AARDVARK
Certification Ltd

Warren Energy Biomethane Plant

CO_2 Analysis Report

November 2019

Prepared for: John Laing Environmental Assets Group (UK) Ltd

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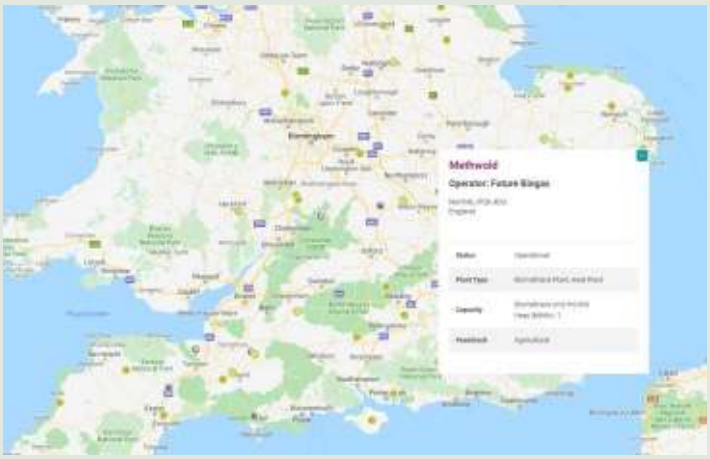
Executive Summary

Aardvark Certification Ltd (ACL) has been instructed by John Laing Environmental Assets Group (UK) Ltd to assess and report against the carbon savings achieved by the 466m3/hr Warren Energy Biomethane Plant located at Methwold in Norfolk. This assessment considers the CO_2 savings made as a result of this biogas plant as well as the wider environmental benefits the project has delivered.

Asset Introduction

The Warren Energy Biomethane Plant is fed on a menu of 49,000 tonnes per annum of agricultural feedstocks including whole crop maize, rye, sugar beet pulp and waste straw. The biogas plant has a designed export capacity of 466m3/hr biomethane with all biomethane produced exported directly to the national gas grid. A 500kW CHP provides heat and power to meet the energy requirements of the plant with surplus electricity exported to the grid. The plant was commissioned in December 2015 and to date has produced 16,654MWh of renewable electricity and a further 146,272MWh of biomethane.



CO2 Savings from Biomethane

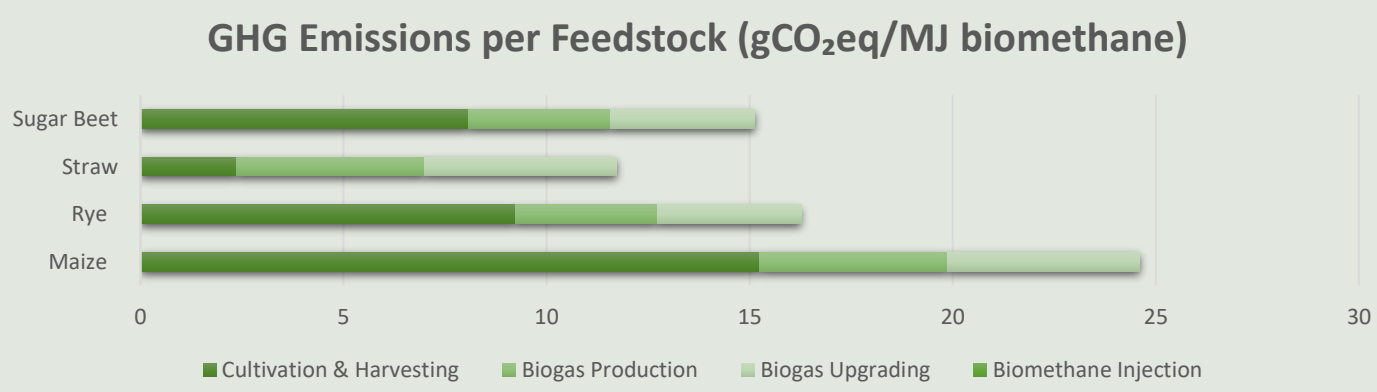
Biomethane offsets significant CO_2 emissions compared with fossil fuel derived gas and electricity. Standard conversion factors for fossil fuel derived electricity, natural gas and biomethane are shown below:
UK Generated Electricity: 0.2556 kg CO_2e per kWh
Natural Gas: 0.18385 kg CO_2e per kWh (gross CV)
Biomethane: 0.000375585 kg CO_2e per kWh (gross CV)
The calculated CO_2 savings shown within this report are based on the actual savings achieved by the site.

Greenhouse Gas Emissions

The Warren Energy Biomethane Plant uses a range of agricultural feedstocks to produce energy which comprise of purpose grown crops. The cultivation, harvesting and conversion of the crops to energy requires an element of fossil fuel use. The actual CO_2 savings achieved therefore need to account for the associated GHG emissions produced through the use of the crop based feedstocks. A simplified illustration of the fuel chain shows each step at which GHG emissions are produced through use of crop based feedstocks.

GHG Emissions by Feedstock

Each crop based feedstock has been assessed to determine the specific GHG emissions associated with their use with emissions at each step in the fuel chain quantified and shown below:



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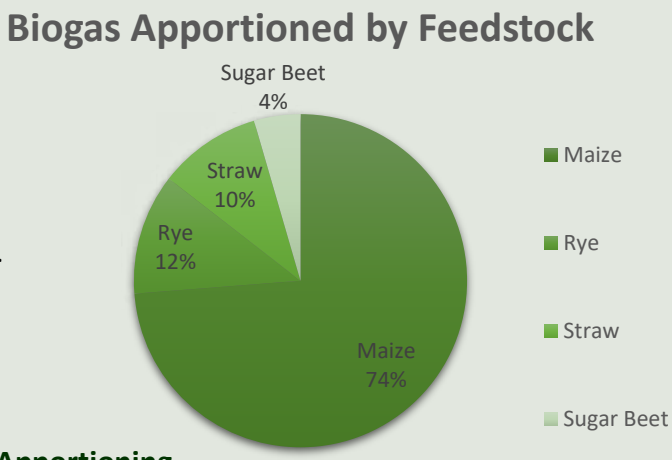
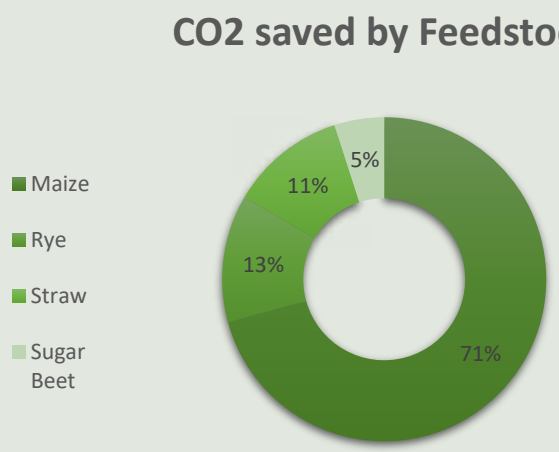
Biogas Apportioning

As the Warren Energy Biomethane Plant uses a range of agricultural feedstocks, it is necessary to understand what proportion of the biogas produced is derived from each feedstock in order to quantify the CO_2 savings achieved by the plant. To do this we apportion the biogas across the range of feedstocks based on their individual biogas yields.





CO_2 Apportioning

In order to account for the associated GHG emissions resulting from the use of purpose grown crops to produce the electricity and biomethane, it is necessary to apportion the CO_2 emissions saved as a result of the operation of the biomethane plant by feedstock type. This shows that whilst some feedstocks contribute more to overall biogas production than others, these are not necessarily delivering the highest levels of CO_2 savings for the plant as emissions associated with their production can be greater.

CO_2 Savings

With the preceding analysis, it is possible to calculate the CO_2 savings the plant has achieved over its lifetime had the equivalent quantity of energy been derived from fossil fuel sources. Total CO_2 emissions which would have come from an equivalent quantity of electricity or natural gas from fossil fuel sources in the UK is shown below along with CO_2 savings made through energy production from the biomethane plant. This shows a total saving to date of 3,916tCO_2e has been saved by the Warren Energy Biomethane Plant through its electricity export and a further 15,293tCO_2e has been saved through biomethane production.

Total Energy Produced				UK Generated Eectricity	Biogas Generated Electricity
			Conversion factors	0.28088	
Electricity	16,712	MWh	CO_2 Equivalient (kg CO_2e)	4,694,067	778,344
			CO_2 Difference (kg CO_2e)	3,915,723	

Total Energy Produced				UK Natural Gas Emissions	Biomethane Emissions
			Conversion factors	0.18396	
Biomethane	147,136	MWh	CO_2 Equivalient (kg CO_2e)	27,067,139	11,774,016
			CO_2 Difference (kg CO_2e)	15,293,123	

CO_2 Forecast

An anaerobic digestion plant is typically designed with a 20 year operational lifetime. In practice this may go on well beyond the planned 20 years. Based on the expected 20 year operational forecast, the Warren Energy plant is expected to save a total of 96,044tCO_2e. This forecast is based on the current GHG emissions associated with the production of feedstocks and operation of the plant. In practice it is expected that improved technology and efficiencies over the remainder of the lifetime of the plant will enable it to reduce its own emissions thereby increasing the overall CO_2 savings it contributes.

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What do these savings mean?

The CO_2 savings achieved by the project can be difficult to comprehend and relate to real world understanding. We therefore equate the savings to every day scenarios such as vehicles, and homes to assist readers in interpreting the data.

The Warren Energy Biomethane Plant has to date offset 19,209tCO_2e since commissioning and is expected to offset at least 96,044tCO_2e over its operational lifetime. This equates to:

- Equivalent emissions produced by a mid-sized diesel car driving around Earth's equator 13,811 times over the lifetime of the plant
- Removing 44,091 mid-sized diesel cars from UK roads based on the lifetime CO_2 savings the plant will achieve whilst it has already offset equivalent emissions to 8,818 cars.
- Providing enough gas for heating and cooking in 2,053 average UK homes over the lifetime of the plant
- Providing enough renewable electricity to power 4,592 average UK homes over the lifetime of the plant

Other Environmental & Community Benefits

The Warren Biomethane Plant delivers another important environmental benefit to the local farms around the plant through provision of a natural biofertilizer they are able to use. This offsets the need for fossil fuel derived fertilisers. The liquid fraction of the digestate has been particularly useful for establishment of cover crop, oilseed rape and grass. Use of the digestate as a direct replacement for traditional fertilisers offsets an estimated 283 t CO_2e per annum.

In addition, the operator of the plant has:

- Sponsored a soil health research project
- Planted 23km of bee friendly, floristically enhanced margins at its own cost to promote biodiversity in AD crops
- Participated in LEAF "Open Farm Sunday" for several years – an education event where the benefits of AD cropping are explained

The farm operates under good farming practice guidance growing cover crops every winter to protect and enhance soil health. As part of the LEAF scheme, the farm facilitates visitor days to engage with the local community and are looking to introduce LEAF education visits looking at the science of farming.

Methodology

This report has been prepared in good faith by Aardvark Certification Ltd based on data obtained from the owner/operator of the asset reviewed. Our calculations of GHG emissions associated with the production of biogas from the plant has been through the Ricardo Biomethane and Heat GHG Calculator Tool, v 1.1 updated on 09/06/2016. Our GHG emissions assumptions for this plant are based on an annualised average emissions value for the plant by feedstock type. Biogas yield data is an average of the UKAS accredited laboratory analysis undertaken of the plants specific feedstocks over a three year period.

Our calculations of CO2 savings are based on IFI Approach to GHG Accounting for Renewable Energy Projects. Baseline Emission Factors used in this analysis are taken directly from the Department for Business, Energy & Industrial Strategy Greenhouse gas reporting: conversion factors 2019.

Energy usage statistics are taken from OfGEM - https://www.ofgem.gov.uk/gas/retail-market/monitoring-data-and-statistics/typical-domestic-consumption-values

Mileage travelled per vehicle in the UK was taken from the RAC Foundation.

Digestate NPK values sourced from Defra's Fertiliser Manual 2017 (RB209) 9th edition

Liability

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