

## **QUARTERLY PROGRESS REPORT**

12/1/17 to 02/27/18

**PROJECT TITLE: Environmental and Economic Impacts of Energy Production from Municipal Solid Waste**

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## **Research Description**

Municipalities today are faced with a variety of options on dealing with solid waste. Tools and guidance are needed to make sound decisions, regards to both environmental and economic factors, that takes into account various site specific constraints such as land and water availability, energy costs and needs, and government policies and tax incentives. The goal of this project is to quantify the benefits of various traditional and proposed Waste-to-Energy (WTE) technologies versus landfilling. The results will aid in identification of an optimal process for maximizing profitability while minimizing environmental impact given various scenarios and constraints. The proposed effort leverages previous and current efforts on the demonstration of syngas production from landfill gas and design and application of selective FTS catalysts (production of diesel and jet fuel) funded by the Hinkley Center, the Florida Energy Systems Consortium (FESC), and the Department of Energy (DOE).

The five WTE technologies selected for this comparison are gasification or anaerobic digestion to produce electricity, incineration to produce heat and power, or gasification to produce compressed natural gas or liquid hydrocarbon fuels (i.e., diesel). These five technologies will be compared to landfilling and single-stream recycling to reach a total of 7 scenarios. These processes will be evaluated at the system level, such as done by the PIs for various WTE and biomass conversion schemes already, to quantify the key parameters needed for making a sound decision taking into consideration economics and environmental impact. These parameters include CAP-EX, OP-EX, energy input requirements, GHG emissions, water input requirements, co-product generation and use/market (if any), solid waste production (if any), and profitability. The process simulations will include a sensitivity analysis, which will include a variable production scale, process lifetime, degrees of tax credits, etc. on the eight parameters identified to compare the conversion technologies.

## **Work Completed To-Date**

For this reporting period, extensive study was done on municipal solid waste (MSW) management. Information on the methods of MSW management and disposal, their process, design, operation, and factors that influence their implementation were obtained. The study took into consideration the impacts of environmental objectives and existing energy economies on these WTE technologies, with specific focus on actual operational data. The technologies considered were landfilling with gas recovery, incineration with heat recovery, gasification and anaerobic digestion. The recoveries of these technologies are typically synthesis gas which can be converted to fuels or combusted in turbines for energy. The various monetary inputs and necessary outputs for these WTE technologies were also identified.

In addition, a compilation of reliable empirical data that included the operating capacities, cost breakdown, and estimated energy returns from these technologies is being conducted. The data compilation is achieved through carrying out an extensive study of actual plant data from various sources. The cost breakdown will be supplemented by a spreadsheet

calculator that simulates predicted costs and returns. The predicted costs and returns will be based off inputs specified by the user seeking guidance. The compilation of data and a returns summary enables the comparison of costs and benefits associated with each of these technologies. Data and cost profiles for various size, location, ownership are also developed.

### **Future Tasks**

Future direction would include the consideration of single-stream recycling, obtain a wider variety of empirical data and categorize more precisely. The Microsoft spreadsheet calculator will continue to be updated with enhanced functionality.

### **TAG Meetings Scheduled**

Our first TAG meeting will take place on March 6, 2018. Details are available on the project website. Below is a list of people who have indicated interest to serve on our TAG.

### **Tentative TAG Members**

John Schert	Director	Hinkley Center
Wester W. Henderson	Research Coordinator III	Hinkley Center
Devin Walker	Process Engineer	BASF
Matt Yung	Researcher	Nat. Renewable Energy Lab
Tim Roberge		T2C-Energy
Richard K Meyers	SWRS Program Manager	Broward County Solid Waste and Recycling Services
Lee Casey	Chief of Environ. Compliance (Retired)	Miami Dade County Dept of Solid Waste
Canan “Janan” Balaban	Asst. Director	Florida Energy Systems Consortium
Ron Beladi	Vice-president	Neel-Schaffer, Inc.
Rebecca Rodriguez	Engineer Manager II	Lee County Solid Waste Division
Linda Monroy	Project Manager Associate	Lee County Solid Waste Division
Sam Levin	President	S2LI
Charles “Peb” Hendrix	Chief Operating Officer	LocatorX

Tony Elwell	Staff Engineer I	HSW Engineering, Inc
Nada Elsayed	Scientist, PD	Catalent Pharma Solutions Inc
Yolanda Daza	Process TD Engineer	Intel Corporation
James Flynt	Chief Engineer	Orange County Utilities Department
Gita Iranipour	Engineer Associate	Hillsborough County Public Utilities Department
Luke Mulford	Water Quality Manager	Hillsborough County Public Utilities Department
Ray Oates	Solid Waste Compliance Manager	Citrus County Division of Solid Waste Management

**Project Website Address (URL):** (<http://www.eng.usf.edu/~jnkuhn/Hinkley2017.html>)

**Informational Dissemination:**

**Metrics:**

1. List graduate or postdoctoral researchers funded by *THIS* Hinkley Center project.

Name	Rank	Dept.	Professor	Institution
Sokefun, Yetunde	2 <sup>nd</sup> year PhD student	Chemical Engineering	Kuhn/Joseph	USF
Ahmad Naqi	MS student	Chemical Engineering	Kuhn/Joseph	USF

2. List undergraduate researchers working on *THIS* Hinkley Center project.

First Name	Dept.	Institution	Professor
Paul Stachurski	Chemical Engineering	USF	Kuhn/Joseph
Daniela Chinchilla	Chemical Engineering	USF	Kuhn/Joseph
Matthew Kastelic	Chemical Engineering	USF	Kuhn/Joseph

3. List research publications resulting from *THIS* Hinkley Center projects.

None at this time.

4. *List research presentations resulting from THIS Hinkley Center project.*

Naqi, A., Joseph, B., and Kuhn, J.N. “Aspen Plus Simulation of the Conversion of Biomass to Liquid Hydrocarbon Fuels: Design and Feasibility Study” International Conference On Renewable Energy 2018, Barcelona Spain, April 2018.

5. *List who has referenced or cited your publications from this project?*

None at this time.

6. *Provide an explanation of how the research results from this Hinkley Center project and previous projects have been leveraged to secure additional research funding.*

We have submitted the following proposals:

Sustainable Energy, Nutrient and Water Recovery from Organic Wastes for Space Applications ( in collaboration with Dr. Ergas, Professor of Civil and Environmental Engineering, USF, T2C-Energy, LLC). Submitted to Florida-Israel Innovation Partnership.

7. *List new collaborations that were initiated based on this Hinkley Center project.*

A collaboration was initiated with Dr. Ergas which resulted in the above named proposal.

8. *Provide an explanation of how have the results from this Hinkley Center funded project have been used (not will be used) by the FDEP or other stakeholders?*

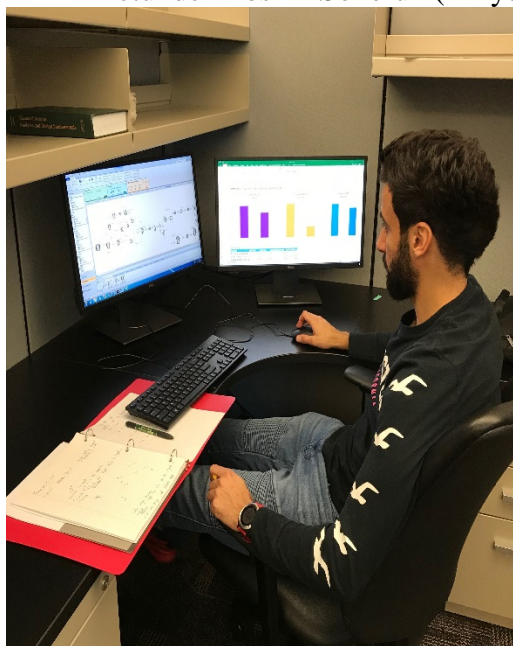
None at this time.

### **Student Researchers**

The student researchers are Yetunde “Tosin” Sokefun, Ahmad Naqi, Daniella Cerna Chinchilla, Matthew Kalstetic and Paul Starchurski



Yetunde "Tosin" Sokefun (2<sup>nd</sup> year PhD Student)



Ahmad Naqi (MS student)



Daniella Cerna Chinchilla  
(Undergraduate student)



Matthew Kalstetic  
(Undergraduate student)



Paul Starchurski  
(Undergraduate student)