



# Life-Cycle Assessment of RDF Jasper (Herrema) Animal Waste Pathway to Compressed Natural Gas (CNG)

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# Table of Contents

<b>I. General Information .....</b>	<b>3</b>
<b>II. Process Description .....</b>	<b>3</b>
<b>III. Data Collection .....</b>	<b>4</b>
<b>IV. Tier 1 Modifications and Results.....</b>	<b>4</b>
1.1 Digester Product Biogas to Biomethane Injection .....	4
1.2 Crediting – Protocol Methane Emissions.....	4
1.3 Selected Electricity Grid Mix .....	4
1.4 Natural Gas Transmission .....	5
2. Herrema Fuel Pathway Results .....	5

## I. General Information

RDF Jasper, an AMP Americas LLC Project, is producing biomethane from three animal waste anaerobic digester (AD) facilities located at Fair Oaks, IN. The biogas is produced by the anaerobic digestion of dairy cow manure with no other material being co-processed with the manure.

The Herrema digester produced [REDACTED] dth (in HHV) of product biomethane from January 2019 – August 2019. This 8-month period was chosen because it is most recent time period when the facility was in full operation and there is a full set of Livestock Offset Protocol reporting data to present. The carbon intensity calculation is utilizing a slightly modified version of the ARB develop Tier 1 Simplified CI Calculator for Biomethane from Anaerobic Digestion of Dairy and Swine Manure. The Jasper facility, when utilizing a methane mass balance approach around the gas upgrading system, has higher quantified fugitive methane emissions than the default 2% resulting in the need to modify cell E86 on the EF Table tab of the calculator.

The use of the existing Tier 1 calculator and only modifying a singular value, fugitive methane from upgrading (also known as feed loss), means the pathways is accepting and using the boundary conditions, feedstock definitions, emission factors, and all other assumptions contained within the model. The following report details the methodology for modifying the fugitive methane from upgrading. All other inputs to the model follow the methodology of the Tier 1 process and are contained in the files identified below.

## II. Process Description

The Jasper facility processes biogas from three plug-flow, heated mesophilic digesters – Bos, Herrema and Windy Ridge. Manure is processed at Bos, Herrema and Windy Ridge dairy farms. The biogas is compressed and dehydrated prior to transport to a central facility co-located at the Windy Ridge dairy farm. The raw biogas goes through a desulphurization unit, the [REDACTED], which removes the hydrogen sulfide (H<sub>2</sub>S) [REDACTED]

[REDACTED] The biogas is then pressurized in a blower and goes through a dehydration process and passes through a [REDACTED] [REDACTED] to remove any impurities such as dirt and sand. The gas goes through a compressor to increase its pressure for further purification and passes through water separators to remove water vapor. The biogas is then heated and goes through a [REDACTED] [REDACTED] to remove the carbon dioxide (CO<sub>2</sub>).

The purified gas is now considered clean product gas meeting NiSource (NIPSCO) pipeline specification. It will pass through a buffer vessel and then a sales gas compressor to boost its pressure to meet utility pressure requirement. A gas chromatograph is located within the gas utility instrument building and takes heating value measurements every 5 minutes.

The dairy farm purchases natural gas for onsite generation of heat for the digesters and electricity for the digesters and farm. Since there is no sub-metering between farm and the digester at this time, the conservative assumption was made to allocate all of the energy and emissions from the generator to the AD pathway. [REDACTED]

### III. Data Collection

There are three (3) main excel files containing the source data for the Tier 1 calculator and reference in the following report are the following:

- (1) Climeco\_LOP\_Databook\_RP7\_v7.0 data book (identified as “ClimeCo DB” in the rest of the report) for 2019 livestock offset protocol (LOP) data
- (2) Climeco\_LOP\_Databook\_RP6\_v7.0 (“identified as “ClimeCo DB” in the rest of the report) for 2018 livestock offset protocol (LOP) data
- (3) RDF Jasper Plant DataBook v11 (identified as “AMP DB” in the rest of the report) for facility specific energy consumption and gas production allocation of product gas between Windy Ridge, Bos and Herrema dairies

### IV. Tier 1 Modifications and Results

#### 1.1 Digester Product Biogas to Biomethane Injection

The fugitive methane emissions from upgrading were modified to be facility specific. The fugitive methane emissions were quantified by subtracting the flare and product methane from raw digester inlet methane. The flare flow is metered [REDACTED]. Upon guidance and discussion with ARB since the gas consumed at the flare is mainly product RNG [REDACTED], the best measure of biomethane concentration was the GC measured concentration of the product gas (reference “RNG Product BTU Content”).

**Exhibit 1. Fugitive Methane for January 2019 to August 2019**

	Total in LHV (MMBtu)	Cell in Tier 1 CI Model	Cell in Tier 1 CI Model edited
Raw Biogas Flow to Upgrading	[REDACTED]	F55 on the Biogas-to-RNG tab	
Flared Methane	[REDACTED]	U55 on the Biogas-to-RNG tab	
Product Biomethane	[REDACTED]	V55 on the Biogas-to-RNG tab	
Fugitive Methane	[REDACTED]	-	
Fugitive Methane (%)	[REDACTED]		E86 on the EF Table Tab

#### 1.2 Crediting – Protocol Methane Emissions

Please See Tier 1 Calculator.

#### 1.3 Selected Electricity Grid Mix

The RFC West (RFCW) 2012 eGRID region was used to model the Jasper facility (in Fair Oaks, IN).

## 1.4 Natural Gas Transmission

The pipeline transport distance was [REDACTED] from Herrema Dairy, Fair Oaks, IN, to Bakersfield, California as instructed by Tier 1 reference. Google Maps was used to determine the driving routes.

## 2. Herrema Fuel Pathway Results

Adopting modification stated above the following table reflects the fuel pathway for Herrema taken from Section 4 of the completed modified Tier 1 calculator.

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### Exhibit 2. Herrema CI Calculation Details

CI Calculation Details – gCO2e/MJ	
Raw Biogas Production – Digester	
Utility Sources Natura Gas	61.88
Biogas Upgrading	
Grid Electricity	17.00
Utility source NG	0.43
Biomethane (flaring)	27.18
Feed Loss (fugitive methane	42.47
Biomethane Transmission	11.91
CNG Production	3.50
Tailpipe Emissions	60.73
Methane Avoided Credit	-330.66
CO2 Diverted Credit	-44.31
Final CNG CI	-151.41

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