

HIGH-EFFICIENCY PROCESS FOR RNG PRODUCTION FROM BIOGAS USING MOF-BASED SOLID ADSORBENTS

Applicant and Prime: Mosaic Materials; Dr. Thomas McDonald, PI
Additional Team Members: AECOM, Napa Sanitation District

The key objectives of this project are as follows:

- Create an FEL-2 design package for a commercial scale biogas upgrading process featuring diamine-appended metal-organic framework solid adsorbents to separate CO₂ from CH₄.
- Show this MOF-based process lowers the capital costs and operating expenses of biogas upgrading by 20-40% and generates an energy return on investment of at least 5.
- In conjunction with a global engineering firm, design, commission, and operate a pilot biogas upgrading system using MOF on real biogas feed for at least 1000 cumulative hours.

This project builds on the successful laboratory process demonstration of using metal-organic frameworks (MOFs) to separate biogas into high-purity CO₂ and methane using the unique diamine-appended MOFs manufactured by Mosaic Materials and funded by the California Energy Commission. The next step in the project is to take these materials from the lab to a wastewater treatment plant and demonstrate their efficacy when fed real biogas to ensure they still perform. Mosaic Materials has partnered with AECOM, a leading global engineering firm, and Napa Sanitation District, a leader in innovation in the wastewater industry, to execute this project.

In the first year, Mosaic and AECOM will collaborate to design and build a pilot skid and MOF materials needed to demonstrate this upgrading process. In the second year, the skid will be placed at Napa Sanitation District's facilities, where a 10% slipstream of their biogas will be fed into the pilot skid. The skid will have the necessary analytical instrumentation to quantify the efficacy of the separation, as well as provide opportunities for process optimization. The data gathered over 1000 hours of run time will lead to an AECOM-designed commercial process (FEL-2).

This project, once successful, has many benefits:

- Refined design and economic assessment of a viable commercial scale upgrading process
- Line-of-sight to commercial refinement and roll-out
- Provides a lower-cost biogas upgrading process vs. current technologies, allowing more biogas producers to enter the market and make RNG a price-competitive fuel source
- Enables a new domestic source of low-cost fuel, reducing dependence on foreign oil
- Takes advantage of existing waste collection infrastructure and helps diminish regulation
- Avoids flaring of excess biogas, thus lowering harmful emissions
- Enables future ability to scale up or down to expand and meet the needs of other biogas providers, such as agricultural/dairy sources and landfills.
- Provides a low-cost, widely dispersed and localized solution to increasing energy demands