the "nutrient contents" of the manure, or jeopardizing "potential fertilizer value" [4]. As reported in *Trends and Developments in Hog Manure Management: 1998-2009*, the methods in which manure is stored is crucial to the environment: "lagoons reduce manure's nitrogen content through aerobic digestion and ammonia volatilization. This allows farmers to apply more manure on less land without exceeding crop nutrient requirements…some covered systems (anaerobic digesters) also capture methane and burn it as biofuel to generate electricity [4]." Pars Bioscience would like to explore the use of a covered anaerobic digester as a "manure handling system" [4] to accompany the Flow Process conversion for generating renewable energy.

A. Flow Process Conversion of Pig Manure

Pig manure is one of the most available biomass resources and is readily available to be processed into renewable energy in the form of methane, diesel, and electricity. On average, pigs will produce approximately between 0.5 and 0.75 cubic feet of manure daily, per 1000 lb. of pig. According to this estimate, a pig weighing 200 pounds will produce anywhere from 0.1 to 0.15 cubic feet of manure. This is approximately 87 to 130 pounds per cubic foot, or an approximately density of 108 pounds per cubic foot [1]. Per this estimate, pig manure is one of the most readily available sources of biomass resources available to be converted to biofuel.

According to the U.S. Department of Energy, approximately "three-fourths of human-cause emissions came from the burning of fossil fuels" [14]. Although the US imports less than 50 percent of overall oil use, diesel prices are on the rise as global demands for oil increase [14]. While the dependency on foreign fuel has decreased since 2009, car use around the world is increasing. An increase of car use means an increase of oil sales in the global market, increasing the need for foreign oil and the national use of fossil fuels [15]. Projected increase in diesel prices and domestic fossil fuel consumption positions the development and use of renewable energy and using a Flow Process for converting pig manure to methane, diesel, and electricity, is a valuable method. With an incentive toward enhanced energy and increasing domestic materials, bioenergy from pig manure is a feasible alternative to fossil fuels and international oil [20].

The proposed Flow Process conversion is directed at demonstrating the feasibility of using a novel process for the removal of CO_2 emissions in the atmosphere, caused by burning fossil fuels. Converting pig manure through a Flow Process conversion system (Exhibit 1) can reduce harmful emissions into the atmosphere and decrease the rate of climate change, one of the most serious national and global environmental and economical threats.

IV. A Renewable Energy

Compared to the limited availability of fossil fuels, renewable energy is produced from readily available sources such as biomass, hydropower, geothermal, wind and solar. Our research efforts focus primarily on converting municipal solid waste, landfill gas and biogas, and pig manure, into renewable energy.

According to the U.S. Energy Information Administration, approximately 13% of electricity originated from renewable energy and "consumption of renewable energy sources in the United States totaled about 9.6 quadrillion British thermal units (Btu)" in 2014 [19]. Over half of renewable energy in the U.S. is used to generate electricity and biomass, specifically wood and waste, ranks as the second source of most commonly used renewable energy [19]. In 2014, approximately 5% of energy use in the United States was produced by biomass fuels, 46% of which "was from wood and wood-derived biomass, 44% was from biofuels (mainly ethanol), and about 10% was from municipal waste" [17]. As researchers develop new strategies for renewable energy, Pars Bioscience proposes using more methods of waste-to-energy and converting biomass to renewable energy.

Converting biomass and bio-waste (pig manure) to renewable energy provides an opportunity to increase

human health and environmental benefits. Pars Bioscience has found the following benefits of this conversion to increase human health and sustain the environment:

1. Decreases waste odor as waste is collected from overflowing landfills, and gas emitted into the atmosphere is also reduced as it is collected to produce electricity.
2. Produces energy from biomass and bio-waste is a cost-efficient substitute to traditional fossil fuels: energy from biomass and bio-waste is a renewable energy source and will reduce greenhouse gas emissions.
3. Provides a responsible solution to the global concern of energy security, the economic development of the modern marketplace and developing countries, and alleviates climate change.
4. Stabilizes fuel prices as dependency on fossil fuels reduces.

B. Biofuels, Economic Growth, and Energy Security

Biofuels and innovative technologies reverse the negative effect of fossil fuels and climate change.

The global push toward advanced biofuels lowers dependency on international fuel sources and also excels industrialization efforts in developing countries where there is an increase in the energy and supply demand [7]. Advancing industrialized development requires the careful reconsideration of industrialization strategies and biofuels in developing countries to include: new jobs in a new job sector described as "green collar jobs" by Rt Hon Lord Drayson, the 2009 Minister for Science and Innovation [7]; "diversification of energy supply, especially where countries obtain a large proportion of their energy from the increasingly unstable global oil market [8];" investing in local agriculture to provide job security and income security [8]; and upscaling national exports to secure "global economic activity [8]." As developing economies stabilize and increase, the demand for energy will also increase globally. For countries not affiliated with the OECD, this will have a greater impact on fossil fuels and a negative effect on chemical emissions and environmental stability. Biofuels, however, "could offer an opportunity to provide fuel for transport with the potential additional advantages of energy security, environmental sustainability and a lower carbon footprint, according to the Nuffield Council on Bioethics [8]."

C. Biofuels and Climate Change

Climate change is a multi-sector concern that must be pursued with national and international policy change and habit change. According to the Nuffield Council on Bioethics, "each sector of the economy will have to make significant contributions to deep carbon cuts in a relatively short timescale (before 2050) [9]." This will be a laborious effort for the transportation sector, as "its demand is fairly inelastic and any economy-wide policy tool that aims to reduce GHG emissions, such as a tax on GHG emissions, will result in little reduction in the transport sector [9]." The Nuffield Council on Bioethics reports that approximately 22% of global CO_2 emissions were caused by vehicle operation and transportation activities [9]. Biofuels compliment today's vehicle technology and have the ability to reduce the carbon footprint.

Renewable fuels were produced and put to use in an effort to alleviate these three international concerns, while also providing an inexpensive substitute for costly, and environmentally damaging, fossil fuels [6]. New policies supporting biofuels in the European Union, the UK, and the United States and countries around the world established "markets for biofuels and acted as incentives to industry to invest in biofuels development and production [6]" between 1995-2005, according to the Nuffield Council on Bioethics' report Biofuels: Ethical Issues. Biofuels provided a timely response to the growing apprehension "over lead in fuel and losses of agricultural jobs and faming subsidies [6]."

Renewable energy will reduce dependency on fossil fuels, reduce CO_2 emissions and improve human health and economic and environmental stability. In an effort to improve economic and environmental stability, Pars Bioscience believes advanced technology must be incentivized to convert biomass and biowaste (pig manure and algae biofuels) to renewable energy (methane gas, diesel, and electricity), in response to the growing energy that is environmentally and economically sound.

V. PRELIMINARY COST ANALYSIS

A. Anticipated Technical Results

In Phase I we will develop a process that selectively separates the water, oil and solid from Pig Manure. We will incorporate this step into a test module and use it to demonstrate the removal of oil from samples of Pig Manure and storage at storage tank from lagoon. We will carry out studies to measure the effect of operating parameters on process removal, including pumping from lagoon to tank and from tank to heat chamber. The results of these studies will be used to make engineering calculations to establish the technical and economic feasibility of the waste removal process.

B. Economic Impact of Proposed Biowaste Process

The economic impact of "biowaste Process" in Pig Manure can be illustrated by examining the commercial production of Pig Manure, Recycling to Oil Pyrolysis & Energy Plant in Iowa. In a typical year, approximately 10 million pounds of Pig Manure is mixed with rain and contaminates our lake and lands.

C. Advantages of the Proposed Biowaste Process

The proposed Pig Manure, Recycling to Oil Pyrolysis & Energy Plant a number of important advantages over existing processes for the removal and waste management of Pig Manure.

Biomass is a source of energy that is derived from municipal solid waste contents found in landfills across the nation. The U.S. Energy Information Administration approximates the average amount of trash thrown away daily by each individual is about 4.4 pounds, 1.5 of which are recycled or composted, and "much of the remaining waste is burned [17]." Before the waste is burned, it is collected in landfills, which are overflowing faster than waste is being collected. Although recycling and composting practices are increasing nationally, about 33%

of total municipal solid waste is "recovered," and the remaining rots in landfills or is burned [3].

Burning municipal solid waste releases harmful pollutants in the environment, effecting human health and environmental sustainability. As landfill space becomes limited, many states, including New York, New Jersey, and California, resort to dumping waste in other states. In addition to negative use of land space, rotting municipal solid waste produces methane and emitting liquid from mounds of waste ooze into surface water and groundwater [3].

While alternatives to burning municipal solid waste in refineries exist, including burning waste-to-energy plants, gasification, and recycling, a multi-system approach must be implemented to address the multi-pronged environmental, economical, and health concerns of waste management collection. Pars Bioscience suggests alleviating these concerns by converting municipal solid waste to biomass energy, acting as a waste management system, and also using pig waste as an alternative form of renewable energy.

D. Structure of the Phased Program

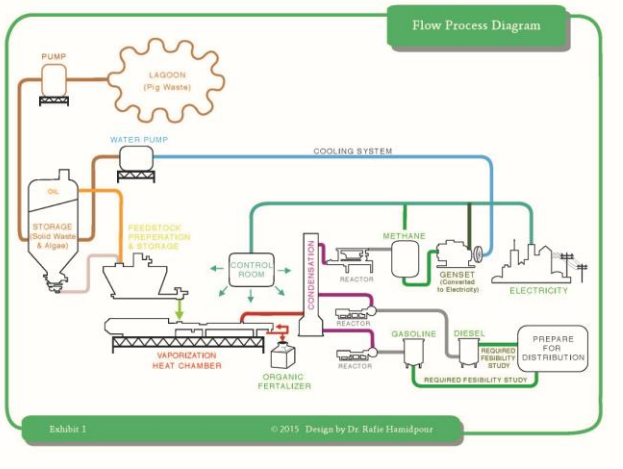
Phase I is directed at demonstrating the feasibility of using a membrane process to Pig Manure, Recycling to Oil Pyrolysis & Energy Plant. Once proof of concept has been accomplished in Phase I, the Phase II effort will focus on 1) optimization of the Pig Manure separation, 2) development of more efficient way of separating water, oil and solid, and 3) fabrication of prototype Recycling to Oil Pyrolysis & Energy Plant. During Phase II, we will do long-term testing of Recycling to Oil Pyrolysis & Energy Plant under realistic field conditions. The goal is to establish that any adverse effects on Energy Plant performance caused by sustained operation on actual Pig Manure, Recycling to Oil Pyrolysis in a way that is consistent with large-scale plant operation. It should be noted that the field tests will form the basis for a comprehensive technical and economic evaluation.

If Phase II is successful, we anticipate entering into an agreement with a commercial sponsor for Phase III of the program. Phase III will involve construction of a 1,000-gal/day field-test unit and approximately 12 months (elapsed time) for field-testing and evaluation before full-scale commercialization would be initiated. We anticipate that the Recycling to Oil Pyrolysis & Energy Plant necessary for Phase III will be fabricated by PWTM, a manufacturing subsidiary of Klean Industries.

VI. Phase I Technical Objectives

The overall goal of this program is to demonstrate the feasibility of using a Pig Manure, Recycling to Oil Pyrolysis & Energy Plant process to remove water from solid and oil. We aim to better understand the opportunities and advantages of converting biomass to renewable energy in an economic and environmentally sustainable manner. Our suggested Flow Process of converting pig manure to renewable energy in the form of methane, diesel, and electricity.

The overall goal of this program is to demonstrate the feasibility of using a Pig Manure, Recycling to Oil Pyrolysis & Energy Plant process to remove water from solid and oil. We aim to better understand the opportunities and advantages of converting biomass to renewable energy in an economic and environmentally sustainable manner. Our suggested Flow Process of converting pig manure to renewable energy in the form of methane, diesel, and electricity is depicted in Exhibit 1.



VII. Research Objectives and Methodology

The purpose of this research application is to discuss the value and potential outcomes of using a Flow Process to convert pig manure to renewable energy, lowering dependency on fossil fuels, lowering CO_2 emissions, and producing diesel, methane, and electricity in an environmentally and economically sound manner. Research objectives include:

1. Understanding the technical capacity of the flow process of converting pig manure to renewable energy
2. Determining the operational capacity of the flow process conversion, including limitations and production rate of inputs and outputs
3. Establishing a mathematical equation to test the production rate of pig manure through the Flow Process conversion and the production of renewable energies
4. Analyze pig manure composition
5. Determining the strongest conversion rates based on operating conditions, including temperature and renewable energy production

A. Methodology

Our pilot study will analyze the use of the pyrolysis reactor method by developing small reactors and burning the pig manure inside the chamber. From that, we will use the stabilizer to separate the methane gas and take the methane gas to gas generator and produce electricity.

1. Identify operating parameters: variables specific to process must be identified for its control
2. Identify the measurables: measurables must correspond with the operating parameters in order to control the

process including temperature, pressure, flow rate, humidity, and electrical behavior
3. Determine most effective measurement methods
4. Define a control method
5. Test control method and limits
6. Analyze final product

B. Phase I

Biomass is a source of energy that is derived from municipal solid waste contents found in landfills across the nation.

Phase I is directed at demonstrating the feasibility of using a membrane process to Pig Manure, Recycling to Oil Pyrolysis & Energy Plant. Once proof of concept has been accomplished in Phase I, the Phase II effort will focus on 1) optimization of the Pig Manure separation, 2) development of more efficient way of separating water, oil and solid, and 3) fabrication of prototype Recycling to Oil Pyrolysis & Energy Plant. During Phase II, we will do long-term testing of Recycling to Oil Pyrolysis & Energy Plant under realistic field conditions. The goal is to establish that any adverse effects on Energy Plant performance caused by sustained operation on actual Pig Manure, Recycling to Oil Pyrolysis in a way that is consistent with large-scale plant operation. It should be noted that the field tests will form the basis for a comprehensive technical and economic evaluation.

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While alternatives to burning municipal solid waste in refineries exist, including burning waste-to-energy plants, gasification, and recycling, a multi-system approach must be implemented to address the multi-pronged environmental, economical, and health concerns of waste management collection. Pars Bioscience suggests alleviating these concerns by converting municipal solid waste to biomass energy, acting as a waste management system, and also using pig waste as an alternative form of renewable energy.

VIII. Related Research and Development

Renewable energy and conversion methods are not new systems of producing renewable energy; there are many approaches and systems in place for converting biomass to renewable energy. As more research is published on the negative environmental impacts of fossil fuels, the impact of climate change, and the environmental damage and economic hits of present-day methods, the need for a responsive option to counteract these negative impacts is crucial. The Flow Process conversion is inspired by present-day conversion methods and pyrolysis methods.

IX. Potential Post Application

Between 2000 and 2014, the creation and implementation of biofuels and "nonhydroelectric renewable energy sources" increased twofold as a result of state and federal government policies and initiatives for renewable energy [16]. Renewable fuels are projected to spike in the next 25 years; according to the U.S. Energy Information Administration (EIA), "the United States will use nonrenewable fuels to meet most of its energy needs through 2040" [16]. In response to this need and pending successful conversion rates provided by the Flow Process, commercialization of renewable energies will be available to the public, lowering national dependency on fossil fuels and international oil.

Following the development and analysis of Flow Process conversion, Pars Bioscience will expand pig manure conversion to algae biofuel. Our Research & Development will be modeled on the Office of Energy Efficiency & Renewable Energy Processing and Conversion using methods of gasification and pyrolysis. Pars Bioscience will conduct necessary research, including major products in the field, and expand on environmental and economic advantages of algae biofuel conversion. Research topics include understanding the natural growth cycle and production of algae, effects of seasonal changes including light and temperature; cost; and optimal methods of conversion [12]. Currently, the U.S. Department of Energy suggests biochemical conversion and thermochemical conversion [12]. The U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy outlined specific Research and Research & Development topics in the "Biopower Technical Strategy Workshop Summary Report," published in 2010. Pars Bioscience will conduct similar research to better understand present-day needs and evaluations. As included in the "Biopower Technical Strategy Workshop Summary Report," Pars Bioscience will analyze.

1. Pretreatment and conversion
2. Large-scale systems
3. Small-scale systems
4. Feedstock for biopower
5. Methods of Conversion

The above topics were included in the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy "Biopower Technical Strategy Workshop Summary Report" from 2010 [13]. Pars Bioscience will amend and add topics for analysis based on thorough research of major competitive products in use, successful conversion practices in use, as research evolves. Ultimately, Pars Bioscience will research with the aim of developing a method for commercialized renewable energy.

X. Satisfying the Public Interest

Flow Process conversion of pig manure to renewable energy meets the public interest of providing an economic and environmentally sustainable solution to landfill

closures, population growth, rising waste removal costs and dependency on fossil fuels; and reduces odor and lowers the risk of biological disease and harmful bacteria emissions from pig manure.

XI. Potential Commercial Applications

Successful development of a biomass to renewable energy processes offers a practical procedure for the renewable energy. Furthermore, successful development would provide the basis for fabricating other supported-equipment for the selective convert biomass to renewable energy processes.

XII. Current and Pending Support

No work substantially similar to that proposed here is being conducted at this time, nor is any pending.

XIII. Conclusion

The report of many studies about present program is to demonstrate the feasibility of using a Pig Manure, Recycling to Oil Pyrolysis & Energy Plant process to remove water from solid and oil. We aim to better understand the opportunities and advantages of converting biomass to renewable energy in an economic and environmentally sustainable manner.

This design offers a distinct advanced system compare to the prior designs and provides a practical means to solve the problem of environmental hazards and risks to human health.

This research paper discusses the opportunities and advantages of using new technologies to convert biomass to renewable energy. Using a Flow Process conversion system, to meet the public interest of providing an economic and environmentally sustainable solution to landfill closures, population growth, rising waste removal costs and dependency on fossil fuels.

We aim to better understand the opportunities and advantages of converting biomass to renewable energy in an economic and environmentally sustainable manner. Our suggested Flow Process of converting pig manure to renewable energy in the form of methane, diesel, and electricity.

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Conflict of Interest

The authors declare no conflict of interest.

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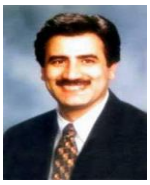
AUTHOR'S PROFILE



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