

FINAL REPORTS—TASKS 1, 2, AND 3
GTI PROJECT NUMBER 20614

Pipeline Quality Biomethane: North American Guidance Document for Introduction of Dairy Waste Derived Biomethane into Existing Natural Gas Networks

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Gas Technology Institute Project Team

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Executive Summary

The Gas Technology Institute has completed a Final Report for the project, *Pipeline Quality Biomethane: North American Guidance Document for Introduction of Dairy Waste Derived Biomethane into Existing Natural Gas Networks*. This Report includes three separate Task Reports; each Task focused on a separate work product. In August, 2007, GTI proposed a project in which the ultimate objective was to develop a Draft Guidance Document regarding pipeline quality biomethane from anaerobic digestion of manure and farm effluent from dairy operations. As background, there is increasing interest to introduce renewable sources of methane into the natural gas infrastructure. The gas industry has a firm knowledge of geologically-sourced natural gas as a result of many decades of operating experience. Biomethane from a variety of sources has the potential be introduced to the pipeline network if its quality is within acceptable analytical boundaries. To this end, biomethane (cleaned biogas) has been viewed against typical tariff and contract constituent considerations detailed in AGA Report 4A (2001 and, updated, 2009). However, biomethane may contain constituents outside the range of species typically addressed in pipeline tariffs. Consequently, additional assays may be appropriate to verify its suitability, particularly with regard to trace chemical and microbiological constituents. Biomethane from dairy waste is posited to be a relatively clean renewable natural gas (RNG) product. Dairy operations are closely monitored, leading to expectations that biogas from anaerobic digestion of waste should be more readily cleaned to pipeline quality (biomethane). It is anticipated that success with dairy waste conversion will provide a basis for follow-on studies of potentially more challenging biogas sources, such as mixed-waste digesters, wastewater treatment plants, and landfill gas facilities.

The project, begun in October, 2007 and entitled *Pipeline Quality Biomethane: North American Guidance Document for Introduction of Dairy Waste Derived Biomethane into Existing Natural Gas Networks* had three primary objectives:

- (1) To assess and document available domestic and international information to develop a broader knowledge base related to biogas production, gas treatment, gas quality standards, and gas quality test protocols.
- (2) To develop and execute a laboratory-testing program to evaluate raw (prior to cleanup) and post-cleanup biomethane from dairy-only facilities in order to assess gas quality. The scope of the experimental work covers representative chemical and biological species that could potentially impact pipeline and downstream equipment operations. While the test matrix includes the proscribed tests compiled in the American Gas Association's (AGA) Report 4A, it goes beyond these assays to include over 400 chemical species and 7 biological characterizations consistent with the broader goals of addressing pipeline integrity and gas interchangeability.
- (3) To prepare a *Guidance Document*, with reference to AGA Report No. 4A (2009), Natural Gas Contract Measurement and Quality Clauses.

The resulting Task structure and deliverables of the project mirror the primary objectives:

Table 1: Project Task Structure and Deliverables.

Task #	Task Name	Deliverables
1	Technology Investigation, Assessment, and Analysis	A Report compiling the information, assumptions, and conclusions related to objective
2	Laboratory Testing and Analysis	A testing and analysis Report
3	Guidance Document	A Guidance Document

Summary of Task 1 Report:

The Task 1 Report provides a wide range of introductory information on biogas production, principally focused on biogas derived from the anaerobic digestion of dairy manure. The spectrum of material contained herein covers topics from the status of European efforts at biogas production to sampling methods for testing dairy biogas. A number of digester designs are summarized and categorized into those that appear suitable for dairy manure and those that are not, under the proviso that digester and process modifications may make these categorizations soft. Among those technologies that are considered suitable for processing dairy manure, 98% of them in actual use on farms in the U.S. are comprised of plug flow digesters, completely mixed digesters, and covered lagoon digesters. Numerous companies on the market can provide consulting, sales, and a range of services for the design, construction, and operation of biogas plants.

Summary of Task 2 Report:

The Task 2 Report is the culmination of GTI's Laboratory Testing and Analysis Program which focused on the analysis of parameters typical of natural gas and potential constituents of concern in raw biogas and biomethane. The test matrix included over 300 chemical species as well as six biological assays to address potential concerns regarding potential contaminants from dairy waste. The results from the testing program were compared to existing analytical parameters outlined in the American Gas Association's (AGA) *Report No. 4A - Natural Gas Contract Measurement and Quality Clauses, 2001* which compiles and references pipeline tariffs from various natural gas transmission and distribution companies in North America. The objective of Task 2 was to verify that the sampled biomethane could meet general natural gas tariff requirements and provide supportive information regarding constituents outside of the set of gas quality parameters covered in AGA Report 4A. The results of testing at two sites show that biomethane from dairy waste can meet typical tariff and contract constituent considerations with utilization of appropriate clean-up technologies. These data served as the basis and rationale for recommendations included in the Guidance Document (Task 3) as part of this project.

Summary of Task 3 Guidance Document:

The Guidance Document provides reference and recommendations for consideration of biomethane from dairy waste digestion for introduction with natural gas in existing gas pipeline networks in North America. The Guidance Document is not prescriptive; it is intended to provide framework for productive discussions regarding biomethane quality. It is a culmination of information gathered as part of Tasks 1 and 2 of the overall project and applies this information against natural gas quality tariff parameters

detailed in the American Gas Association's (AGA) *Report No. 4A - Natural Gas Contract Measurement and Quality Clauses – Revised 2009 (DRAFT)*. Knowledge of biomethane production is detailed in the Report from Task 1 work and the results of a biogas/biomethane sampling and analytical testing program are compiled in the Report from Task 2 work. The Guidance Document (Task 3) compiles analytical parameters of consideration for safe interchange, overview of the parameter, recommended biomethane analytical range for the parameter and a verification testing procedure and schedule to monitor for proper gas quality.

Through the total work effort of this project executed by GTI, it is concluded and demonstrated that dairy-waste based biomethane of high quality may be produced within typical natural gas tariff and contract constituent values. The Guidance Document (Task 3) addresses general interchange of biomethane and suggests tolerance limits.

Biogas needs to be conditioned, cleaned and/or filtered depending on the specifics of the on-farm digester, the biomass digested, and the specific requirements of the natural gas pipeline network into which the biomethane is to be injected. The degree to which the biomethane is conditioned, etc. may be company specific. *Specific tariff requirements for individual gas companies must be considered for the purpose of constructing a suitable contract for biomethane.*