

26th World Gas Conference

1 – 5 June 2015, Paris, France



DECARBONISATION OF HEAT USING BIOSNG - DEMONSTRATION PROJECT

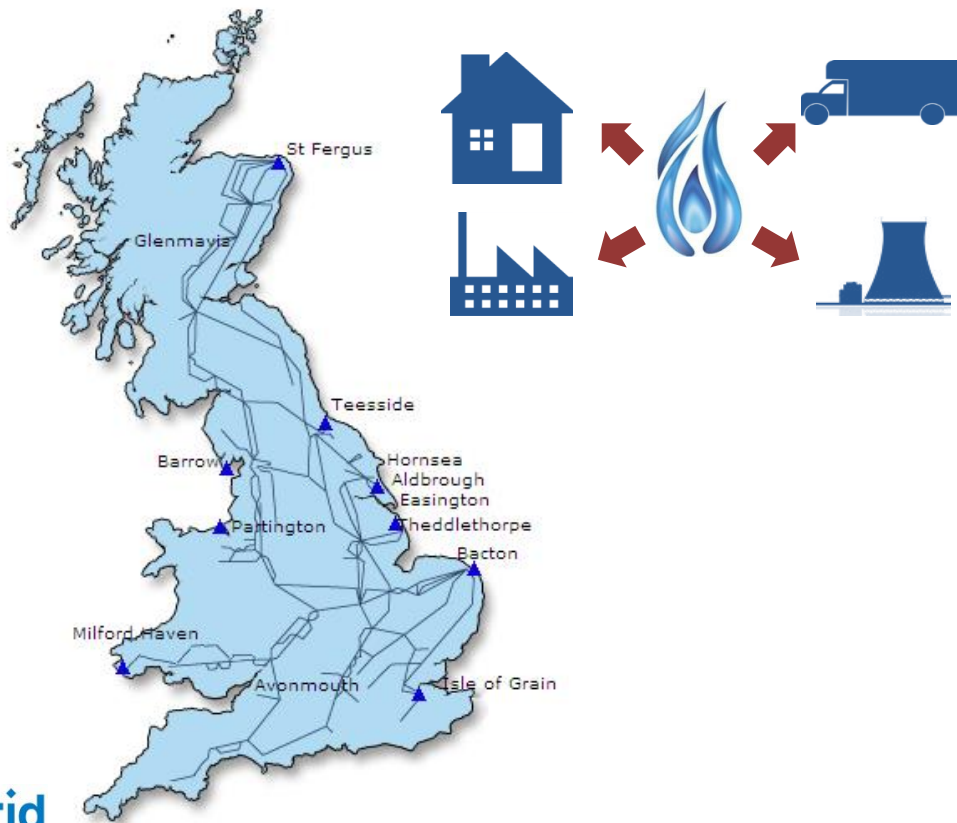
David Pickering
National Grid, UK



Introduction

- The problem: the need to decarbonise heat
- Renewable gas and how BioSNG increases its potential
- Outline of the BioSNG project

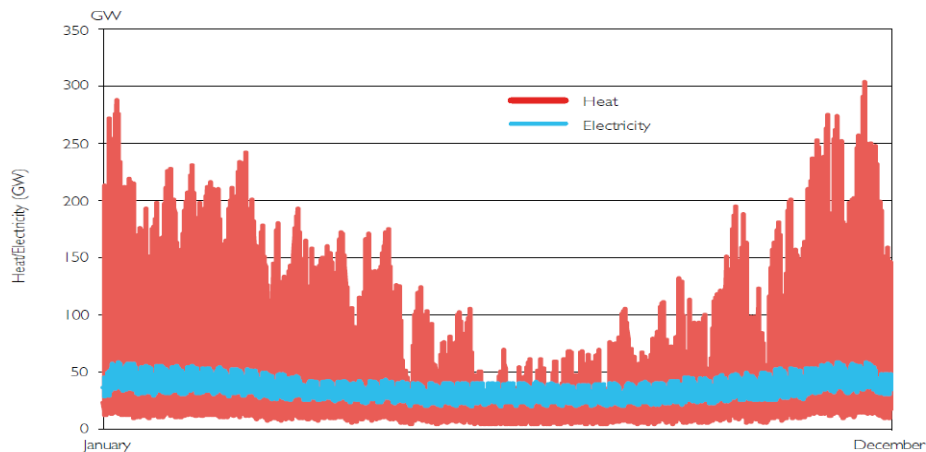
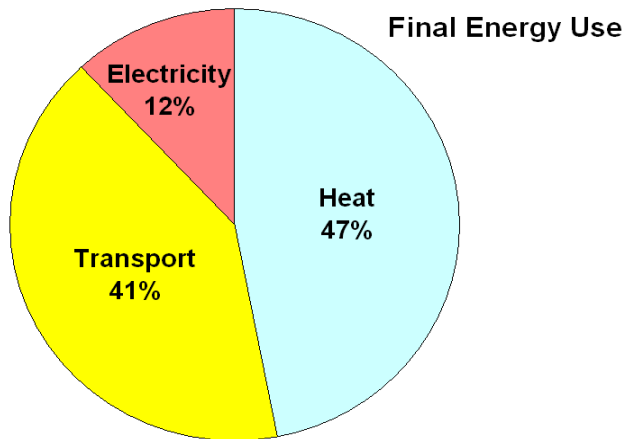
Importance of Gas as a UK Energy Vector



- Over 280,000 km of pipelines
- Delivers ~35% of primary energy in UK and nearly 70% of domestic heat
- Flexible to meet demand

The challenge... 80% CO₂ reduction by 2050

Heat accounts for 50% of final energy use
and 30% of carbon emissions



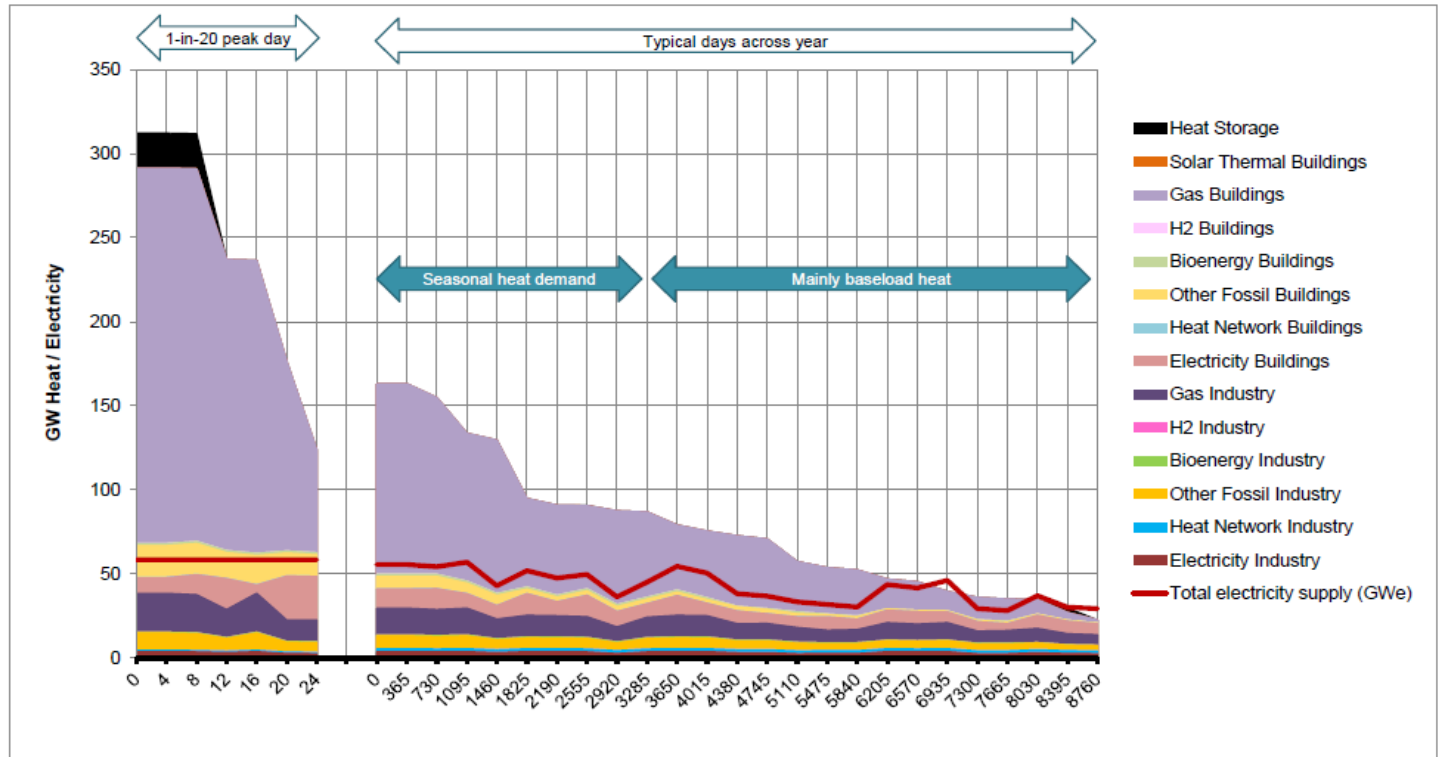
Source: Imperial College for DECC (2012) The Future of Heating: A strategic framework for low carbon heat in the UK.

Notes: Illustration only for 2010 based on half-hourly electricity demand and an estimate of heat demand using a proxy of natural gas consumption, based on data from National Grid.

The size and seasonality of heat load is important

How to meet seasonal and peak heat economically?

- From 'Pathways for decarbonising heat' 2012
- Gas dominates, particularly building heat



The Role for Renewable Gas



Heat pumps

✗ More Generation



✗ More Wires



✗ New Appliances

Heat networks

✗ More Generation

✗ New Pipes

✗ New Appliances

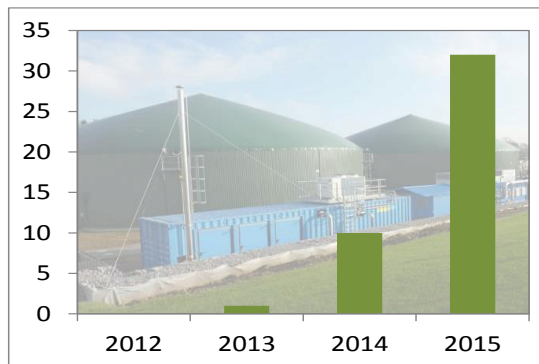
Renewable Gas

✗ New Production

✓ Existing Pipes

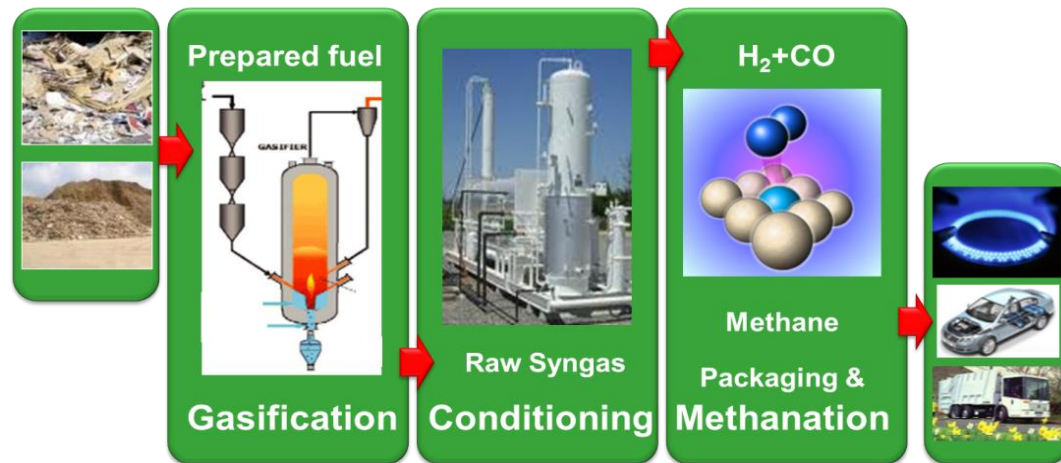
✓ Existing Appliances

- Delivering low carbon heat, easily
- Substantial recent growth in biogas
- 2.3TWhrs of production from > 30 projects in 2015
- How to grow this substantially?



Project Name	Feedstock	GDN	LDZ	Grid	Technology	Supplier
Avonmouth	Sewage Sludge	WVU	WW	MP	Water Wash	Malmberg
Apsley Farm	Agricultural	SGN	So	MP	Membrane	DMT
Beccles	Agricultural	NG	EA	IP	Water Wash	Chesterfield Biogas
Cannington	Food Waste	WVU	SW	MP	Water Wash	Chesterfield Biogas
Chittering	Agricultural	NG	E	MP	Membrane	MethaPower
Coupar Angus	Agricultural	SGN	So	MP	Water Wash	Chesterfield Biogas
Crosslands Farm	Agricultural	SGN	So	LTS	Chemical Wash	Purac Puregas
Oldest	Sewage Sludge	SGN	So	MP	Water Wash	Chesterfield Biogas
Doncaster	Agricultural	NG	E	IP	Membrane	Air Liquide
Euston Estates	Agricultural	NG	E	LTS	Membrane	Pentair Hoffmann
Five Fords	Sewage Sludge	WVU	WW	IP	Membrane	Air Liquide
Fraddon	Food Waste	WVU	SW	MP	Membrane	DMT
Grants Girvan	Food Processing	SGN	So	LTS	Water Wash	Chesterfield Biogas
GW Finn AD	Agricultural	SGN	So	MP	Membrane	MT Energie
Helmdon	Food Waste	SGN	So	MP	Membrane	TBC
Hibaldstow	Agricultural	NG	EA	MP	Membrane	Air Liquide
Holkham	Agricultural	NG	E	LTS	Membrane	Air Liquide
Howdon BG	Sewage Sludge	NGN	N	IP	Water Wash	Malmberg
Iskfield Farm	Agricultural	SGN	So	IP	Membrane	Envitec
Isle of Wight	Agricultural	SGN	So	MP	Membrane	Pentair Hoffmann
Minworth	Sewage Sludge	NG	WM	LTS	Water Wash	Malmberg
Micham	Food Waste	SGN	SE	MP	Water Wash	Chesterfield Biogas
RAF Leeming	Waste	NGN	N	MP	Membrane	DMT
Poundbury	Agricultural	SGN	So	MP	Membrane	DMT
Scampton	Agricultural	NG	E	IP	Membrane	Air Liquide
Southold	Food Processing	NG	E	IP	Membrane	Alkane
St Barwells	Agricultural	SGN	So	MP	Water Wash	Chesterfield Biogas
Stockport	Biodegradable	NG	NW	MP	Water Wash	Chesterfield Biogas
Vale Green 1	Agricultural	WVU	WW	IP	Membrane	Pentair Hoffmann
Vale Green 2	Agricultural	WVU	WW	IP	Membrane	Pentair Hoffmann
Widnes	Food Waste	NG	NW	MP	Water Wash	Chesterfield Biogas
Wyke Farms	Agricultural	WVU	WW	MP	Membrane	DMT

BioSNG - Renewable Gas at Volume



Bio-Substitute Natural Gas – The advantages

- Feedstock is abundantly available mixed waste resource
- Plant suitably sized for large town or city (200k tonnes RDF per year)
- UK potential up to 100TWh of renewable gas per year

- How to Get there....

BioSNG Project Timeline



Concept feasibility
& technology study

National Grid,
Centrica,
CNG Services,
Progressive Energy



Project feasibility &
detailed design

National Grid,
Progressive Energy
Advanced Plasma
Power



Secured NIC & EU Funding.
Build and demonstration

National Grid,
Progressive Energy
Advanced Plasma Power
Carbotech



Commercialise at scale

Third party developers
Progressive Energy
Advanced Plasma Power

Time

2010

2011 - 2013

2014 - 2017

2017 onwards

Each stage builds on previous work undertaken by the partners, ensuring a clear and mature scope plus a strong relationship that has proven delivery capability

Feasibility Study 2010/11



Truly fungible fuel
for heat and
transport

Full lifecycle carbon
savings typically >
90%

Distributed heat
from waste more
feasible than
District Heating

Competitive with
other renewables
per tonne of
Carbon abated

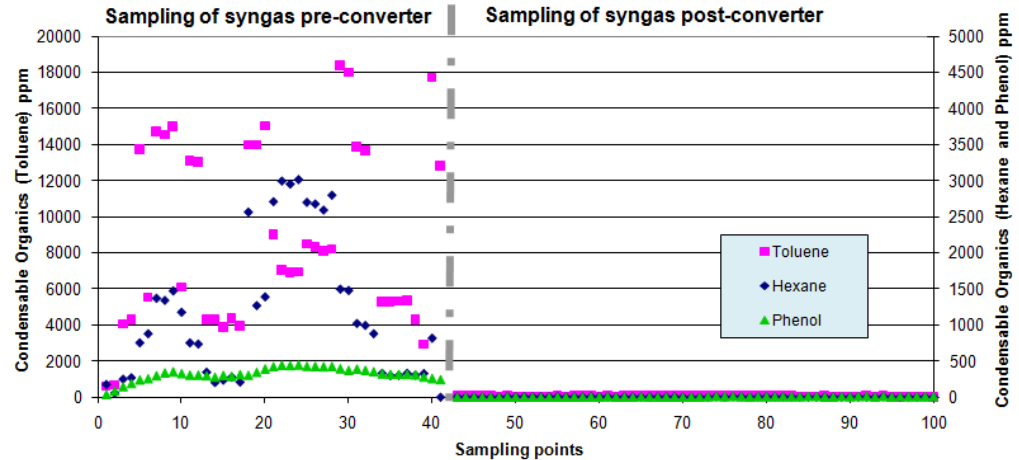


- Feedstock : The UK's dominant biomass resource is waste derived. Globally no Bio-SNG projects are using a waste feedstock
- The technical challenges:
 - Provision of a clean, high quality synthesis gas from bio & waste,
 - Methanation at moderate scale implicit in renewable resources
- Development Pathway:
 - A commercial scale full chain project is unfinanceable without demonstration
 - A new build full chain pilot scale project is a significant investment and has a long lead time
 - Using good quality syngas from an existing facility, reduces timescale, risk, and funding quantum

Consortium Formation and Detailed Design



Identification of Advanced Plasma Power as one of very few existing UK sources of high quality waste derived syngas

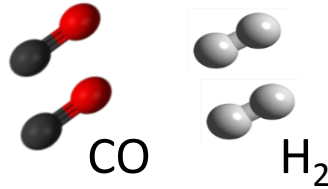


APP joined Consortium and together undertook detailed design of a pilot plant, and assessed commercial facility viability

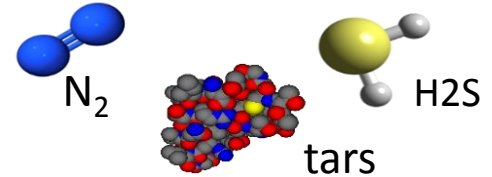
Ultimate recycling: Rearranging atoms

Starting Syngas

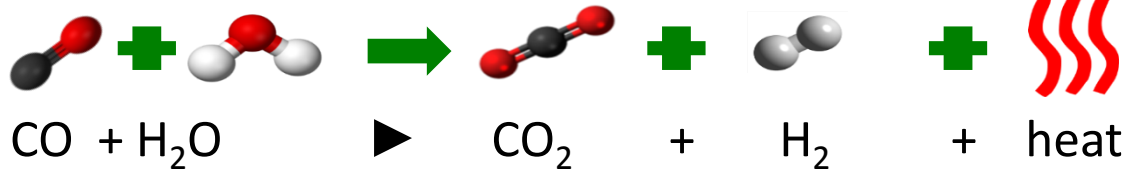
"Almost the right amounts of Carbon & Hydrogen"



"Plus a few inconvenient components to be dealt with..... eg"



"Liberating more Hydrogen"

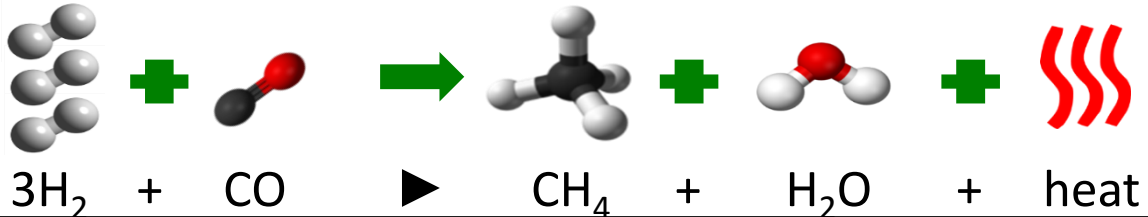


Shift Reaction

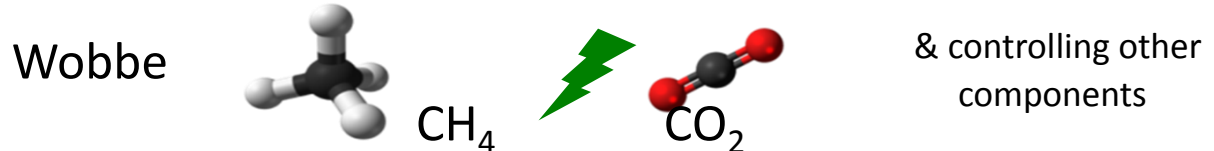
"Re-bolting Carbon & Hydrogen together"

Main Methanation

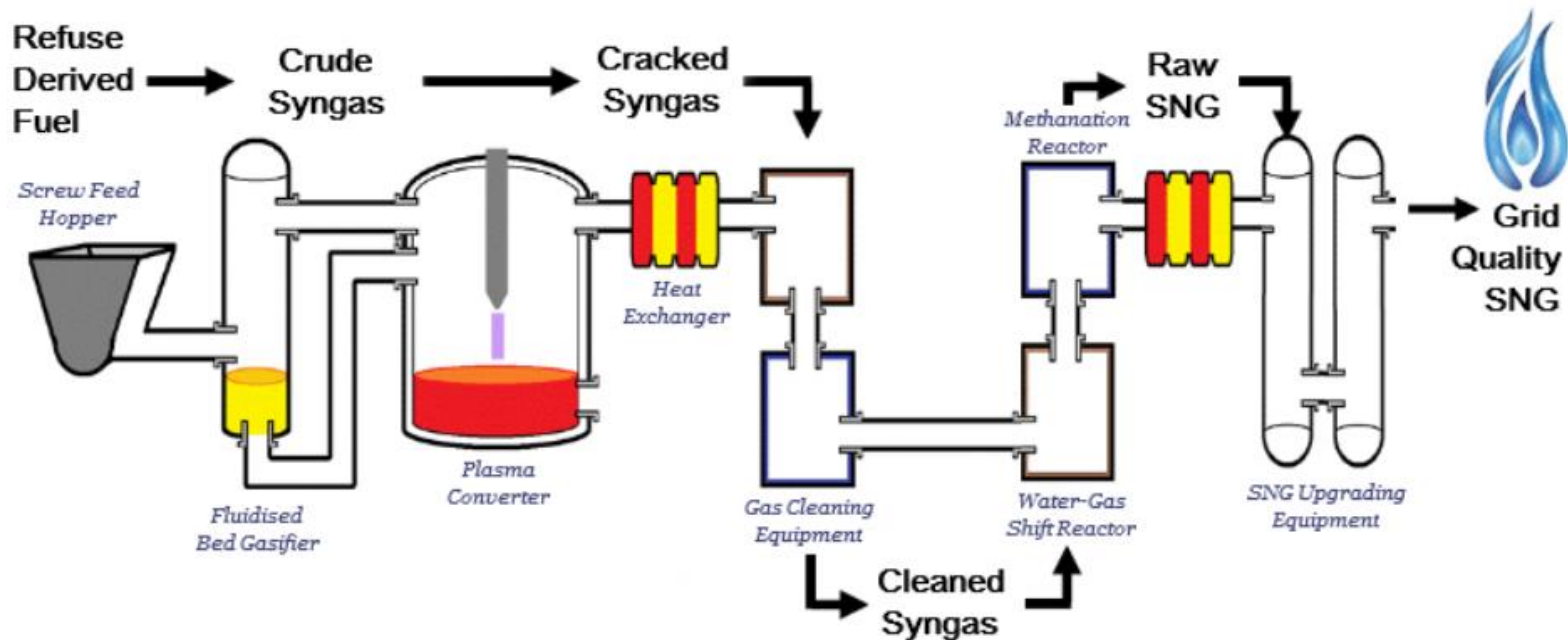
Reaction



"Meeting the Specification"
Upgrading to GSMR



Pilot plant BioSNG Production



The Gasplasma[®] Process

BioSNG Production

Key Design Phase Outcomes

- Syngas Quality is key, especially tar formation
 - Common issue for many gasification to power applications (ppm)
 - Catalysis requirements are substantially more stringent (ppb)
- Requires very different operating conditions compared with methanation of coal as used in the chemical industry
- There are design challenges in controlling the exotherm and the unusual molar concentrations of this application
- Must meet the quality requirements of the gas grid
- Resulted in the development of patented Intellectual Property and understanding of commercial plant feasibility
- Sought funding for a pilot and extensive testing & optimisation programme (~£5Million)

Pilot Plant Delivery

**Network Innovation
Competition
£1.9 million**

**One of 4 awards in first
year funding round**



**BESTF ERANET
European Funding
£2.2 million**

**One of 3 awards in
funding round**



**National
Grid**

nationalgrid

**Advanced
Plasma
Power**



**Progressive
Energy**



Progressive energy

Carbotech

Carbotech

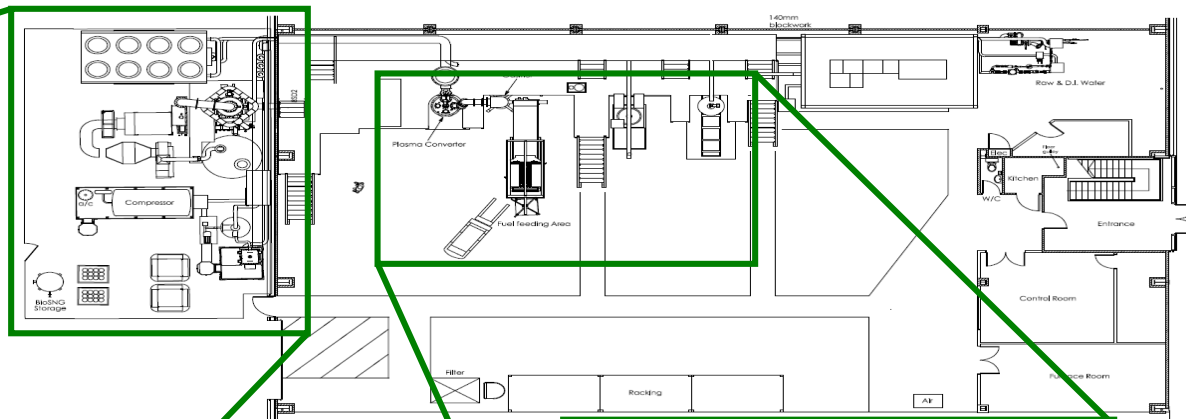
VIESSMANN Group

**A 3 year demonstration
programme comprising**

- Finalisation of design and safety review,
- Procurement,
- Construction and installation
- Extensive testing and optimisation
- Dissemination

Existing Gasification Facility

Basic Gas
Processing &
Engine



Materials in-feed,
Gasifier & Plasma
converter



Project Plan

BioSNG Demonstration Programme	2014				2015				2016				'17
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
Final design and Safety Review Assessment		█	█										
Procurement, Fabrication & installation of: <i>BioSNG Generation facility</i>			█	█	█	█							
<i>BioSNG Conditioning facility</i>		█	█	█	█								
Commissioning of BioSNG full chain facility						█	█						
Testing and proving of full chain facility								█	█				
Detailed investigation of BioSNG operation <i>BioSNG Generation facility</i>									█	█	█	█	█
<i>BioSNG Conditioning facility</i>									█	█	█	█	█
Commercial Plant Scheme Development										█	█	█	█
Dissemination		█	█	█	█	█	█	█	█	█	█	█	█
Project Management		█	█	█	█	█	█	█	█	█	█	█	█

The plant under construction – May 2015



Dissemination and Knowledge Transfer



- As part of the testing facility we are building a showcase to demonstrate production of BioSNG
- We will be reporting results from our work at a variety of conferences over the next 2 years
- We have a website hosted by National Grid:

<http://www.nationalgrid.com/biosng>

Thank you

David Pickering
Innovation Project Manager
National Grid Gas Distribution
david.c.pickering@nationalgrid.com
+44 07867 537360

