

# Western Wisconsin Renewable Natural Gas Dairy Basin Project

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## OVERVIEW



Agri-Waste Energy, Inc. (AWE) is the developer of the Western Wisconsin Renewable Natural Gas Dairy Basin Project (WWP). The project's **First Phase** began in 2004 with the construction of an anaerobic digester on a 1600 cow dairy farm (Emerald Dairy) near Baldwin, WI. In 2005, AWE and A&B Process Systems built a Gas Conditioning Facility next to the digester at Emerald Dairy. Also, in 2005, AWE worked with Northern Natural Gas to build a Pipeline Interconnect Facility at Northern's Town Border Station west of Baldwin, WI. The GCF became operational in 2007 with the first deliveries of Renewable Natural Gas (RNG), in compressed natural gas trailers, to Northern's Pipeline Interconnect Facility at Baldwin. The RNG was transferred into Northern's Pipeline System for delivery and sale to The 3M Company. During 2007-2008, AWE participated in a study conducted by the Gas Technology Institute that verified the efficacy of the GCF technology, developed by AWE & A&B Process Systems, for producing pipeline quality RNG from dairy farm waste. Testing and modification of the GCF technology and delivery of RNG to Northern's pipeline continued through October, 2008 with the completion of the **First Phase** of the WWP.

# Phase I

## 2004-2008



Phase I of the project started in 2004 and was completed in November, 2008.

Anaerobic Digester (plug-flow) & Gas Conditioning Facility (GCF) on 1600 cow Emerald Dairy near Baldwin, WI



Since 2007, biogas from a digester located at Emerald Dairy 11 miles northeast of Baldwin, WI has been processed in a GCF, also located at Emerald Dairy, and transported in Compressed Natural Gas trailers to the Northern Natural Gas Pipeline Interconnect Facility at Baldwin.

## Pipeline Interconnect to Northern Natural Gas pipeline at Baldwin, WI



Agri-Waste Energy (AWE) has constructed a Renewable Natural Gas Transfer Facility adjacent to NNG's Town Border Station & Pipeline Interconnect Facility.

## Renewable Natural Gas (RNG) delivered from Emerald Dairy in CNG (Compressed Natural Gas) transport trailer



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AWE processes dairy manure in an anaerobic digester located 11 miles northeast of Baldwin at Emerald Dairy. The digester produces biogas which AWE processes in a Gas Conditioning Facility, also located at Emerald Dairy. A pipeline quality Renewable Natural Gas is produced and compressed for transport in CNG (compressed natural gas) transport trailers which are delivered by truck to AWE's RNG Transfer Facility.

# RNG Transferred to Northern Natural Gas (NNG) Facility



The RNG in the trailers is compressed at 2200 psi.

## Hose Connected to CNG Trailer



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A high pressure hose is connected to the CNG transport trailer for injection into the NNG pipeline system.

## Monitoring Transfer Pressure



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During the injection process the RNG is monitored for a continuous pipeline transfer pressure of 730 – 350 psi.

# Pipeline Interconnect



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RNG is injected directly into the NNG pipeline system

## Gas Quality Monitoring Equipment Building



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During the injection process gas quality specifications are constantly monitored by NNG's monitoring equipment.

## RNG Quality Monitored for...



RNG is monitored for BTU, oxygen, hydrogen sulfide, carbon dioxide, nitrogen and water content.

# Oxygen Content



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Oxygen content must not exceed .2%.

# Water Content



Water content must not exceed .5%.

# Hydrogen Sulfide Content



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Hydrogen Sulfide content must be less than .1%.

## NNG Chromatograph



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A NNG chromatograph continually monitors the gas going through the system to determine that the RNG continually meets pipeline quality specifications.

# Chromatograph Report

Baldwin-Wisc stream 1 on 10/26/2007 12:37:23

	MolPct	BTUGross	RelDens	
C6+ 50/50/00	0.0000	0.00	0.00	0.0000
PROPANE	0.0000	0.00	0.00	0.0000
i-BUTANE	0.0000	0.00	0.00	0.0000
n-BUTANE	0.0000	0.00	0.00	0.0000
NEOPENTANE	0.0000	0.00	0.00	0.0000
i-PENTANE	0.0000	0.00	0.00	0.0000
n-PENTANE	0.0000	0.00	0.00	0.0000
NITROGEN	2.3909	0.00	0.00	0.0231
METHANE	96.8446	980.40	0.00	0.5365
CARBON DIOXIDE	0.7608	0.00	0.00	0.0116
ETHANE	37.2 PPM	0.07	0.00	0.0000
TOTAL	100.0000	980.46	0.00	0.5712

Compressibility Factor	1.0019
Heating Value Gross BTU Dry	982.36
Relative Density Gas Corr.	0.5721
Total Unnormalized Conc.	99.370
WOBBE Index	1296.79



The NNG Chromatograph produces a report on the gas quality specifications.

# NNG Tariff Baldwin, WI

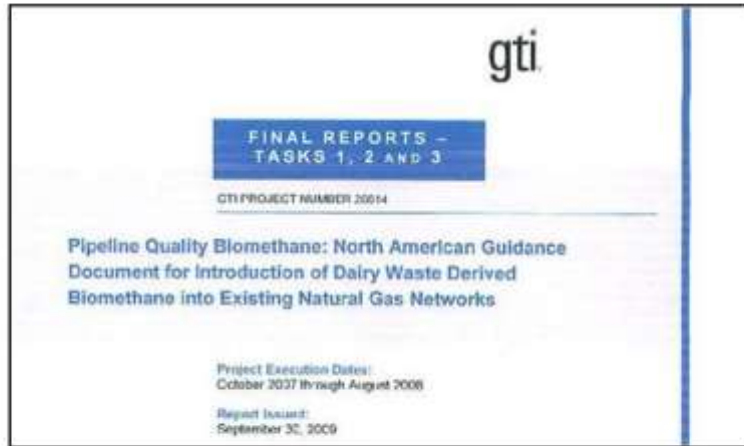
Component / Property	Units of Measure	Pipeline Spec <sup>1</sup>	CNG Spec per DOT <sup>2</sup>
Water vapor	Lbs per mmscf (million std cu ft)	Less than 6	Less than 0.5
Hydrogen sulfide	Grains per Ccf	Less than or equal to 0.25	Less than or equal to 0.10
Total sulfur	Grains per Ccf	Less than or equal to 20	Less than 0.1
Heating value	Btu per Cubic Foot	Greater than or equal to 950	
Temperature	Degrees Fahrenheit	Less than or equal to 120 F.	
Oxygen	Per cent by volume	Less than or equal to 0.2	Less than 1.0
Carbon dioxide	Per cent by volume	Less than or equal to 2.0	Less than 3.0
Non-hydrocarbon gases	Per cent by volume		Less than 4.0

<sup>1</sup> Issued May 1, 2003 Northern Natural Gas Company FERC Tariff - fourth revised sheet 281

<sup>2</sup> DOT regulations DOT-E-9009 13<sup>th</sup> revision

AWE is required to meet the Northern Natural Gas “Tariff” or specification for pipeline quality Renewable Natural Gas.

# GTI Study Executive Summary



AWE participated with the Gas Technology Institute as a test site for this report.

## Phase II

### 2008-2011

- Planning
- Permitting
- Financing



Phase II of the project involves the planning, permitting and financing for: GCF relocation; Building digesters at 2 dairies; Building 9.5 miles of biogas pipeline.

## Project Components

- Construction of Gas Conditioning Facility
- Construction of Digester on two Dairies
- Construction of Biogas Pipeline



The above project components are planned for Summer 2011

# Construction of Gas Conditioning Facility adjacent to Northern Natural Gas Interconnect

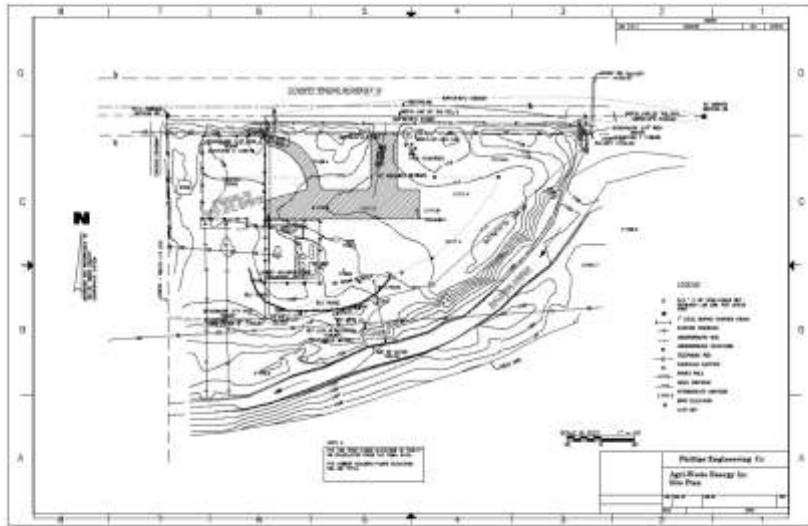
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A new building will be built adjacent to the Northern Natural Gas Pipeline Interconnect west of Baldwin. The new building will house the Guild PSA Gas Conditioning equipment.

# GCF Building Site Plan



The Guild PSA Gas Conditioning equipment will be located in a new building at this site adjacent to the Northern Natural Gas pipeline interconnect.

# Construction of Digester on two Dairies

## Jon-De Farm



Jon-De Farm is a family owned dairy with 1700 cows.

# Construction of Digester on two Dairies

## Bomaz Farms



Bomaz Farms is a family owned dairy with 1000 cows.

## Construction of Digester on two Dairies by Genex Farm Systems using Andigen design



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Digesters at Jon-De Farm and Bomaz Farms will be built by Genex Farm Systems. Genex has licensed digester technology from Andigen Digester Systems. Genex constructed the digester in the above photo at a 150 cow dairy in Minnesota. It is a “one tank” system and has been operating since April 2008. The digester at Jon-De Farm will have nine tanks like the one pictured above, and Bomaz Farms will have six of the same tanks.

## Andigen System 9 Tank at Stanton Farm, Ontario



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The above project is an operating Andigen system similar to those planned for Jon-De and Bomaz Dairies.

## Construction of Biogas Pipeline



Build 9.5 miles  
of Biogas  
Pipeline in  
Township  
Right-of-Way



The 9.5 miles of four inch biogas pipeline will be built in township right-way to deliver biogas from the dairies to the Gas Conditioning Facility and Pipeline Interconnect.



## Permitting / Construction

- Permitting completed
- Construction planned for Summer 2011



All of the permitting for the construction of the new Gas Conditioning Facility is completed. County and township permitting for the biogas pipeline is completed. Wisconsin DNR permitting for the digesters and biogas pipeline are completed. All construction is planned for Summer 2011.