IEA Bioenergy Task 37

IEA Bioenergy Task 37: Energy from Biogas

Overview of Task 37 Activities by Prof Jerry D Murphy

Circular economy in the food system Workshop
Kokousravintola Hatmooni, Jyvaskyla, Finland,
Thursday March 8

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IEA Bioenergy

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IEA Bioenergy presently has 10 Tasks

Task 32: Biomass Combustion and Co-Firing
Task 33: Thermal Gasification of Biomass
Task 34: Pyrolysis of Biomass
Task 36: Integrating Energy Recovery into Solid Waste Management
Task 37: Energy from Biogas
Task 38: Climate Change Impacts of Biomass and Bioenergy Systems
Task 39: Commercialisation of Conventional and Advanced Liquid Biofuels from Biomass
Task 40: Sustainable Bioenergy Markets and International Trade: Securing Supply and Demand
Task 42: Biorefineries: Sustainable Processing of Biomass into a Spectrum of Marketable Biobased Products and Bioenergy
Task 43: Biomass Feedstocks for Energy Markets

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Member countries participating in Task 37

Australia	Bernadette McCabe
Austria	Bernard Drosg / Günther Bochmann
Brazil	Rodrigo Regis / Marcello Alves de Sousa
Denmark	Teodorita Al-Seadi
Estonia	Elis Volimer
Finland	Saija Rasi
France	Olivier Théobald / Guillaume Bastide
Germany	Jan Liebertrau
Ireland	Jerry Murphy
Korea	Soon Chul Park
Norway	Tormod Briseid
Sweden	Anton Fagerstrom
Switzerland	Urs Baier
The Netherlands	Mathieu Dumont
United Kingdom	Clare Lukehurst / Charles Banks

Technical Reports Triennium 2013 - 2015

1. A perspective on algal biogas,
2. Nutrient recovery by biogas digestate processing,
3. A perspective on the potential role of biogas in smart energy grids,
4. Pretreatment of feedstock for enhanced biogas production,
5. Process monitoring in biogas plants
6. Source separation of municipal solid waste
7. Sustainable biogas production in municipal wastewater treatment plants
8. Exploring the viability of small scale anaerobic digesters in livestock farming

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Nutrient Recovery by Biogas Digestate Processing

Bernhard Drosg
Werner Fuchs
Teodorita Al Seadi
Michael Madsen
Bernd Linke

SUMMARY

This report reviews various approaches for processing of biogas plant digestate for the purpose of nutrient recovery. It covers both established and emerging technologies and assesses technical performance and where possible economics. Techniques for nutrient recovery from digestate are developing rapidly and aim to improve nutrient management in agriculture and in waste treatment systems.

The report is aimed at biogas plant developers and operators as well as agriculture policy makers and was produced by IEA Bioenergy Task 37. IEA Bioenergy Task 37 addresses challenges related to the economic and environmental sustainability of biogas production and utilisation.

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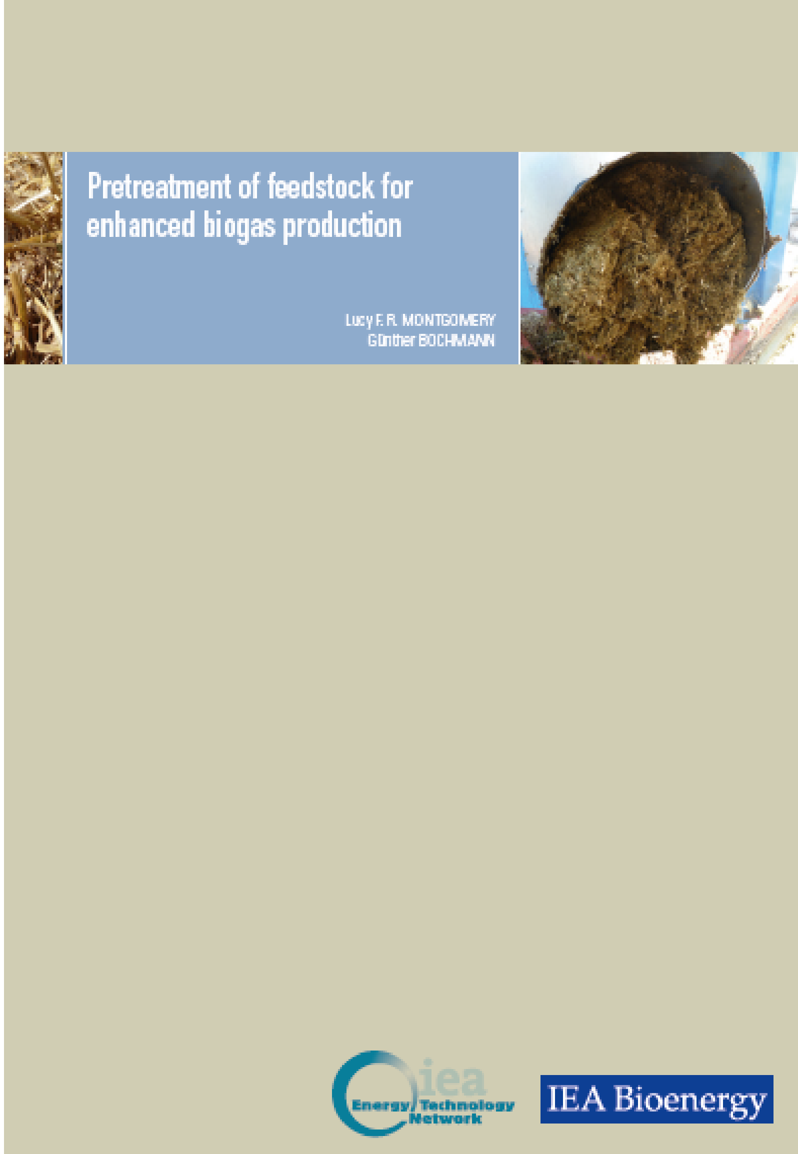

Pretreatment of feedstock for enhanced biogas production

Lucy F. R. MONTGOMERY
Günther BOCHMANN

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A perspective on algal biogas

Jerry D MURPHY
Bernhard DROSG
Eoin ALLEN
Jacqueline JERNEY
Ao XIA
Christiane HERRMANN

SUMMARY

Algae are suggested as a biomass source with significant growth rates, which may be cultivated in the ocean (seaweed) or on marginal land (microalgae). Biogas is suggested as a beneficial route to sustainable energy, however the scientific literature on algal biogas is relatively sparse. This report comprises a review of the literature and provides a state of the art in algal biogas and is aimed at an audience of academics and energy policy makers. It was produced by IEA Bioenergy Task 37 which addresses the challenges related to the economic and environmental sustainability of biogas production and utilisation.

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A perspective on the potential role of biogas in smart energy grids

Tobias PERSSON, Jerry MURPHY,
Anna-Karin JANNASCH, Eoin AHERN,
Jan LIEBETRAU, Marcus TROMMLER,
Jeferson TOYAMA

SUMMARY

This report documents the potential role of biogas in smart energy grids. Biogas systems can facilitate increased proportions of variable renewable electricity on the electricity grid through use of two different technologies:

- Demand driven biogas systems which increase production of electricity from biogas facilities at times of high demand for electricity, or store biogas temporarily at times of low electricity demand.
- Power to gas systems when demand for electricity is less than supply of electricity to the electricity grid, allowing conversion of surplus electricity to gas.

The report is aimed at an audience of energy developers, energy policy makers and academics and was produced by IEA Bioenergy Task 37. Task 37 is a part of IEA Bioenergy, which is one of the 42 Implementing Agreements within IEA. IEA Bioenergy Task 37 addresses the challenges related to the economic and environmental sustainability of biogas production and utilisation.

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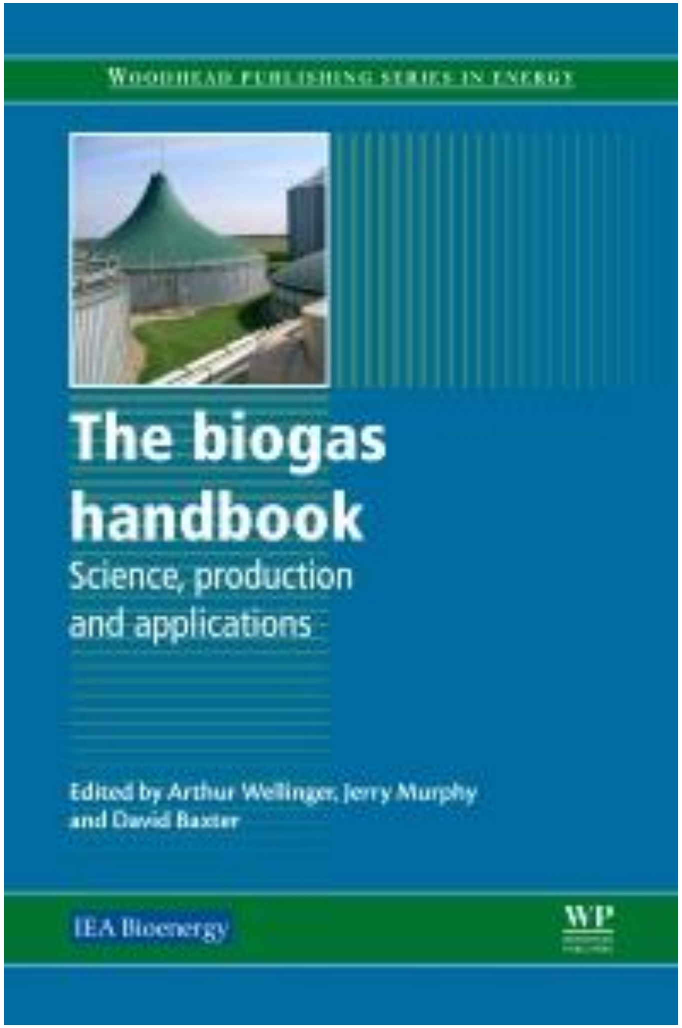
The Biogas Handbook

Science, production
And applications

2013

http://www.woodheadpublishing.com/en/book.aspx?bookID=2576



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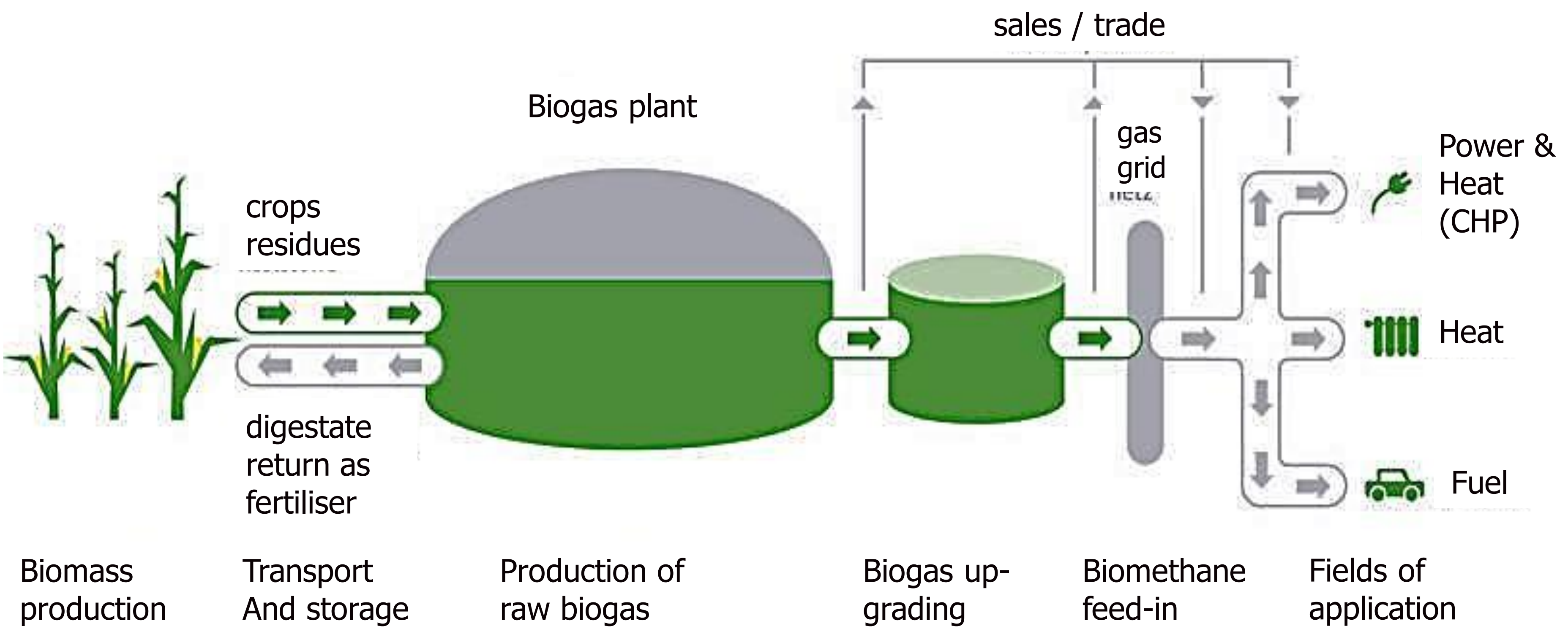
Task 37
Work Programme 2016-2018

The Biogas/Biomethane Process Chain



Source: dena, biogasregister 2011

Case studies Triennium 2016 - 2018

1. Den Eelder Farm: small farm scale mono-digestion of dairy slurry.
2. Green Gas Hub: provision of biogas by farmers by pipe to a Green Gas Hub with a centralised upgrading process.
3. Biomethane demonstration: Innovation in urban waste treatment and in biomethane vehicle fuel production in Brazil.
4. Profitable on- farm biogas in the Australian pork sector.
5. Sondrerjysk Biogas Bevtoft: Hi tech Danish biogas installation a key player in local rural development

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BIOGAS IN SOCIETY
A Case Story

DEN EELDER FARM

Small farm scale mono-digestion of dairy slurry for energy independence and reduction in greenhouse gas emissions

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IEA Bioenergy: Task 37: February 2017

Specifications of digester system at Den Eelder farm

- Technique: mono-digestion
- Input (per year): 15,000 tons of fresh cow manure
- Capacity: 66 kW electricity / 700 kW heat
- Net output (per year): 500,000 kWh of electricity and 1.5 million kWh of heat

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BIOGAS IN SOCIETY
A Case Story

GREEN GAS HUB

Provision of biogas by farmers by pipe to a Green Gas Hub with a centralised upgrading process

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IEA Bioenergy: Task 37: April 2017

Figure 2:gas upgrading membranes at the Wijster green gas hub

Technique	Capacity Nm³ biogas/ hour	Green Gas Nm³ biogas/h	Year of installation
PSA.	1200	840	1989
Water Scrubbing	1000	700	2012
Membrane	800	560 (plus liquid CO_2)	2014

Table 1: Attero's gas refining installations at Wijster

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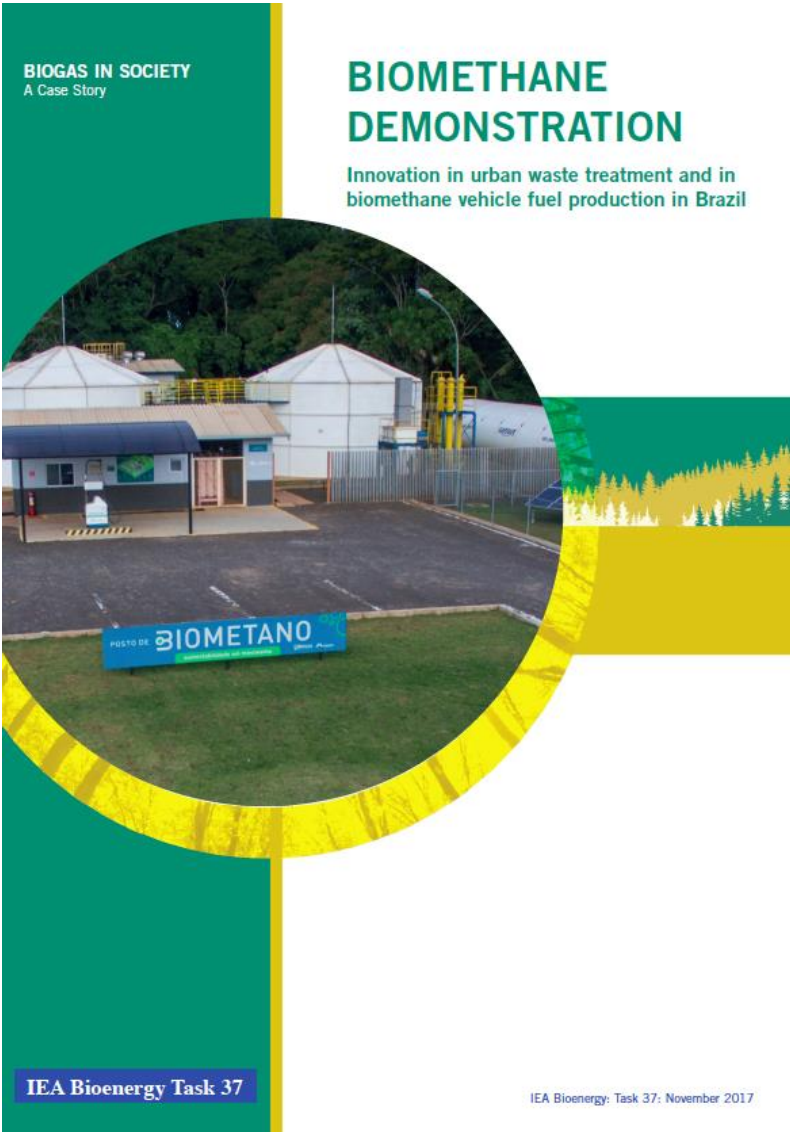
BIOGAS IN SOCIETY
A Case Story

BIOMETHANE DEMONSTRATION

Innovation in urban waste treatment and in biomethane vehicle fuel production in Brazil

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60 cars fuelled

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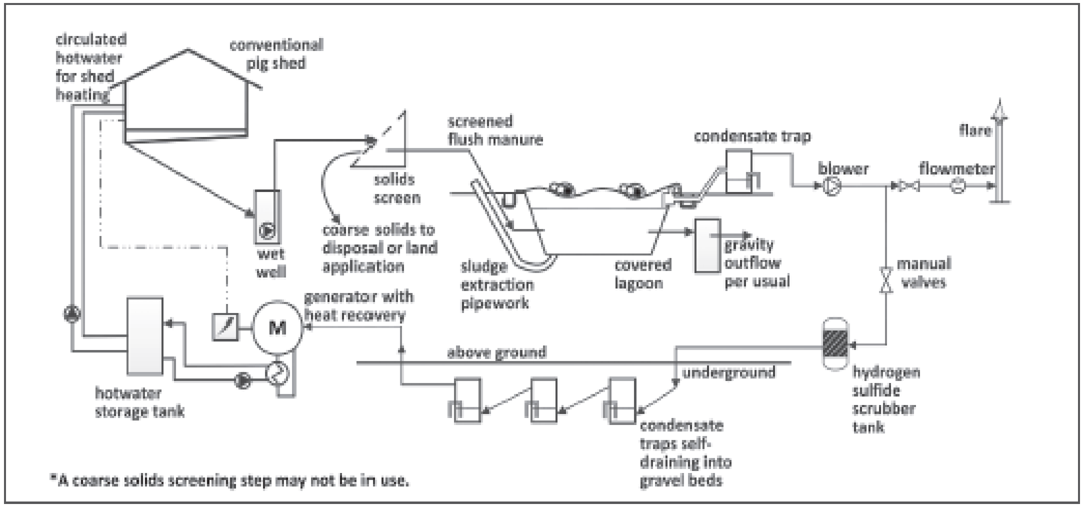

Figure 3: A schematic overview of a covered lagoon biogas set-up at a piggery

Table 1: Results from five feasibility studies of various Australian piggeries

Piggery	– Standard Pig Units (SPU)*	Payback period (years)	10 year return on investment (%)	Total capital cost (AUD)
Multi-site farrow-to-finish	12,692	4.2	198	411,900
Grow-out unit	5,112	8.5	7	279,400
Sow multiplier	7,089	1.8	597	170,200
Farrow-to-finish	5,432	4.7	151	345,600
Farrow-to-finish	6,975	7.2	64	298,300

* A standard pig unit (SPU) has a waste output (volatile solids production) equivalent to a typical 40 kg (live weight) grower pig. Expressing piggery capacities in terms of SPUs provides a measure of the piggery waste production for various types of production units (e.g. breeder, grower and farrow to finish). For example, a typical 100-sow farrow-to-finish piggery has a capacity of about 1000 SPUs.

Source: Pork CRC http://porkcrc.com.au/wp-content/uploads/2013/08/4C-102-Final-Report-130420.pdf

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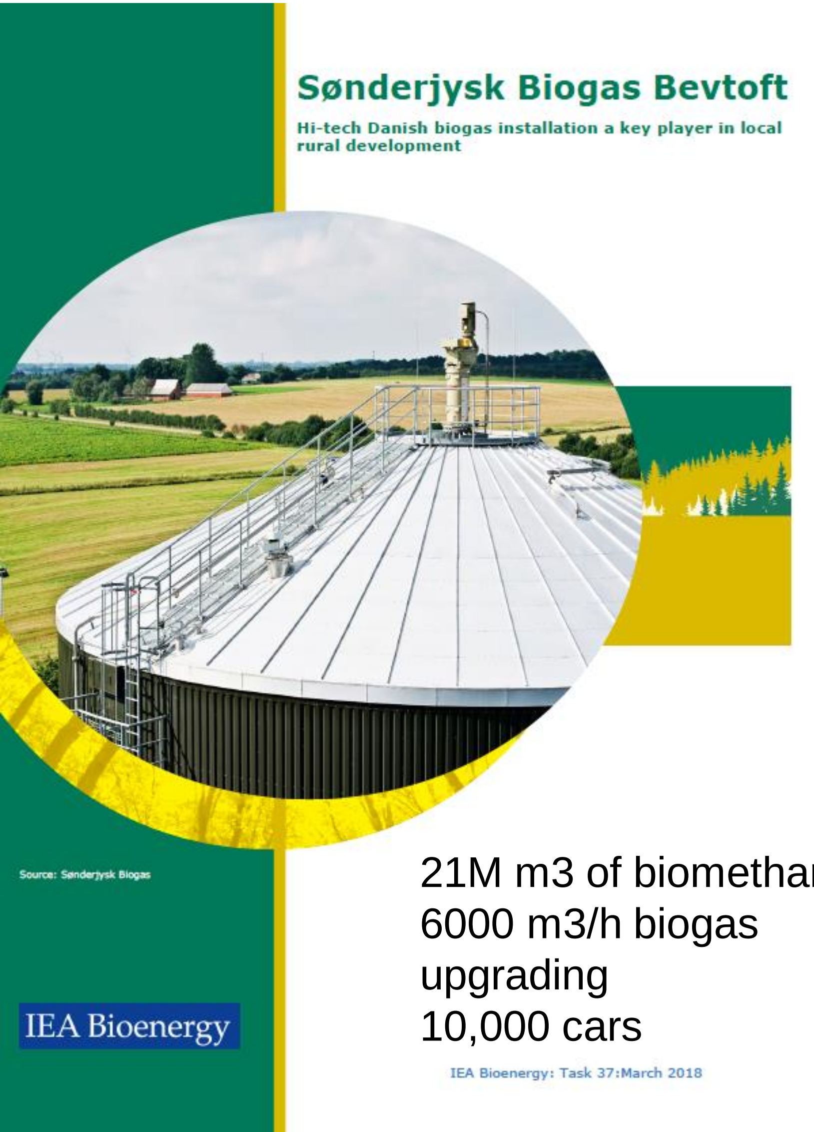

21M m3 of biomethane
6000 m3/h biogas upgrading
10,000 cars

Type	Tons
Animal slurries	425,000
Animal bedding /deep litter	10,000
Straw	50,000
Organic wastes	55,000
TOTAL	**540,000**

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Technical Reports Triennium 2016 - 2018

1. Food waste digestion systems.
2. Local applications to sustainable anaerobic digestion
3. Green Gas
4. The role of anaerobic digestion and biogas in the circular economy
5. Validity of BMP results
6. Methane emissions
7. Sustainable Bioenergy Chains (Collaboration with Task 40)

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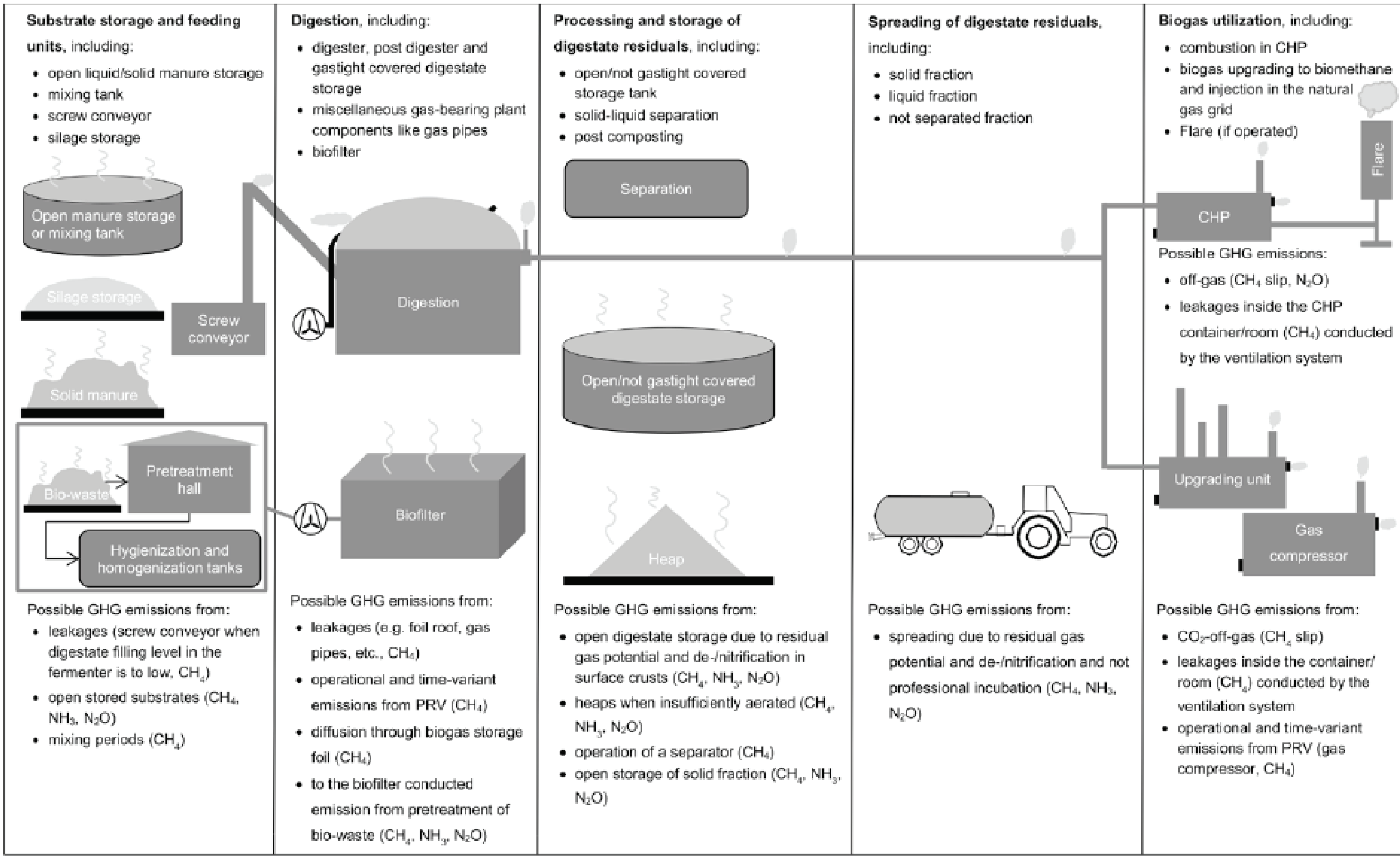
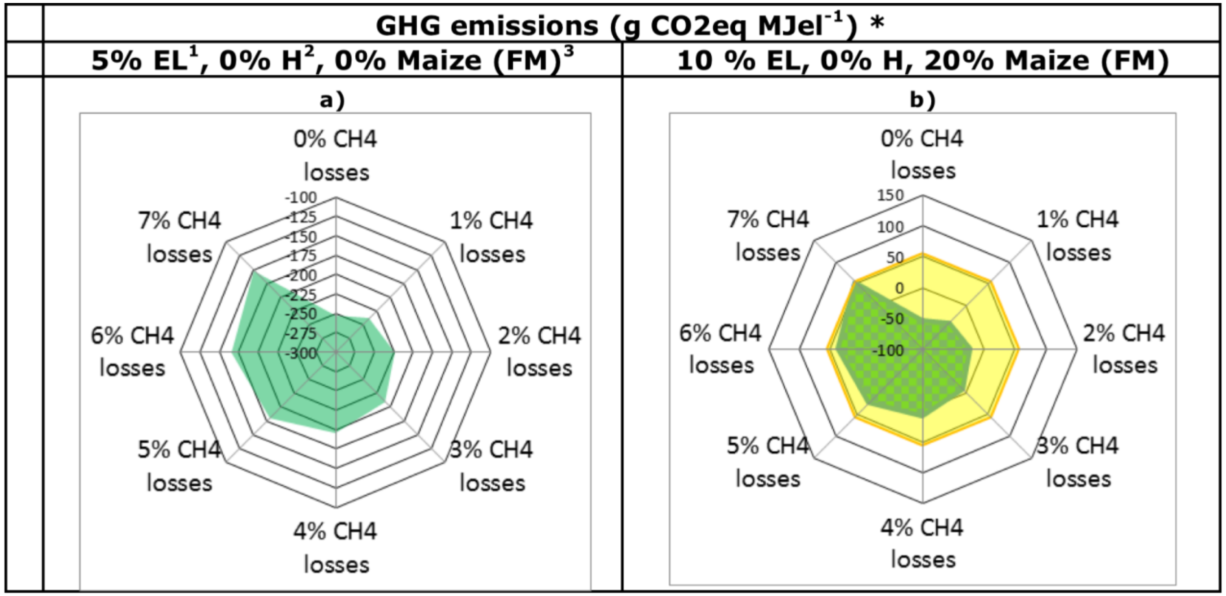


Figure 25: Overview about GHG emission sources from components and processes applied within biogas production and utilisation

All slurry



20% Maize
80% slurry

Methane slippage and sustainability

Must save 70% GHG savings as compared to fossil fuel displaced to be deemed sustainable

Fossil fuel comparator (FFC) is equal to 186 g CO2eq. per MJ of electricity

30 % of the FFC, which corresponds to 55.8 gCO_2/MJ

Slurry storage without digestion assumed to produce 17.5% of methane produced; thus carbon negative feedstock

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Decarbonised buses

California Air Resources Board (CARB) awarded a Carbon Intensity (CI) score of -254.94 gCO_2e/MJ for a dairy waste to vehicle fuel pathway. This is the lowest ever issued by CARB.

Renewable Energy Directive requires 3.6% of transport energy by 2030 to be from advanced biofuels. Ryegrass is a significant source of advanced biofuel.

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Green gas

Facilitating a future green gas grid though the production of renewable gas

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IEA Bioenergy: Task 37: 2018: 2

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journal homepage: www.elsevier.com/locate/biortech

Review

Cascading biomethane energy systems for sustainable green gas production in a circular economy

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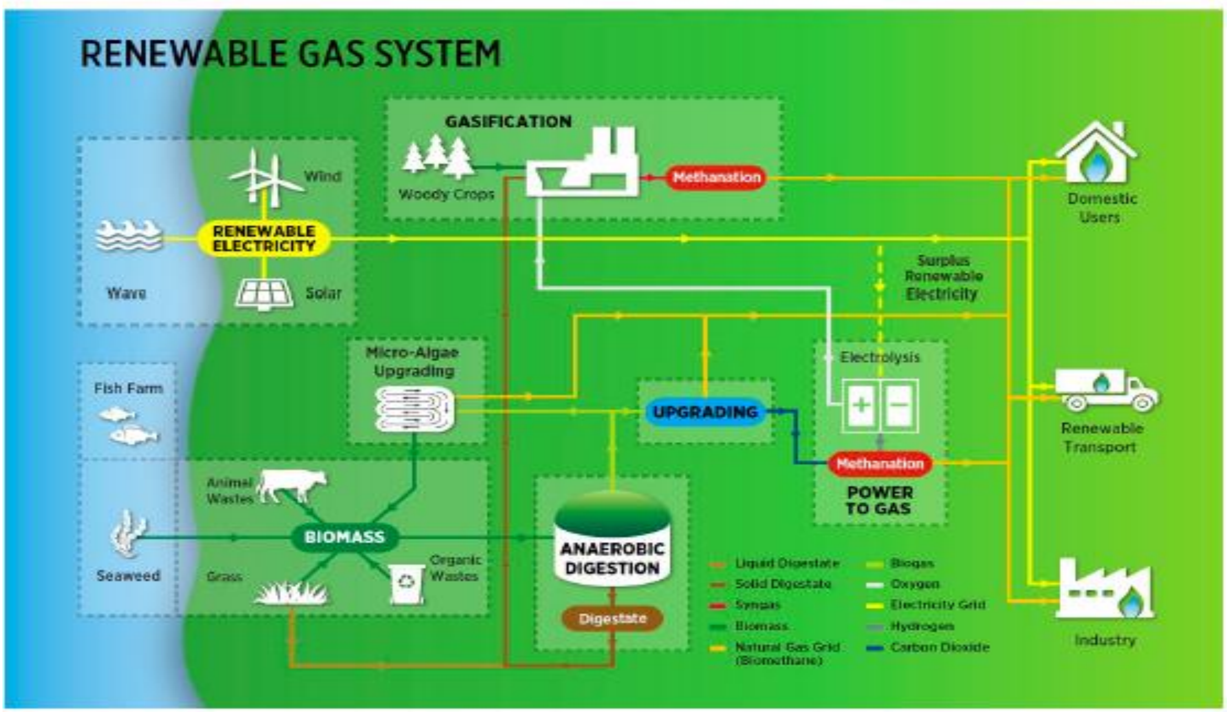
[b] School of Engineering, University College Cork (UCC), Ireland
[c] International Energy Agency Bioenergy Task 37 "Energy from Biogas"

6 European gas grids have committed to 100% green gas in the gas grid by 2050



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All input welcome

All opportunities for dissemination welcome

Thank you for your attention

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