IEA Bioenergy Task 37

International Energy Agency Bioenergy Task 37: Energy from Biogas

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European Biomethane Conference, Clontarf, Dublin
20 September 2018

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Task 37
Work Programme 2016-2018


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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
6. Icknield Farm Biogas: an integrated farm enterprise

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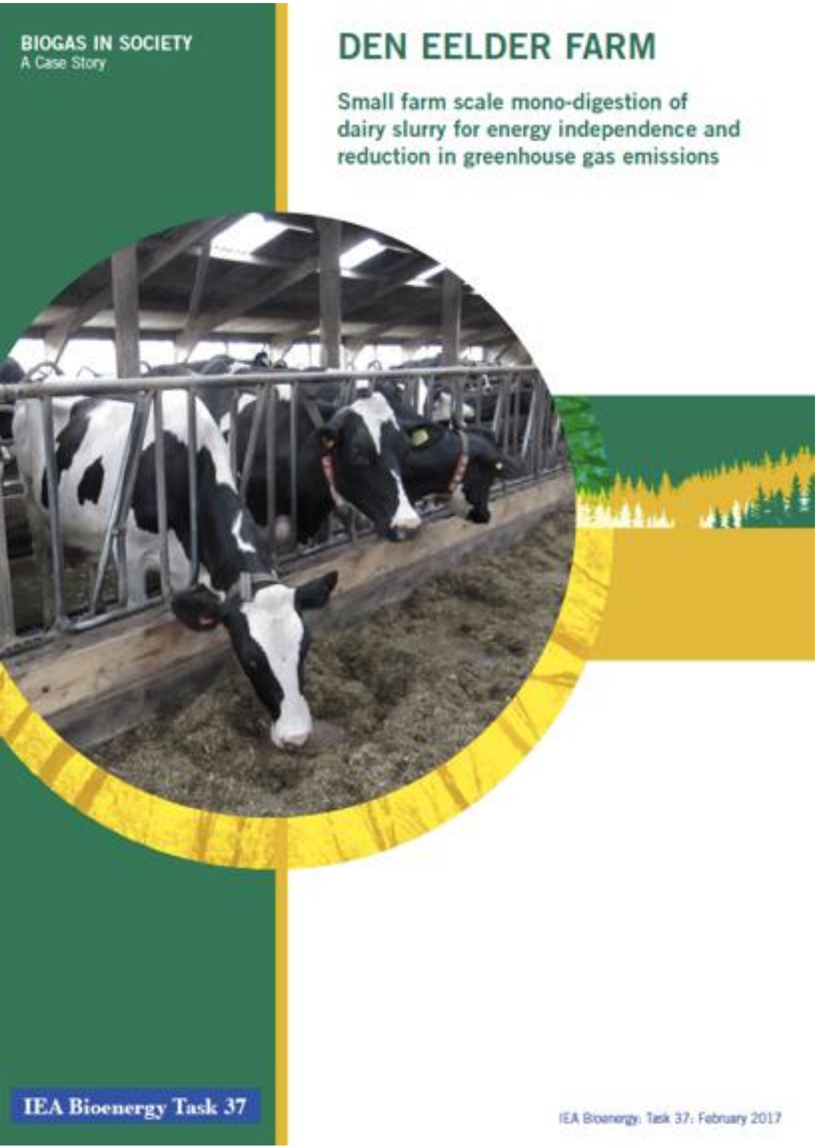

BIOGAS IN SOCIETY
A Case Story

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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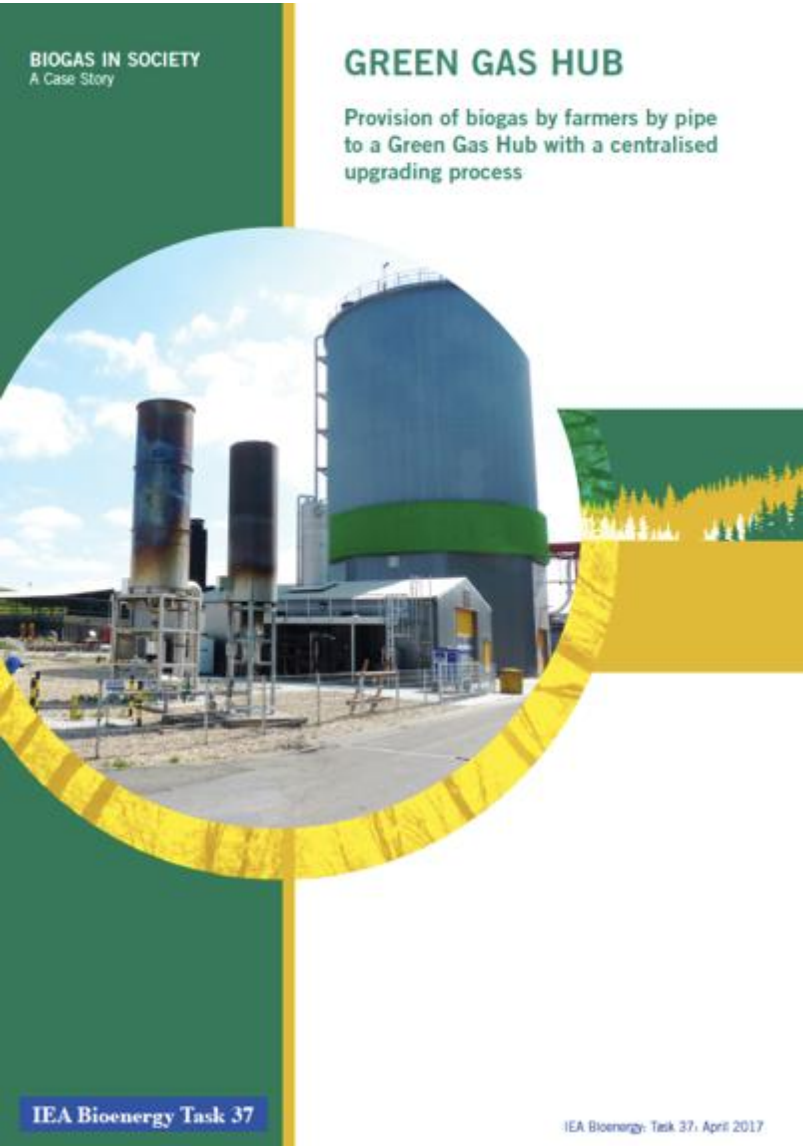
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A Case Story

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 Nm^3 biogas/ hour	Green Gas Nm^3 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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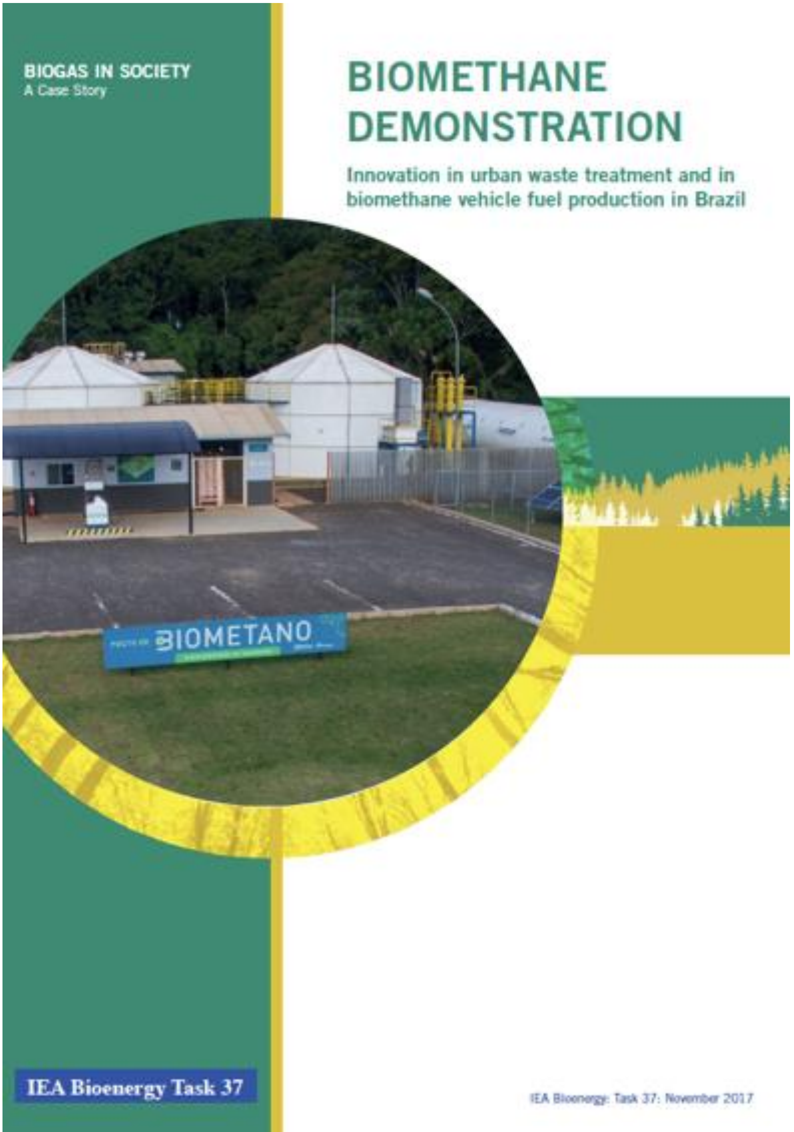
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BIOMETHANE DEMONSTRATION

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

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60 cars fuelled

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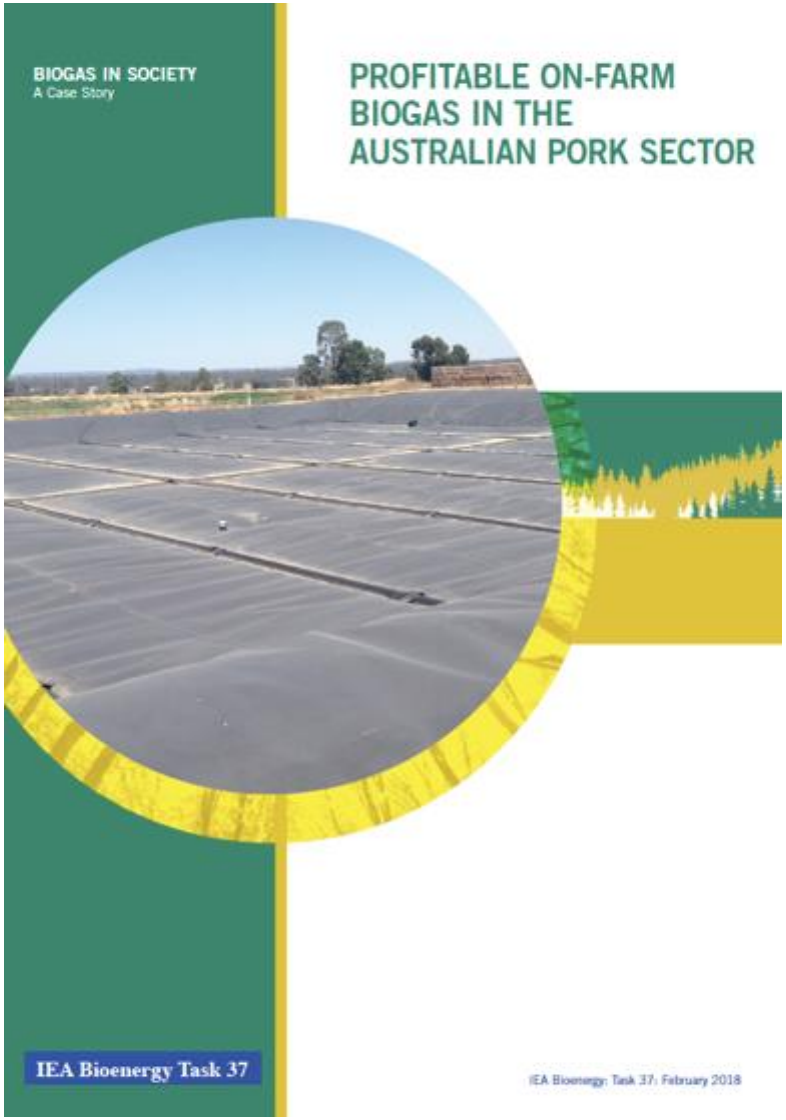

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A Case Story

PROFITABLE ON-FARM BIOGAS IN THE AUSTRALIAN PORK SECTOR

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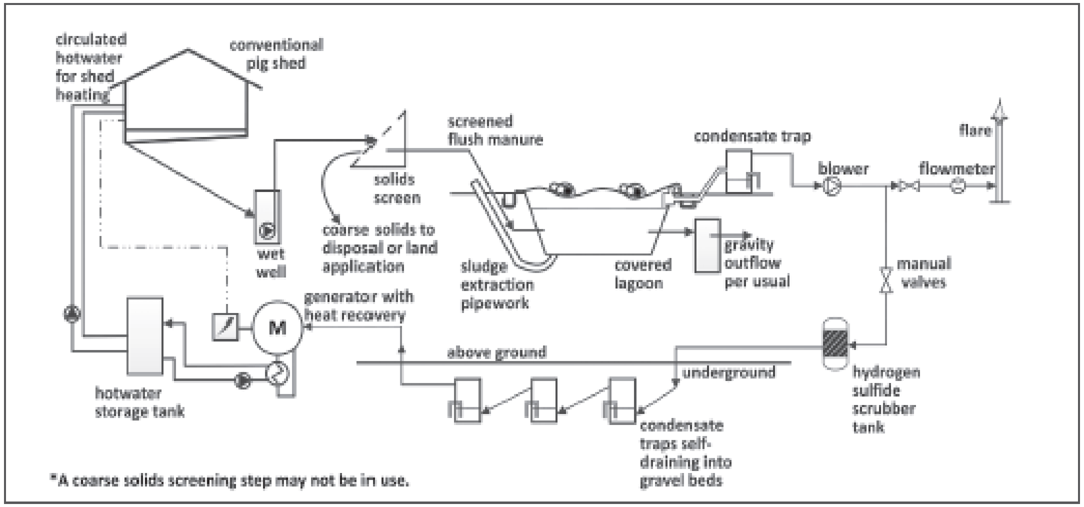

Figure 3: A schematic overview of a covered lagoon biogas set-up at a piggery

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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BIOGAS IN SOCIETY
A Case Story
ICKNIELD FARM BIOGAS
AN INTEGRATED FARM ENTERPRISE
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Table 1: Inputs and outputs of Icknield Farm

Input		Output	
Pig manure	10,000 t/a	Biogas	9.2 million m³/a
Cereals/ Screenings	11,000 t/a	Biomethane	4.4 million m³/a
Maize/Rye	13,000 t/a		47.3 million kWh/a
Other cereals if required		CHP	360 kW

IMPACT ON THE FARM BUSINESS

The installation of biogas/biomethane plant introduced a diversification which forms an integral part of the whole farm management system. Prior to the biogas development the farm had a three-crop rotation of oilseed rape, wheat and barley. This has been replaced by a four-crop rotation consisting of: maize as a spring crop; wheat; rye for silage; and turnips. The latter provide winter grazing for 2,000 ewes from a neighbouring farm. This has the advantage of trampling and dunging the mainly gravel soils. The installation of the plant has changed its output from oil for margarine and cereals for bread to bread, meat and energy. Guy Hildred also reports that the addition of the biogas/biomethane plant has brought changes which have led to a number of farm improvements:

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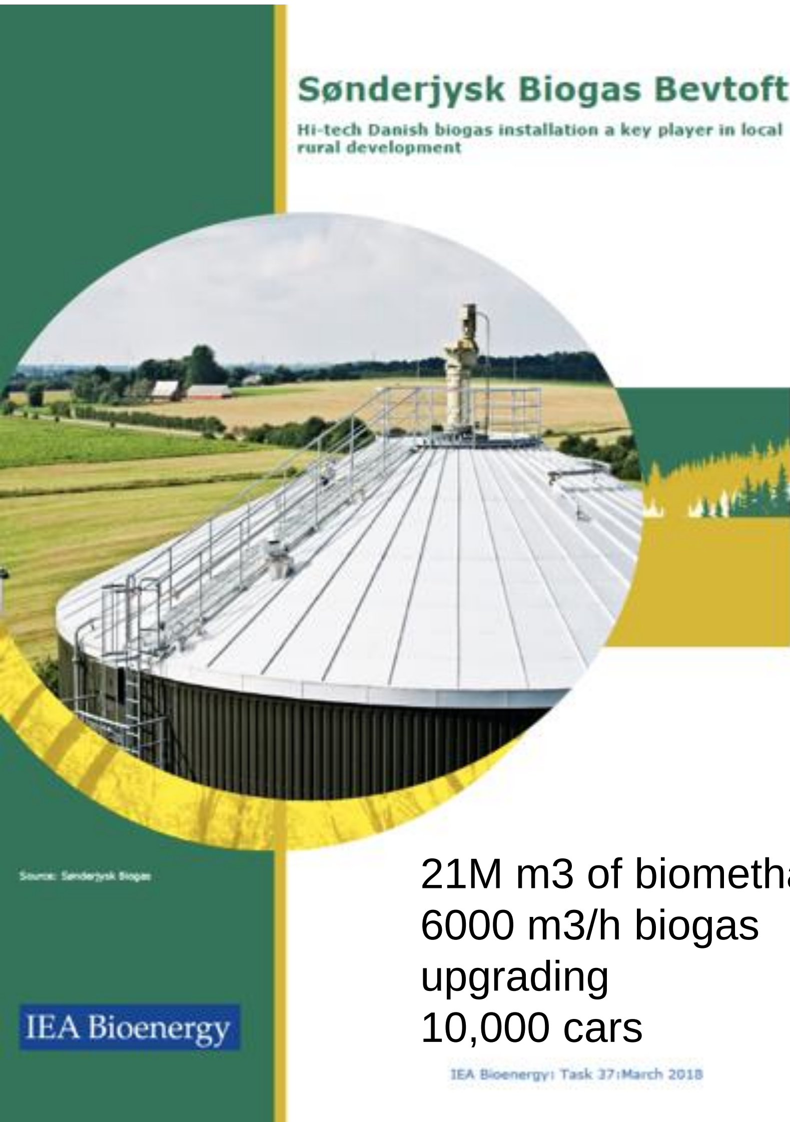

21M m3 of biomethane
6000 m3/h biogas upgrading
10,000 cars

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. Methane emissions from biogas plants
2. Green Gas
3. Integrated Biogas Systems
4. The role of anaerobic digestion and biogas in the circular economy
5. Governance of environmental sustainability
6. Value of batch tests for biogas potential analysis
7. Food waste digestion systems.

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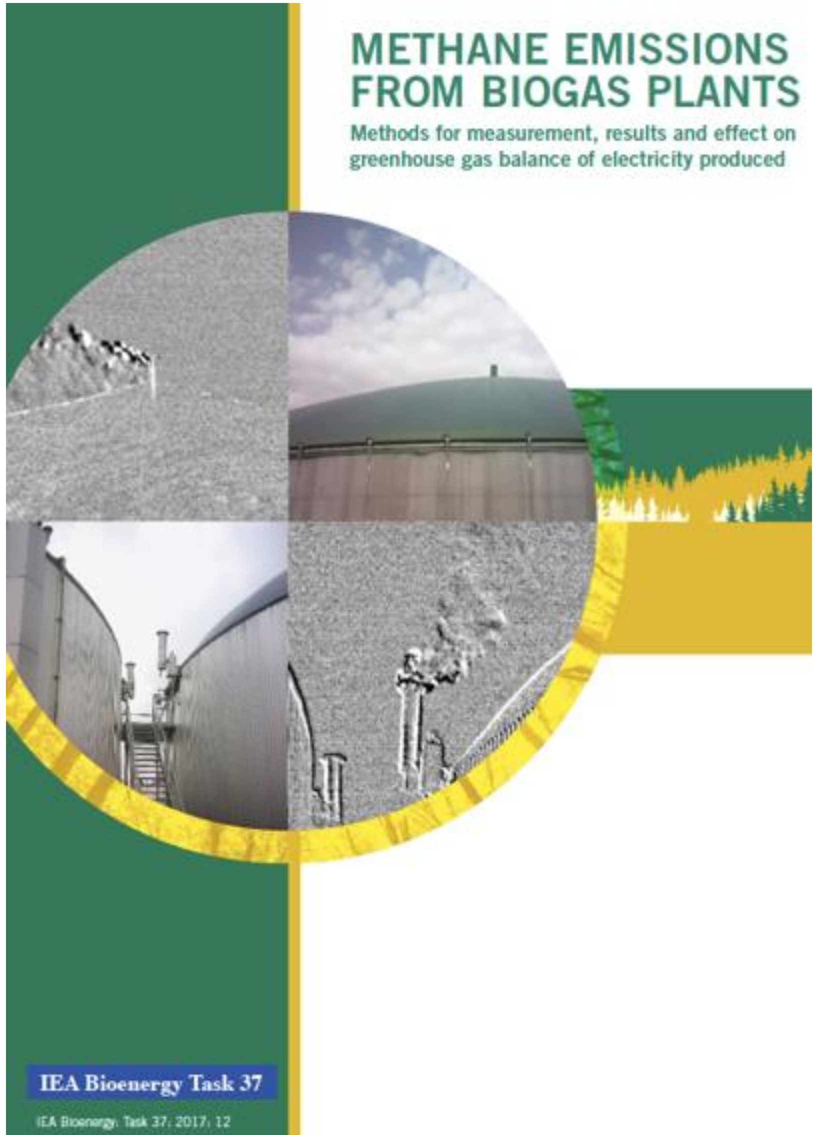

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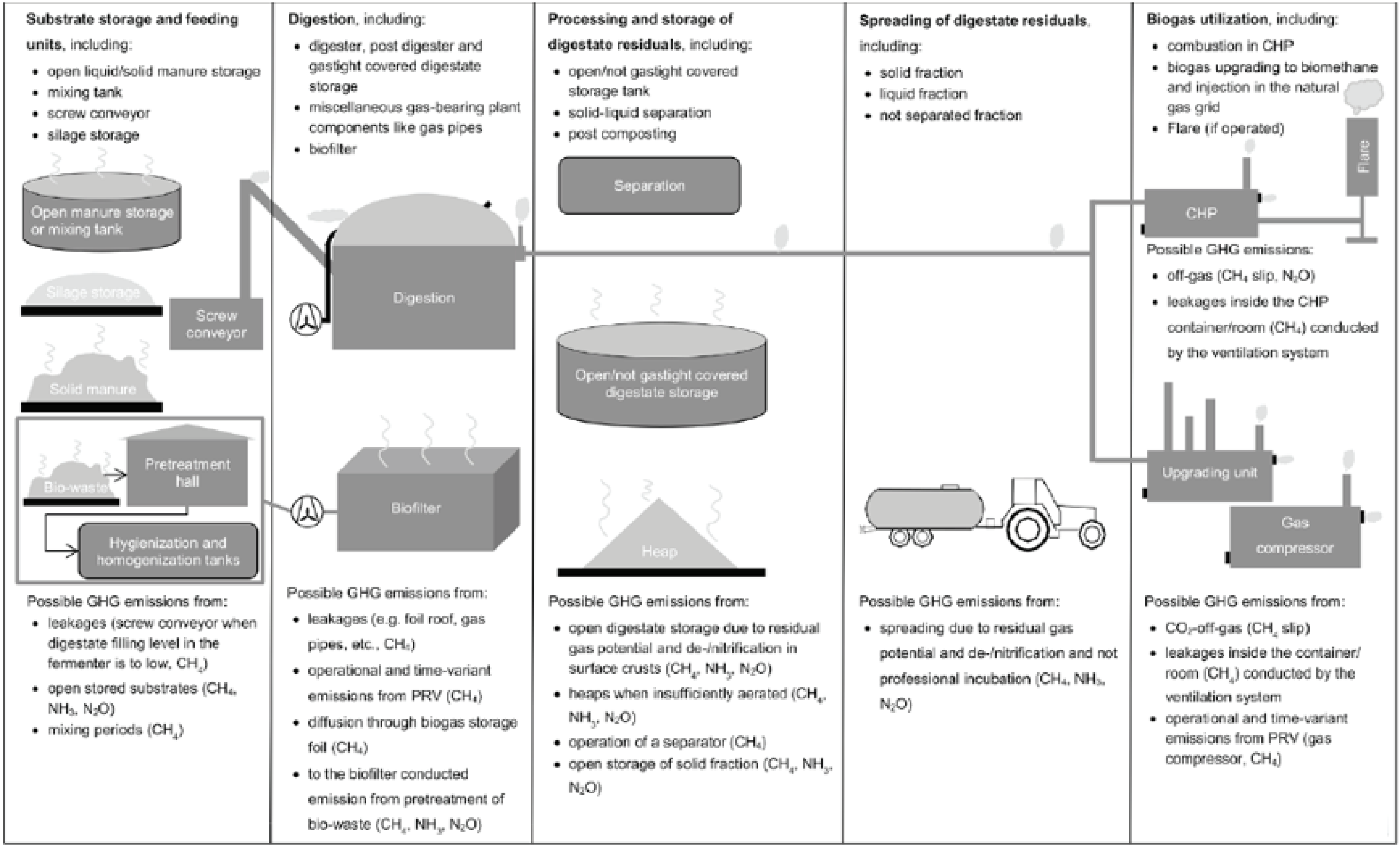

Figure 25: Overview about GHG emission sources from components and processes applied within biogas production and utilisation

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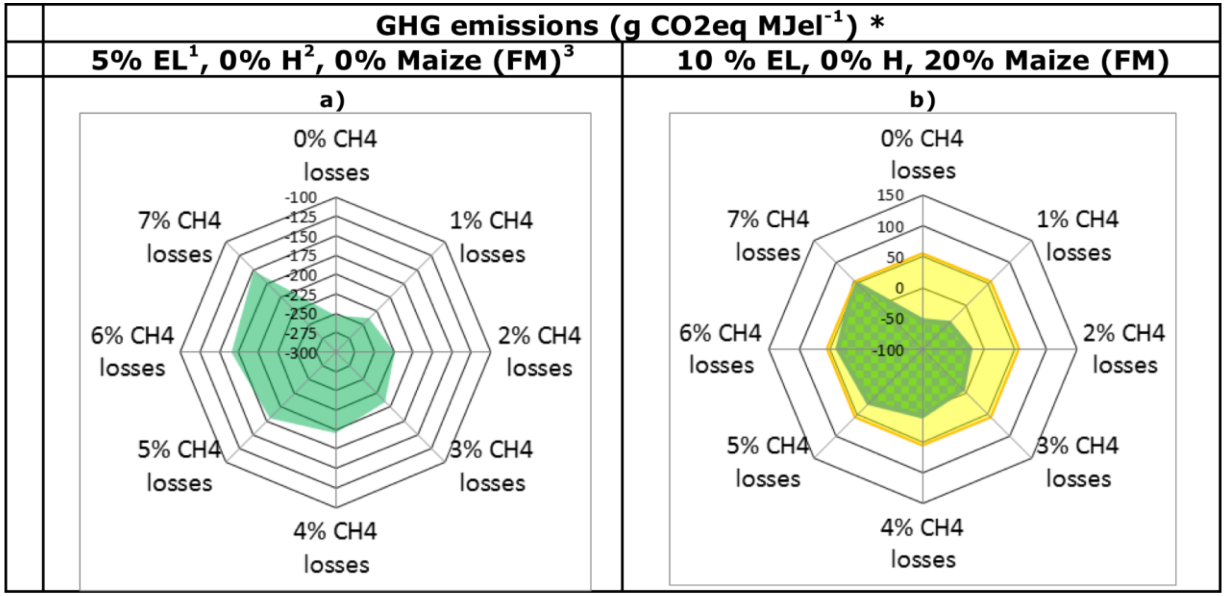
All slurry



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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Bioresource Technology 243 (2017) 1207–1215

Contents lists available at ScienceDirect

Bioresource Technology

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

ELSEVIER

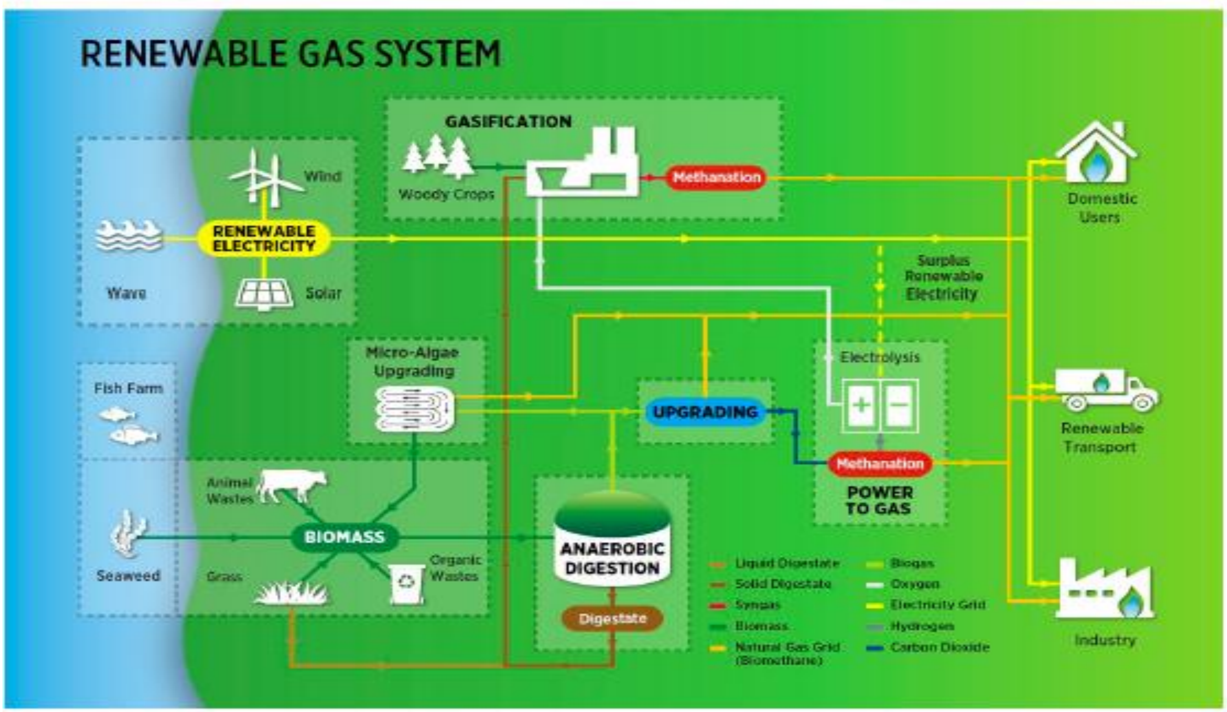
Review

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

David M. Wall[a,b], Shane McDonagh[a,b], Jerry D. Murphy[a,b,c,*]

[a] MaREI Centre, Environmental Research Institute (ERI), University College Cork (UCC), Ireland
[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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5.8 Kigali Institute of Science and Technology for prisons: Rwanda

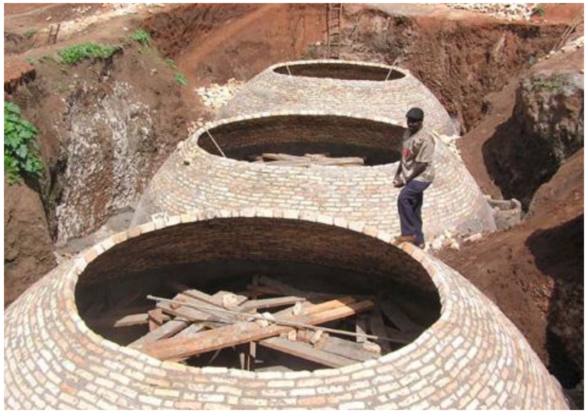

Figure 5.8 (a) Building underground domes
Source: Ashden (www.Asden.org)

(b) Garden over a sewage treatment plant

Summary

Feedstock	Human sewage
Technology	Underground brick dome
Use of biogas and by-products	Gas for cooking for prison inmates Effluent for fertilising gardens
Simple payback	Plant for 5000 inmates [500 m^3 total internal volume (TIV)] costs US$ 65,000 (paid for by government and Red Cross)
Energy saved	1866 kW (heat) from plants serving 30,000 inmates in total
Other attributes	Saves raw sewage polluting local environment

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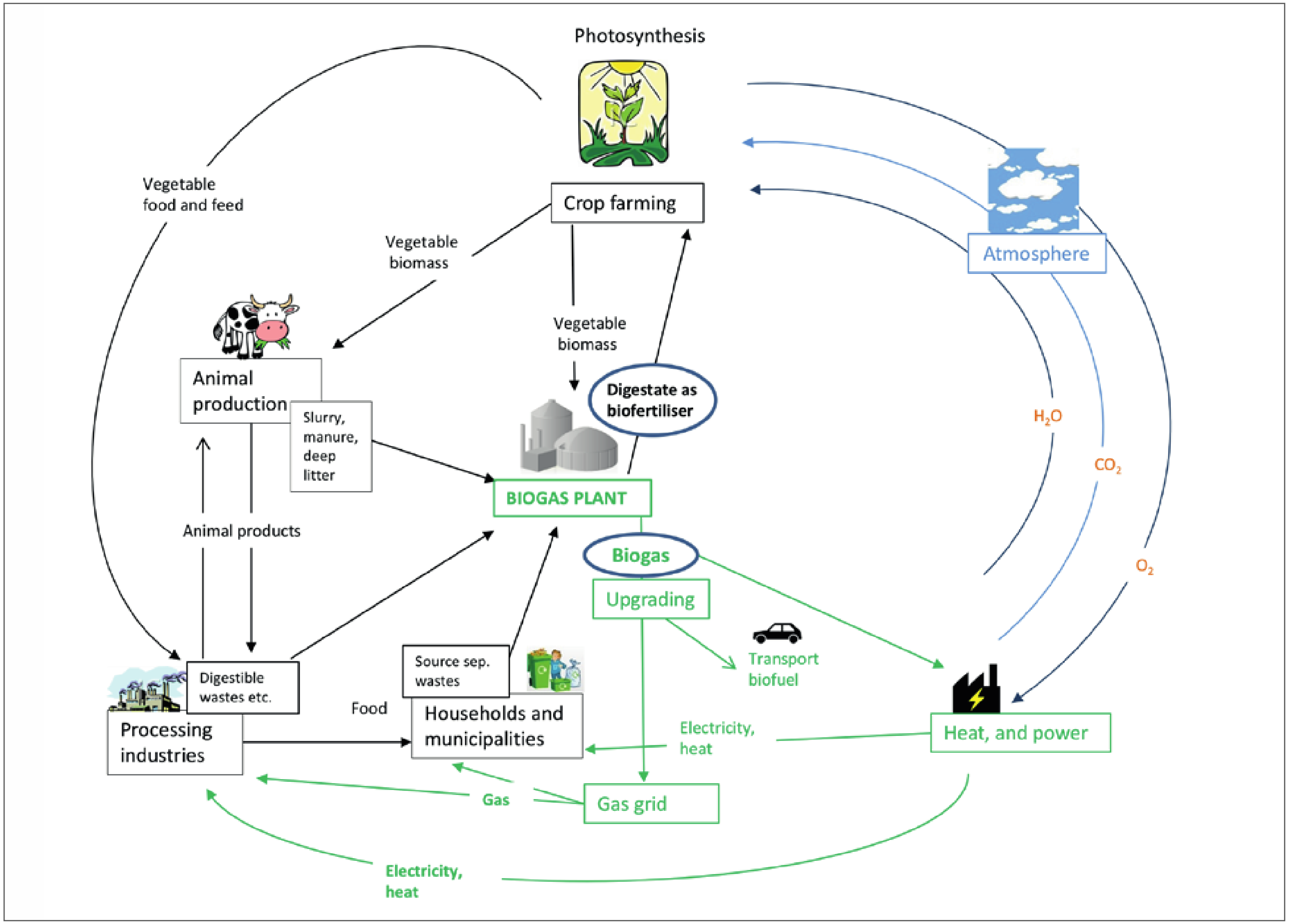

Figure 4. An example of how a modern co-digestion biogas plant fits into the circular economy (Source: Al Seadi et al, 2018)

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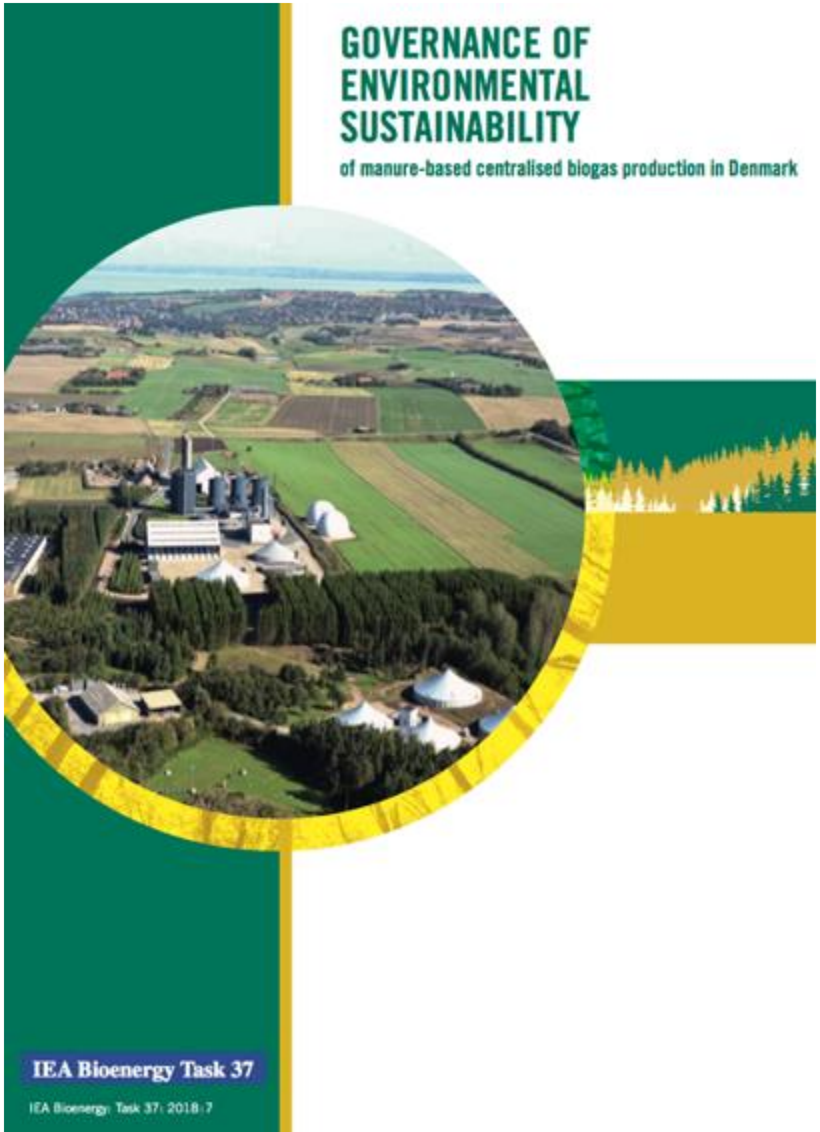

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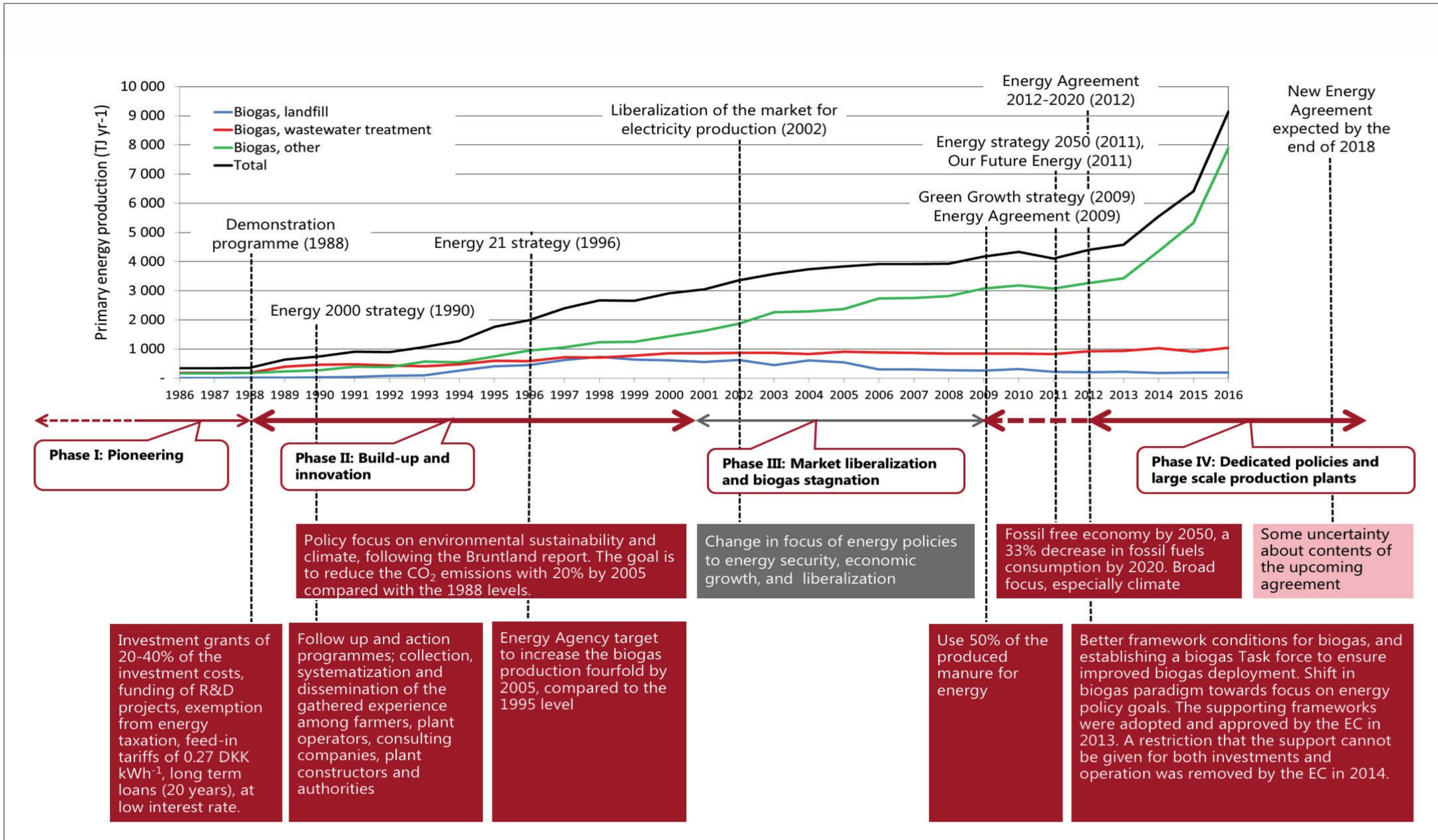

Figure 6. Comparison of biogas production levels with selected relevant energy, agricultural and environmental policy strategies and agreements during the period 1986-2016. A new energy agreement is expected in 2018

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Bioresource Technology 219 (2016) 228–238

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Biogas production generated through continuous digestion of natural and cultivated seaweeds with dairy slurry

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School of Engineering, University College Cork, Cork, Ireland

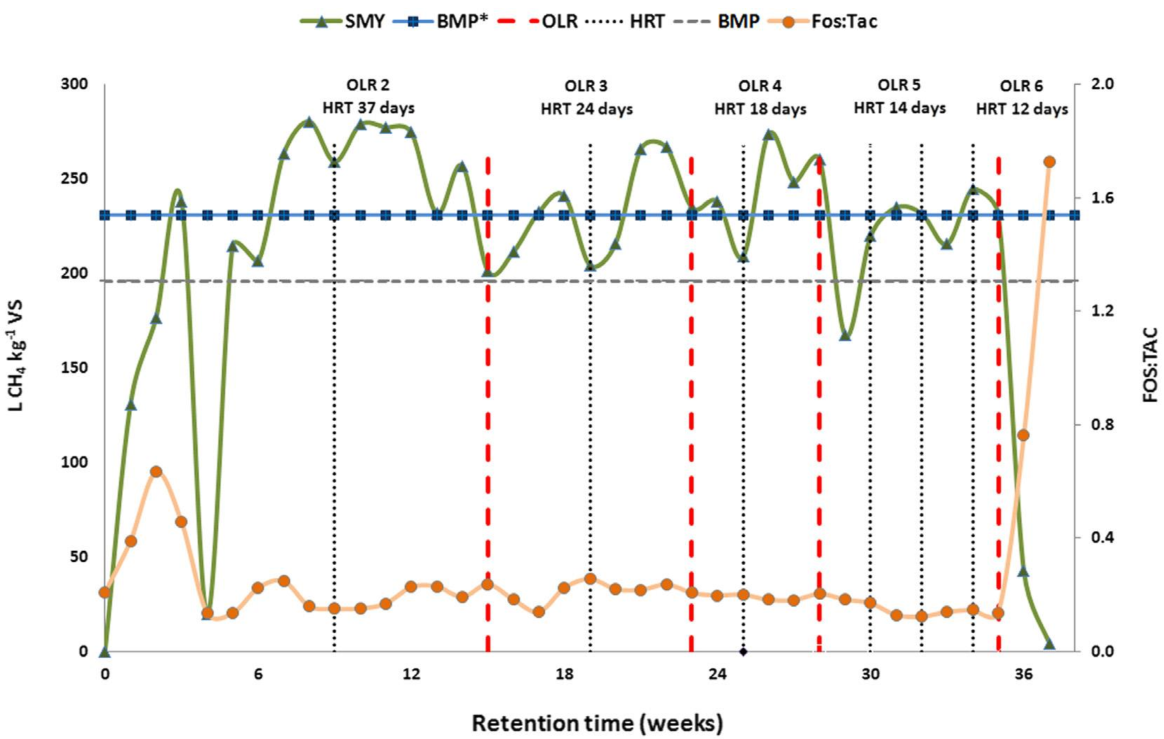

Fig. 1A. Co-digestion of 66.6% *L. digitata* with 33.3% dairy slurry: Variation in SMY and FOS:TAC with increasing organic loading rate. Specific methane yield (SMY), biomethane potential before acclimatization (BMP), after acclimatization (BMP*), and the fermentation stability (FOS:TAC). Vertical darker lines indicate changes in organic loading rate (OLR), vertical small dashed lines indicate retention times (HRTs).

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All input welcome

All opportunities for dissemination welcome

Thank you for your attention

www.iea-biogas.net

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