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PMC-EF2a
(2.01.02)

U.S. DEPARTMENT OF ENERGY
EERE PROJECT MANAGEMENT CENTER
NEPA DETERMINATION

RECIPIENT: Michigan Economic Development Corporation **STATE:** MI

PROJECT TITLE : Michigan Biogas Center of Excellence

Funding Opportunity Announcement Number	Procurement Instrument Number	NEPA Control Number	CID Number
	EE0000617	GFO-10-042	EE0

Based on my review of the information concerning the proposed action, as NEPA Compliance Officer (authorized under DOE Order 451.1A), I have made the following determination:

CX, EA, EIS APPENDIX AND NUMBER:
Description:

A9 Information gathering (including, but not limited to, literature surveys, inventories, audits), data analysis (including computer modeling), document preparation (such as conceptual design or feasibility studies, analytical energy supply and demand studies), and dissemination (including, but not limited to, document mailings, publication, and distribution; and classroom training and informational programs), but not including site characterization or environmental monitoring.

B3.6 Siting, construction (or modification), operation, and decommissioning of facilities for indoor bench-scale research projects and conventional laboratory operations (for example, preparation of chemical standards and sample analysis); small-scale research and development projects; and small-scale pilot projects (generally less than two years) conducted to verify a concept before demonstration actions. Construction (or modification) will be within or contiguous to an already developed area (where active utilities and currently used roads are readily accessible).

Rational for determination:

Michigan Economic Development Corporation would demonstrate the feasibility of biogas research and development generated at the Flint Waste Water Treatment Plant. Laboratory work and field tests would take place at Kettering University (KU), Department of Chemistry/Biochemistry, Mott Building, 1700 West University Avenue, Flint, Michigan and City of Flint Water Pollution Control Facility (WPCF) at G-4652 Beecher Road, Flint, Michigan. The project consists of five tasks:

Task 1.0 Establishment of an Anaerobic Digestion and Verification Laboratory

An Anaerobic Digestion and Verification Laboratory would be established to aid in optimizing the biogas production. The production of the biogas would mimic the processing units at the Flint, MI wastewater treatment facilities. This existing lab would be equipped with various bioreactors and analytical equipment using similar biogas laboratories in Sweden as a model. This existing lab would also be used to further research in the area of biogas production and use.

Subtask 1.1 Perform a benchmark study of current Biogas technology

A literature survey of current state of the art technology related to biogas production, monitoring, purification and use would be performed to aid in the development of a sound research program around biogas. This would help in determining the best methods to optimize the process and the most efficient use of the biogas produced.

Subtask 1.2 Set-up prototype anaerobic digester and analysis equipment

In order to optimize the process of anaerobic digestion and biogas production, prototypes of the digestion equipment would be installed in the existing lab. These units would be used to process the pretreated wastewater similarly to the digester units constructed at the Flint, MI wastewater treatment site. The biogas produced from the digesters would be monitored and verified using gas chromatography (GC) in addition to other technologies to determine the biogas composition.

Digesters would be operated to ensure digestion of the biomass is occurring. Detailed test procedures and safety precautions that are associated with the handling of wastewater would be put into place. These include but are not limited to, a standard operating procedure for the transportation, handling and disposal of samples. The EPA guidelines would be used to determine these procedures.

This existing laboratory would allow for small scale testing of the processing and handling of the effluent as it is entering the digesters. The laboratory would support the optimization of biogas generation without compromising the wastewater treatment facility.

Subtask 1.3 Biomass fermentation and processing

Once the effluent has been processed through clarifiers at the wastewater treatment facility, the material is sent to the primary digester which allows for the bacterial breakdown of the organic material in an oxygen-free environment. The process and conditions of fermentation would be analyzed. This includes the examination of retention times,

temperatures, pH, osmolarity, and growth factors present. These processes would allow for the analysis of conditions for biogas production and further research on protocols that can be developed to increase methane production.
Subtask 1.4 Analysis of biogas components
The gas generated by the anaerobic process contains approximately 50-75% methane, the principal energy component. However, it contains other contaminants such as water, carbon dioxide, and hydrogen sulfides, which can cause severe corrosion and corrupt measures used to convert the gas into energy. Typical treatment for removal of these contaminants is refrigeration, molecular sieves, or reaction with iron sulfide. In addition, the Siloxanes - components of hair gels, shaving products and various other beauty products- are contained in the biogas generated by wastewater treatment plants. These compounds, when combusted, are oxidized to form silicon dioxide, a solid that deposits on metal surfaces and causes corrosion.
Samples of the biogas generated at various stages of processing at the wastewater treatment plant and from the prototype digesters would be captured and analyzed. The samples would be collected and concentrated if needed and examined using GC. Components of the gas generated would be detected using a Flame Ionization Detector or a Thermal Conductivity Detector depending upon the nature of the contaminant to be analyzed. In order to identify components present in the gaseous mixture, Mass Spectrometry would be employed. Infrared Spectroscopy would also be employed to analyze the composition of biogas generated. This technique would be supplemental and adds support for analysis by GC. The results would be compared to standardized mixtures of gases that contain the contaminants. This would determine the composition of the gas so that appropriate measures can be taken to remove the contaminants from the gas so that it can be used to generate energy.
Task 2.0 Methane-Powered Vehicle Center (MPVC)
Subtask 2.1 Vehicle selection and conversion to dual fuel at KU
Utilization of bio-methane in vehicles would be demonstrated by acquiring a Silverado truck to convert into a dual-fuel vehicle.
Engine conversion would involve the addition of a gas filling valve, CNG storage tanks, high-pressure gas piping, pressure reducing regulator, cut-off valve, electronic fuel switcher, air-fuel mixer, cylinder head valve and a fuel tank pressure indicator. The engine control module (ECM) must be modified. Switching between petroleum and bio-gas can be done manually or automatically. The DOT-certified bio-fuel tank(s) may be placed on an aerodynamic roof, under the seats or in the bed of a truck. The conversion kit must be EPA-certified.
Subtask 2.2 Testing and evaluation of the converted vehicle
The converted used truck would be tested for performance, fuel economy, emissions and range on a chassis dynamometer. A 10-15 % drop in engine torque and power is expected. Other issues of interest include installation of conversion kits, component wear and maintenance as well as fill-up time at 3600 psi. The effect of the vehicle conversion on the catalytic converter as well as the influence of automatic control devices on emissions must also be investigated.
The high octane number of bio-methane allows higher compression ratios with expected higher engine and combustion efficiency, lower NOx in exhuast, lower CO2 emitted per mile traveled and low levels of CO and volatile organic compounds (VOC). Some methane (another greenhouse gas) would be emitted through the exhaust system. Market potential and economic and environmental impact of this technology on the State of Michigan should also be studied. Tax incentives and credits may be available to offset the cost of conversion to CNG.
Using Bio-Methane for Power Generation
Task 3.0 Methane-Powered Power Generator (MPPG)
Subtask 3.1 Power source selection
Stirling engines have recently become popular in conjunction with solar energy to generate power. A Stirling engine and a fuel cell stack would be selected to use bio-methane as fuel. A biodigester utilizing left-over food would be considered as a provider of biogas to the fuel cell stack.
Subtask 3.2 Stirling engine and fuel cell acquisition and implementation
Once a fuel cell stack and a Stirling engine are selected, they would be installed at the Center for Fuel Cell Systems and Powertrain Integration and the Automotive Laboratory.
Subtask 3.3 Stirling engine/fuel cell testing
The fuel cell stack and the Stirling engine would be tested for performance, efficiency and emissions. Their overall performance characteristics would be compared with conventional power generation devices.
Bio-Methane Market Research
Task 4.0 Market Research (MR)
Market research would be conducted to understand consumer perceptions, gauging social and economic impacts of bio-methane as an alternative fuel for transportation and power generation purposes. In addition, market studies and analyses of the potential implementation of biogas and other by-products of the anaerobic digestion process in Michigan would be conducted.
Task 5.0 Project Management and Reporting
Reports and other deliverables would be provided in accordance with the Federal Assistance reporting. Checklist following the instructions included therein.

KU claims no additional permits are needed; test engines would create automotive exhaust (emissions). However, vented gas cabinets and fume hoods are used with scrubbers to prevent release of air pollutants. KU claims that all hazardous waste is disposed of according to university, local, state, and federals regulations. KU contracts with Clean Harbors Environmental Services, Incorporated for off campus hazardous waste transport, treatment, storage, and

disposal. According to KU, a Chemical Hygiene Plan, waste disposal, and safety protocols are in place monitored by KU's Department of Environmental Health and Safety.

Based on the information above, this project's impacts to the human and natural environment can be deemed less than significant and this project would qualify for Categorical Exclusions A9, B3.6.

NEPA PROVISION

DOE has made a final NEPA determination for this award

Insert the following language in the award:

Note to Specialist :

none

SIGNATURE OF THIS MEMORANDUM CONSTITUTES A RECORD OF THIS DECISION.

NEPA Compliance Officer Signature: _____ Date: 11/23/09
NEPA Compliance Officer

FIELD OFFICE MANAGER DETERMINATION

☐ Field Office Manager review required

NCO REQUESTS THE FIELD OFFICE MANAGER REVIEW FOR THE FOLLOWING REASON:

☐ Proposed action fits within a categorical exclusion but involves a high profile or controversial issue that warrants Field Office Manager's attention.
☐ Proposed action falls within an EA or EIS category and therefore requires Field Office Manager's review and determination.

BASED ON MY REVIEW I CONCUR WITH THE DETERMINATION OF THE NCO :

Field Office Manager's Signature: _____ Date: _____
Field Office Manager