City Council Report

Date: July 1, 2020

To: City Council

Through: John Pombier, Assistant City Manager

From: Scott Bouchie, Director - Environmental Management & Sustainability (EM&S)
Laura Hyneman, Deputy Director – EM&S
Tom Sheber, Energy Conservation Coordinator – EM&S

Subject: Intergovernmental Agreement between Arizona State University and the City of Mesa pertaining to the U.S. Department of Energy (DoE) funded research concerning Efficient Carbon Utilization in Algal Systems, DE-FOA-001908 (Citywide)

Purpose and Recommendation

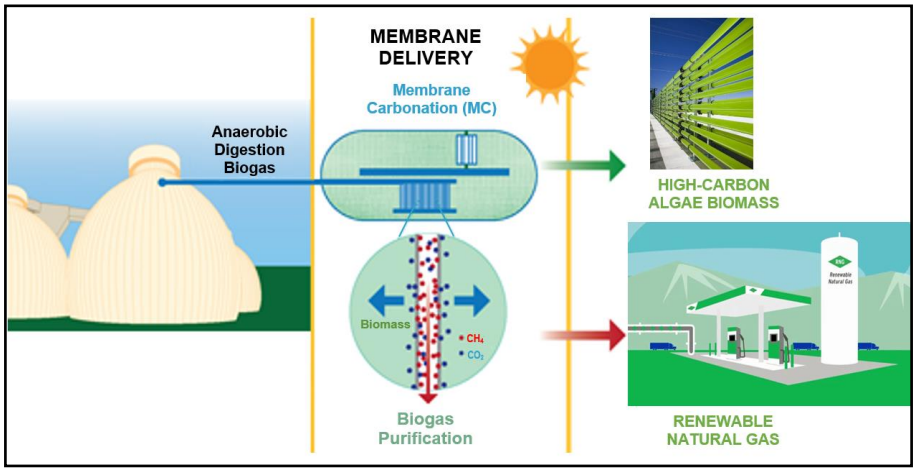
Request to authorize the City Manager or his designee to enter into an Intergovernmental Agreement (IGA) between Arizona State University (ASU) and the City of Mesa (COM) that covers reciprocal interests stemming from a DoE Funded Research Project – "Membrane Carbonation for 100% Efficient Delivery of CO_2 from Industrial Gases". A copy of the proposed IGA is attached. COM is motivated in finding economically viable and environmentally sustainable uses for the biogas produced from our anaerobic digesters (AD) where the Northwest Water Reclamation Plant (Northwest Plant) currently produces about 68 million cubic feet of biogas per year that holds 60% to 65% methane and 35% to 40% carbon dioxide. Currently, the digester biogas is mostly flared.

Background

On June 1st, 2018, EM&S was contacted by ASU's director of the Swette Center for Environmental Biotechnology at the Biodesign Institute regarding a DoE funding opportunity for early-stage bioenergy research and development (R&D) in capturing of carbon dioxide (CO_2) from industrial sources to grow microalgae for beneficial use such as feedstock for transportation fuel. On June 25th, 2018 COM provided a letter of support for ASU's submittal to DoE and on September 4th, 2018 ASU received notice from DoE for a funding award of $1,992,766 for the three-year research project. Though not yet commercially available, this research into efficient carbon utilization in algal systems will lead to renewable hydrocarbon fuels, bio-based products, and power from algal-based biomass and waste feedstocks.

This early-stage bioenergy research technology incorporates delivery of CO_2, via biogas CO_2 content, to a Mem-brane Carbonation (MC), in which the CO_2 diffuses through the walls of non-porous gas-transfer membranes on demand according to the rate of photosynthesis. The microalgae also oxidize any H_2S to sulfate, so, the remaining gas is primarily methane (CH_4) made available for beneficial use. Gas-transfer modeling, techno-economic analysis, and life-cycle assessment are conducted throughout the project to guide the experimental research where these modeling techniques also generate optimal design and operating strategies for large-scale implementation of MC. Consequently, the remnant high carbon content algae biomass also has beneficial use; however, this is beyond the current DoE-

funded research.
The 3-year project started with initial laboratory testing with algae materials at ASU Biodesign Institute followed by evaluation of synthetic biogas comprising 40% CO_2 and 60% CH_4 in three 4 m^2 algal raceways at the Arizona Center for Algal Technology and Innovation (AzCATI). Additional evaluations at the AzCATI algal raceways includes synthetic biogas with various H_2S concentrations. In May and June 2021 the project will involve evaluation of biogas from the Northwest Plant anaerobic digesters in the three AzCATI raceways or three 25 m^2 temporary algal raceways or at the Northwest Plant.



Discussion

Though not yet commercially available, application of the membrane carbonation (MC) technology could potentially lead to revenue from about 44 million cubic feet of pipeline quality renewable natural gas (RNG) annually while eliminating about 24 million cubic feet of CO_2 from the atmosphere or about 1,400 metric tons of CO_2 per year at the Northwest Plant. Other potential benefits include some combination of additional onsite power generation at the Northwest Plant, the possible use of pre-processed high carbon content algae biomass as replacement of methanol currently used in liquid phase processing at the Northwest Plant, and supplemental anaerobic digester feedstock in the form of carbon-rich algae biomass to affect increased biogas production with benefits thereof.

Alternatives

Taking no action precludes COM from protections and economies, perceived or otherwise, afforded by a viable intergovernmental agreement between COM and ASU that is specific to this DoE-funded research project should the technology be found as commercially viable in the future.

Fiscal Impact

COM resources are provided to the project as in-kind contributions toward the project's cost share requirements, with an estimated value of $22,392.

Coordinated With

COM interest for this DoE-funded research project exists across key departments that include Environmental Management and Sustainability, to help the city meet its sustainability goals, Water Resources, to help make its wastewater treatment processes more efficient, and Energy Resources, to explore energy revenue opportunities from the biomass and methane produced. Together COM has committed participation from these departments to advance the goals of the research project throughout the course of the 36-month project. The attached letter of commitment dated June 25, 2018 provides additional details in this regard.