

# Vulcan Renewables Biomethane Plant CO<sub>2</sub> Analysis Report

August 2018

# Vulcan Renewables Biomethane Plant

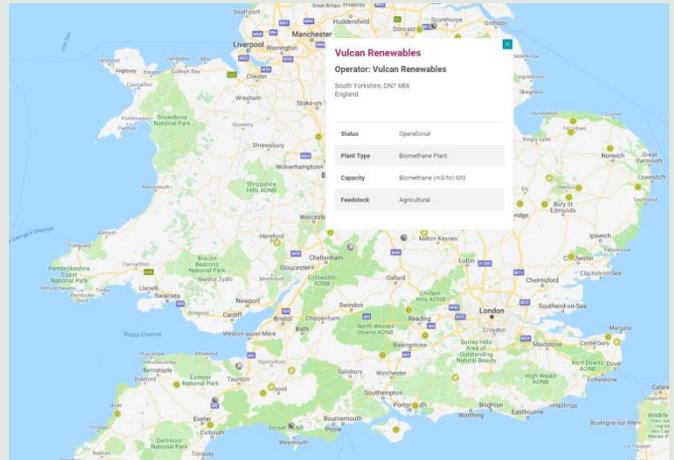
## CO<sub>2</sub> Analysis Report

### Executive Summary

Aardvark Certification Ltd (ACL) has been instructed by John Laing Environmental Assets Group Ltd to assess and report against the carbon savings achieved by the 600m<sup>3</sup>/hr Vulcan Renewables Biomethane Plant located at Bawtry Road, Lindolme, Doncaster, DN7 6BY. This assessment considers the CO<sub>2</sub> savings made as a result of this biogas plant as well as the wider environmental benefits the project has delivered.

### Asset Introduction

The Vulcan Renewables Biomethane Plant is fed on a menu of 42,000 tonnes per annum of agricultural feedstocks including whole crop maize, rye, sugar beet and grass silage. The biogas plant has a designed export capacity of 450m<sup>3</sup>/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 October 2013 and to date has exported 14,000MWh of renewable electricity and a further 186,000MWh of biomethane.



### CO<sub>2</sub> Savings from Biomethane

Biomethane offsets significant CO<sub>2</sub> emissions compared with fossil fuel derived gas and electricity. Conversion factors for fossil fuel derived electricity, natural gas and biomethane are shown below:

- UK Generated Electricity: 0.28037 kg CO<sub>2</sub>e per kWh
- Natural Gas: 0.18396 kg CO<sub>2</sub>e per kWh (gross CV)
- Biomethane: 0.00037703 kg CO<sub>2</sub>e per kWh (gross CV)

The calculated CO<sub>2</sub> savings shown within this report are based on the actual savings achieved by the site.

### Greenhouse Gas Emissions

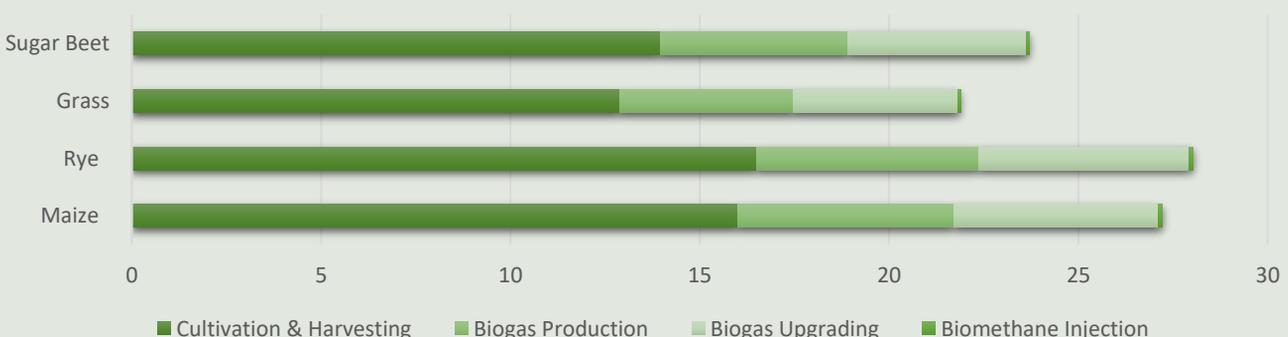
The Vulcan Renewables Biomethane Plant uses a range of agricultural feedstocks to produce energy which comprise of purpose grown crops. The cultivation, harvesting and conversion of the crops to energy requires an element of fossil fuel use. The actual CO<sub>2</sub> savings achieved therefore need to 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:

**GHG Emissions per Feedstock (gCO<sub>2</sub>eq/MJ biomethane)**



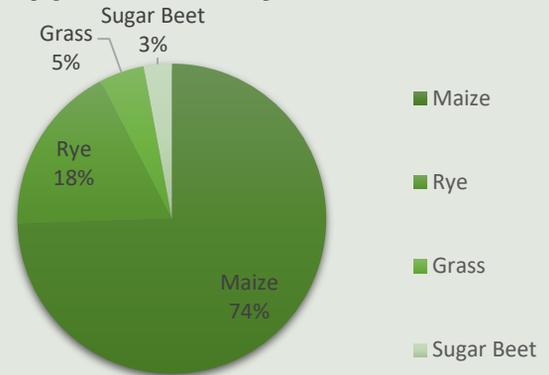
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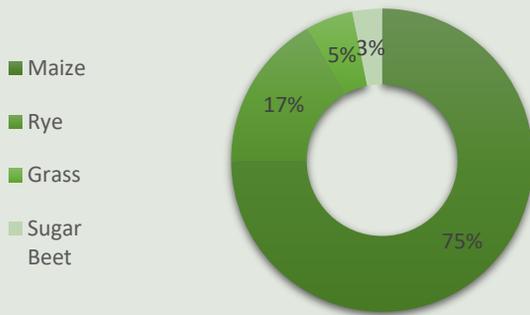
### Biogas Apportioning

As the Vulcan Renewables 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<sub>2</sub> savings achieved by the plant. To do this we apportion the biogas across the range of feedstocks based on their individual biogas yields.

### Biogas Apportioned by Feedstock



### CO<sub>2</sub> saved by Feedstock



### CO<sub>2</sub> 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<sub>2</sub> 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<sub>2</sub> savings for the plant as emissions associated with their production can be greater.

### CO<sub>2</sub> Savings

With the preceding analysis, it is possible to calculate the CO<sub>2</sub> savings the plant has achieved over its lifetime had the equivalent quantity of energy been derived from fossil fuel sources. Total CO<sub>2</sub> 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<sub>2</sub> savings made through energy production from the biomethane plant. This shows a total saving to date of 3,264tCO<sub>2</sub>e has been saved by the Vulcan Renewables plant through its electricity export and a further 15,827tCO<sub>2</sub>e has been saved through biomethane production.

Total Energy Produced			Conversion factors		UK Generated Electricity	Biomethane Emissions
Electricity	14,000	MWh	CO <sub>2</sub> Equivalent (kg CO <sub>2</sub> e)	0.28088	3,932,320	18,389,501
			CO <sub>2</sub> Difference (kg CO <sub>2</sub> e)		3,264,172	

Total Energy Produced			Conversion factors		UK Natural Gas Emissions	Biomethane Emissions
Biomethane	186,000	MWh	CO <sub>2</sub> Equivalent (kg CO <sub>2</sub> e)	0.18396	34,216,560	18,389,501
			CO <sub>2</sub> Difference (kg CO <sub>2</sub> e)		15,827,059	

### CO<sub>2</sub> 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 Vulcan Renewables plant is expected to save a total of 95,456tCO<sub>2</sub>e. 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<sub>2</sub> savings it contributes.

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### What do these savings mean?

The CO<sub>2</sub> 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 Vulcan Renewables Biomethane Plant has to date offset 19,091tCO<sub>2</sub>e since commissioning and is expected to offset at least 95,456tCO<sub>2</sub>e over its operational lifetime. This equates to:

- Equivalent emissions produced by a mid-sized diesel car driving around Earth's equator 13,276 times over the lifetime of the plant
- Removing 2,178 mid-sized diesel cars from UK roads every year over the lifetime of the project
- Providing enough gas for heating and cooking in 3,100 average UK homes over the lifetime of the plant
- Providing enough renewable electricity to power 1,000 average UK homes over the lifetime of the plant

### Other Environmental/Social Benefits

The Vulcan Renewables Biomethane Plant delivers several other environmental and local community benefits. These have included to date:

- £5,000 paid to a local community benefit fund in the last financial year which has been used for:
  - new playground equipment for a local primary school
  - payment of brownie and girl guide annual subscriptions
  - purchase of a trailer for the local scout group
  - a new boiler for the local Methodist Church
  - Payment of rent for the local gardening society
- The resultant digestate from the plant is used on local farmland as a valuable biofertilizer. The liquid fraction 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 472 t CO<sub>2</sub>e per annum

### 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 CO<sub>2</sub> 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 2018.

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) 9<sup>th</sup> edition

### Liability

This document contains information and may contain conclusions and recommendations. Every effort has been made to ensure that the information is accurate and that the opinions expressed are sound. However, Aardvark EM Limited cannot be made liable for any errors or omissions or for any losses or consequential losses resulting from decisions based on the information.



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