

# Maximizing Your CH4 Recovery

## Utilizing Sweep for Optimized Recovery

### Background

With increased global focus on reducing greenhouse gas (GHG) emissions to slow down the global warming effect, it is critical that all industries take action to reduce their GHG outputs. For the biogas sector, the most critical GHGs are methane (CH<sub>4</sub>) and carbon dioxide (CO<sub>2</sub>). One method of reducing GHG emissions is to liquefy CH<sub>4</sub> into bio-LNG, and CO<sub>2</sub> into bio-liquid CO<sub>2</sub>. This enables a near-100% recovery of both streams, and can be achieved by diverting the off-gas streams back to the raw biogas stream. When an OEM client of Air Products Membrane Solutions became involved in the design and fabrication of a biogas to bio-LNG plant, they reached out to Air Products Membrane Solutions to discuss the impact of their off-gas stream from the liquefaction unit on their feed compressor design. Air Products Membrane Solutions proposed a novel, proprietary solution that leads to both CAPEX and OPEX savings for the final product configuration.

### Solution

The proprietary solution for this biogas to bio-LNG project involves the use of a concept called "sweep." To enable the sweep, a fourth port located on the low pressure/permeate side of the membrane is utilized to feed a gas stream back to the membrane, creating the "sweep" effect. In this specific case, the off-gas stream from a thermal swing adsorption unit (TSA), which is located between the outlet of the membrane upgrading unit and the inlet of the liquefaction equipment, is fed back into the membrane. This off-gas stream contains a lower CO<sub>2</sub> concentration than the feed gas to the membrane stage, thus diluting the CO<sub>2</sub> on the permeate side of the membrane and increasing both the driving force of CO<sub>2</sub>, as well as the efficiency of the separation. This back-feeding of the "sweep" gas leads to an improved performance of the membrane stage utilizing the sweep.



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## Comparison

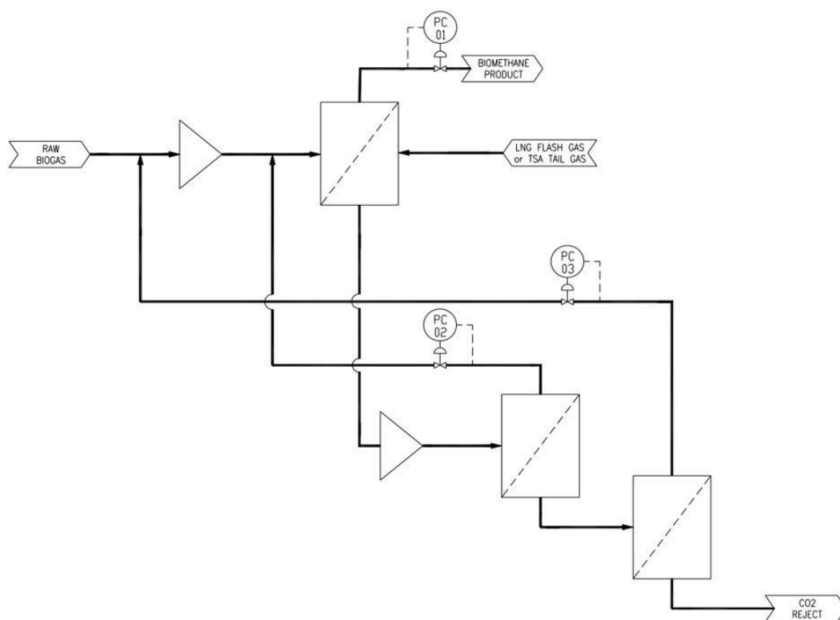
The novel solution designed by Air Products Membrane Solutions is compared to a scenario where the off-gas is fed directly back to the interstage compressor. CH<sub>4</sub> purity and the CH<sub>4</sub> recovery have been kept at the same target performance in the comparison. By utilizing the off-gas sweep to the membrane, Air Products Membrane Solutions novel design improves system performance on two crucial points:

- Reducing membrane count on the sweep stage by >30%
- Reducing power consumption of the overall system by ~20%

By utilizing the off-gas sweep-to-membrane design, the OEM was able to offer a competitive solution in terms of CAPEX and OPEX costs to the end user, providing them with a both a technical and commercial benefit over competing biogas to bio-LNG configurations.

## Conclusion

Air Products' proprietary off-gas sweep-to-membrane design helps you improve and recover more CH<sub>4</sub> from a biogas to bio-LNG system, in a manner that ensures operational and capital expenses remain steady. For more information on how Air Products Membrane Solutions can help with your biogas upgrading projects, contact us.



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