Le Biogas and le biomethane
Montreal Gas Conference 2012

UK biogas market Developments

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UK Experience with Gas Grid Injection

1. CNG Services Ltd
2. Didcot Biomethane to Grid Project
3. CBM Vehicle Fuel
4. Biogas clean-up and upgrading
5. CV enrichment
6. Injection to grid
7. Economics of Biogas Utilisation Options
8. Green Gas Certificates
9. Conclusions

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CNG SERVICES LTD

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CNG Services Ltd

- Supports projects to inject biomethane into the gas grid
  - Working on 30 further biomethane injection projects in UK
- CNG as a fuel for trucks
  - Gas supplied from 30 bar grid
  - Own UK's largest CNG filling station

We are independent from all makers of plant, vehicles, clean-up, compression....we help clients get the best solution for their projects

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Crewe CNG Station

- We have re-opened our Crewe CNG station
- Filling CNG dual fuel trucks for GIST/M&S, John Lewis/Waitrose and Tesco

Largest grid supplied CNG station in UK – takes gas from 4 bar grid and so uses 20% less electricity compared to 0.2 bar grid

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DIDCOT
BIOMETHANE PROJECT

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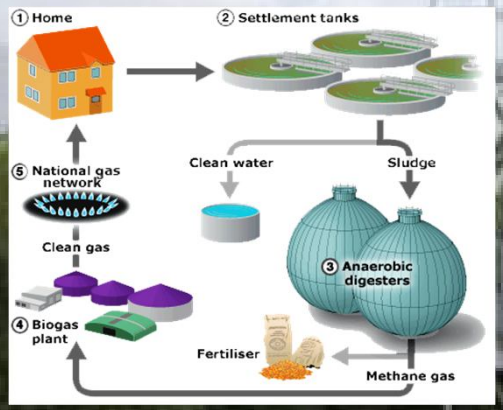
Didcot – UK's First BtG Project



Anaerobic Digesters

Propane Storage

Gas bag

Propane Injector

Telemetry

Energy & quality Measurement

H2S and Siloxane filters

Biogas upgrader

CSL – Designer and Project Manager

Flow of biogas - 100 m^3/hr

First gas to grid on 3rd Oct 2010

BIOMETHANE AS A VEHICLE FUEL

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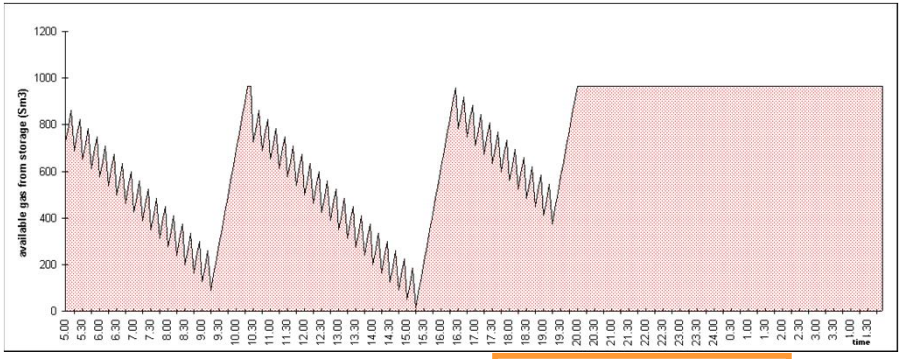
Biomethane as a Vehicle Fuel

Vehicle Fill Profile



Storage Cascade

Dispenser

300 bar

250 bar

Local Gas Grid Pipe

Supply from gas grid

CNG-CBM Compressors

Typically 1 bar

7 bar

3 bar

0.02 bar

Biogas Clean-up and upgrading plant

Biogas supply from Anaerobic Digester

Propane Added

Odorant and gas quality monitoring

There are practical difficulties running vehicles directly on biomethane because AD production is constant, vehicle fill patterns very lumpy.....need to use the gas grid

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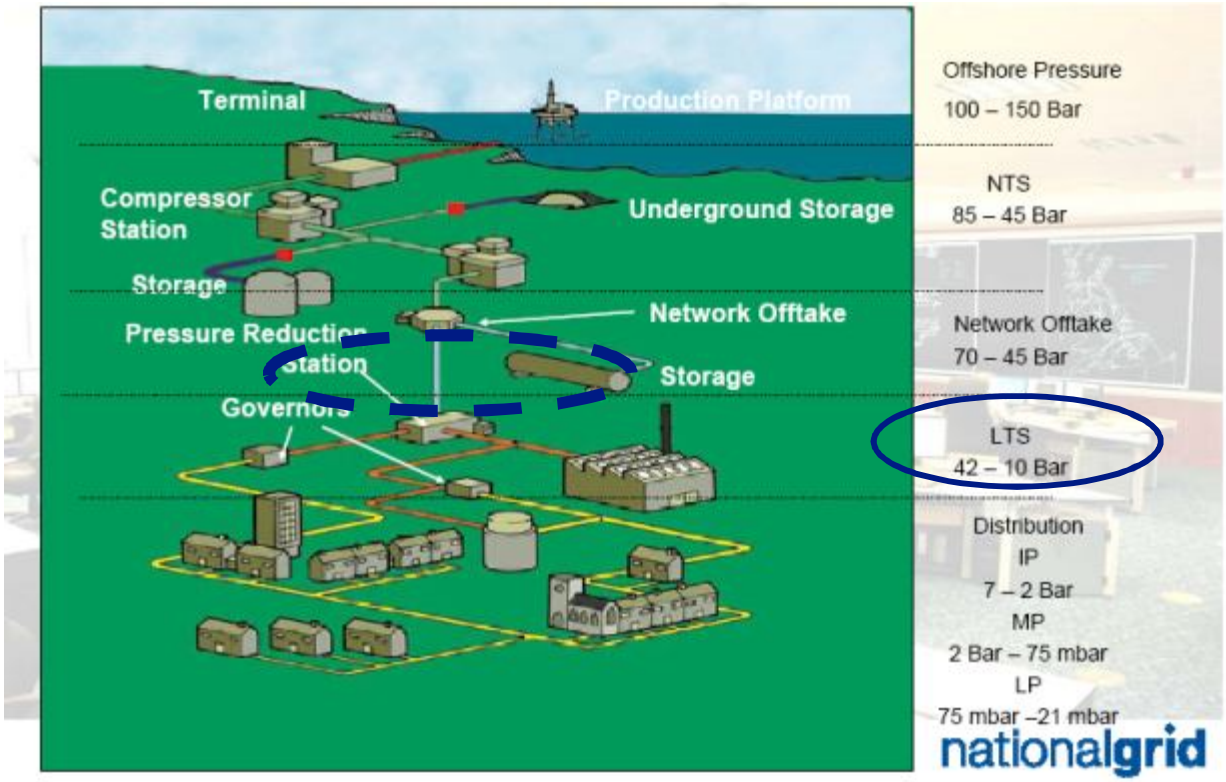
UK gas system – Local Transmission System



LTS is a vital national asset - ideal for CNG – it would cost >£15 billion to build NTS/LTS – these assets can help reduce diesel demand and reduce CO2 from trucks

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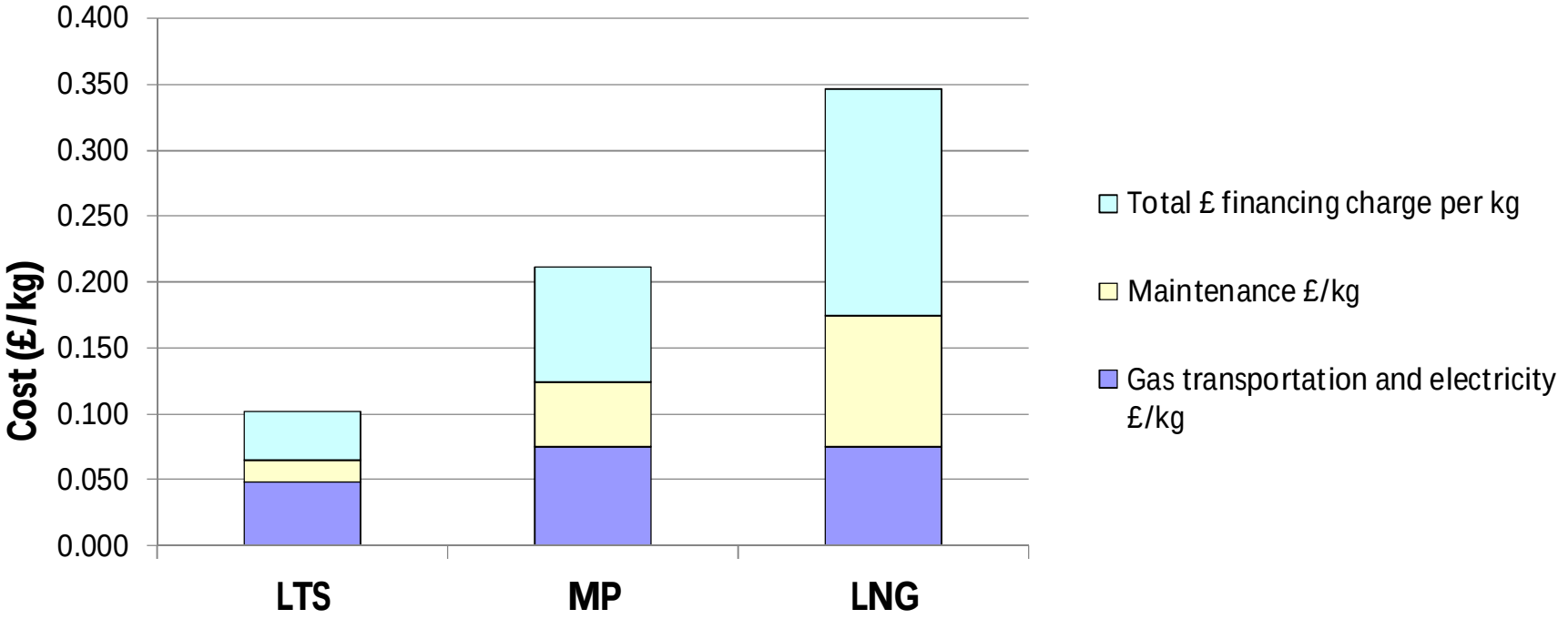
Costs for Compression/Liquefaction Service CNG (LTS v MP) and LNG



CNG station throughput assumed to be 10 million kg/annum (e.g. around 500 trucks). LTS cost lower due to fewer compressors, reduced running hours and much less electricity

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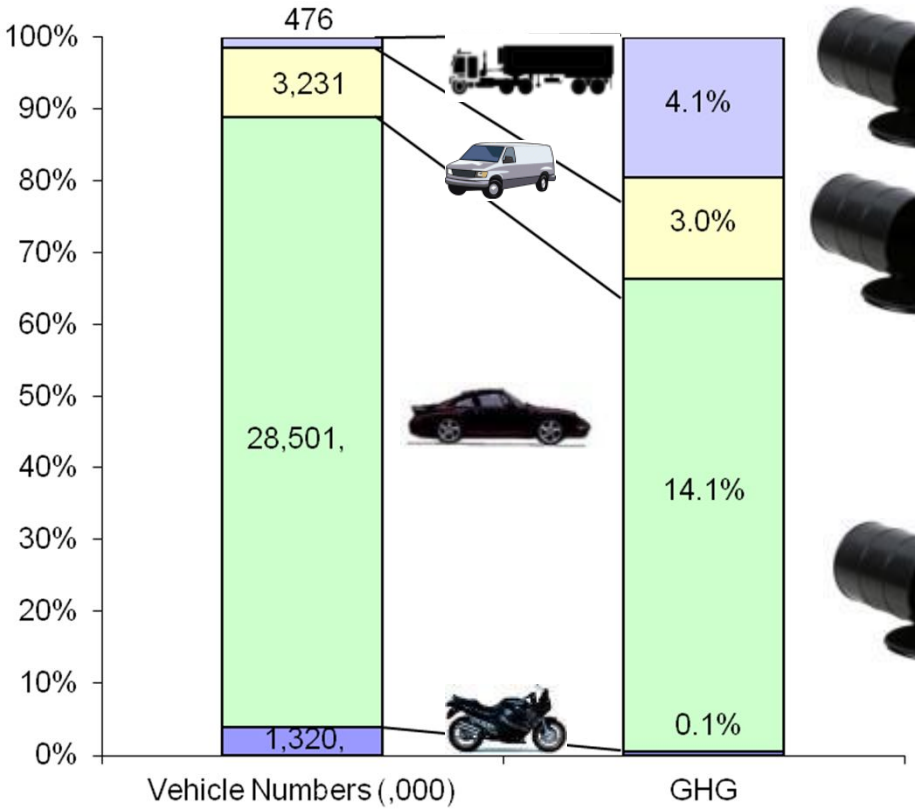
HGV sector provides the best opportunity for CNG



Fuel options in each sector

Cars are not the target for natural gas – trucks are relatively few in number but use a lot of diesel and cause significant GHG emissions

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CNG for HGV Transport

- 100,000 HGVs = 59TWh/a (10% throughput of annual non power gas demand)
- Cost of natural gas is 40% of cost of oil on an energy basis
- Trucks area available – Mercedes Benz and Volvo
- Use 6,000 km of 30 bar grid to supply trucks

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BIOGAS CLEAN-UP AND UPGRADING TECHNOLOGY SUMMARY

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Biogas Composition

• Methane	55 - 60%
• CO_2	35 - 40%
• O_2	0.1 – 0.4%
• N_2	0.4 – 1.6%
• H_2S	200 – 2,000 ppm
• H_2O	Biogas is saturated with water
• Siloxanes	Typically present in sewage derived biogas

To get biomethane into the grid, need to remove all H_2S, most CO_2, dry the gas

In UK water wash and membrane appear most popular

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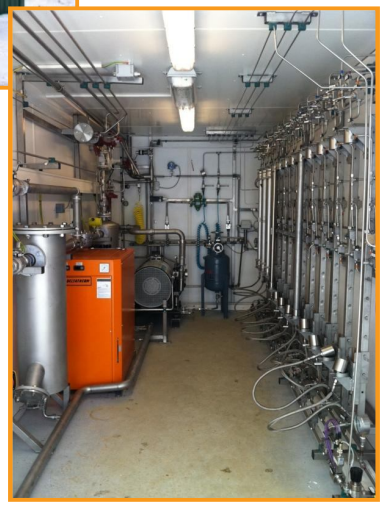
Water Wash

Water Wash:

- 99% of biomethane goes into grid
- Key issue is methane slip
- 14m high towers
- Plant also removes H_2S and siloxanes



Membrane:

- Good technology if can reduce CH_4 in off-gas...new system being installed in UK in 2012 with 99% Ch4 to grid
- Membrane with off-gas to cryogenic process also attractive – all gas to grid and liquid CO2 by-product – installed Q1 2013

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INCREASE IN CALORIFIC VALUE

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Propane Enrichment

Propane Mixing Vessel

- The Gross Calorific Value (GCV) in the GB gas grid is 39 – 39.5 MJ/m^3
- The typical biomethane GCV is 37 MJ/m^3 (CH_4 with 2% $CO_2/N_2/O_2$)

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INJECTION OF GAS INTO GAS NETWORK – ENTRY FACILITIES

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Entry Facility Plant

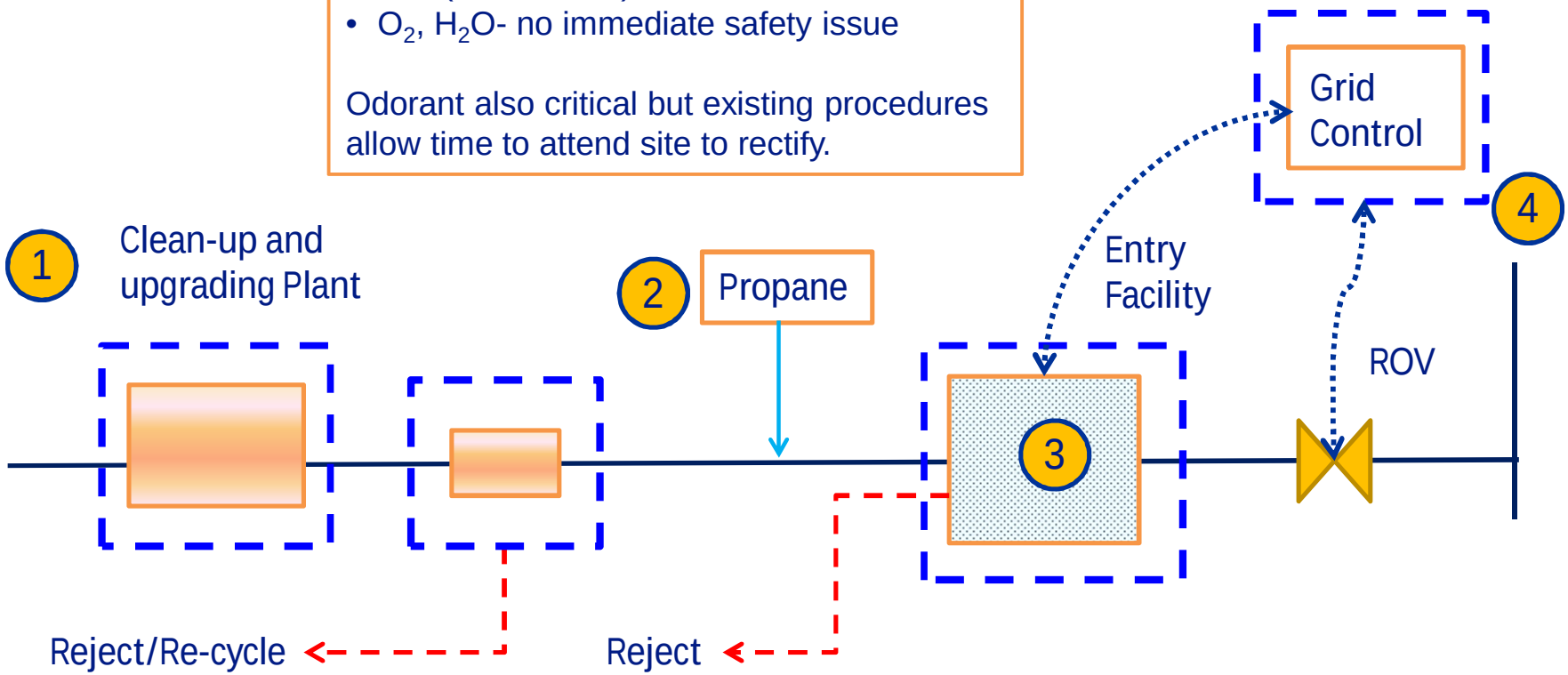
- Entry Facility located after the Clean-up and Upgrading Plant and before the connection pipeline to the gas grid
- The purpose of the Entry Facility plant is to ensure that gas entering the GDN network is of acceptable quality and its energy value known
- Entry Facility comprises the following:
  - Odorant storage and injection
  - Gas quality monitoring
  - Gas CV measurement
  - Gas flow measurement
  - Pressure control
- Aim is to have total capex of <£300k for this plant in 2012 falling to < £150k by 2015

Biomethane to Grid - gas sampling and network protection – typically 4 systems in series to ensure full compliance

Safety priority values:
- H_2S and Wobbe

Other components:
- CV (for FWACV)
- O_2, H_2O- no immediate safety issue

Odorant also critical but existing procedures allow time to attend site to rectify.



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ECONOMICS OF BIOGAS UTILISATION OPTIONS

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Renewable Transport Fuel Certificates

- Electricity is rewarded
- Biomethane injected into grid is rewarded
- Biomethane as vehicle fuel (CBM) is rewarded
- 40 p/kg still not as good as income from electricity or for grid injection

300 m3/hr gives around 1 MWh of electricity = renewable subsidy of around £650k/annum

300 m3/hr gives around 15 million kWh of gas into grid = renewable subsidy of around £700k/annum

1 million kg of Compressed Biomethane = renewable subsidy of around £400k/annum

So vehicles unlikely to run directly on biomethane.....Green Gas Certificates will be the model, see next slides

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GREEN GAS CERTIFICATES

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REAL Green Gas Certificate Scheme

- Announced on 8 October 2010
- Formal launch was on 3rd March 2011 by Renewable Energy Assurance Ltd
- Designed to allow ‘tracking of biomethane from injection point to customer”
  - Integrity - no ‘double counting’
- It is expected that the Green Gas Certificate will be bought by the gas purchaser and not sold separately
- Allows the gas purchaser to work with the producer to market biomethane to customers

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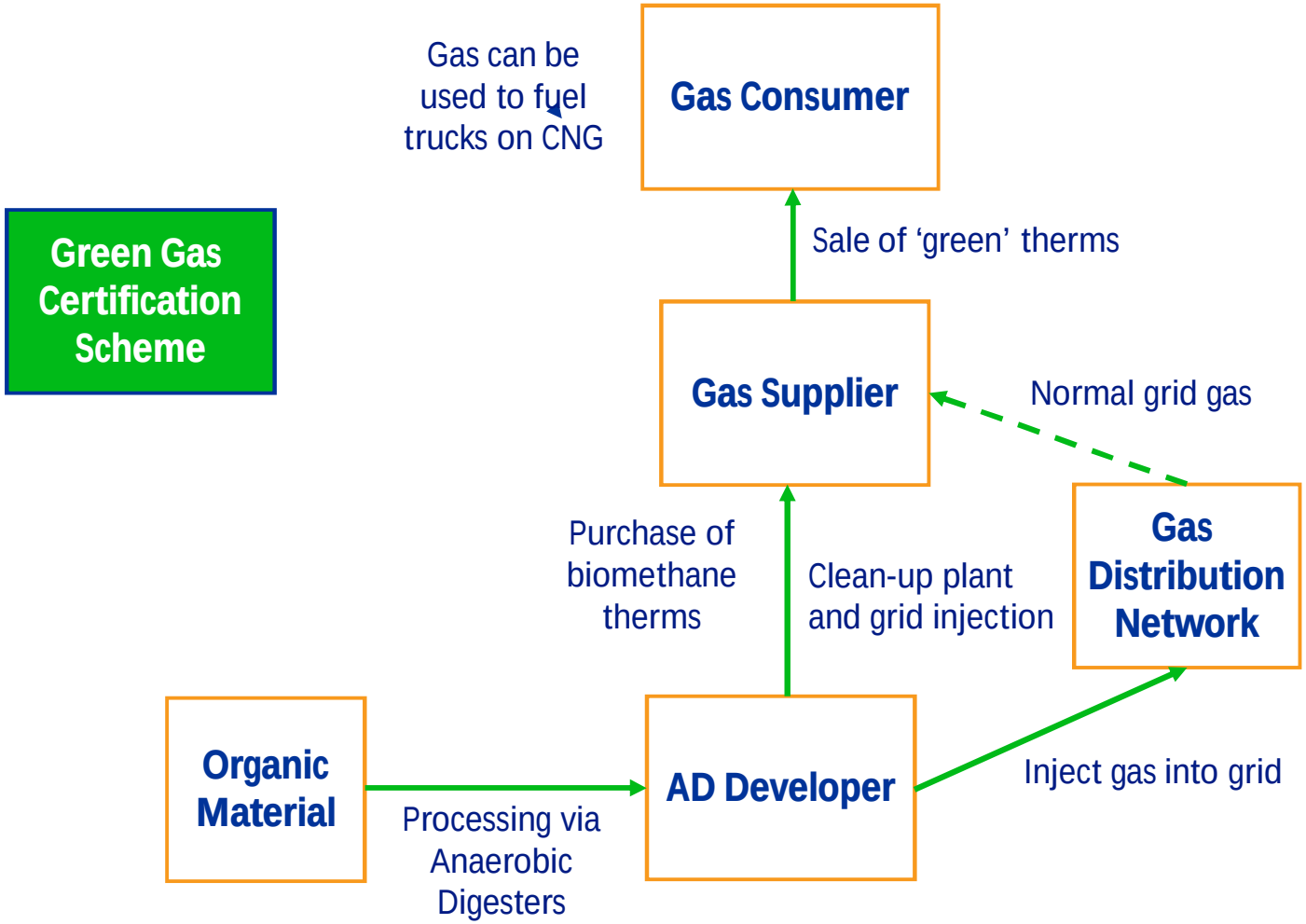
GGCS Launch Members

- National Grid
- British Gas
- E.ON
- Thames Water (Didcot)
- Adnams Biogroup (Adnams)
- Milton Keynes City Council
- CNG Services Ltd
- http://www.greengas.org.uk/
- 4 projects going ahead in 2012 all using the REAL Green Gas Certificate Scheme

AD Developer – Gas Supplier – Gas Grid – Gas Consumer (CNG Trucks)



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Biomethane Conclusions

- Biogas should only generate electricity when all the heat can be used
- UK has an extensive gas grid and the full support of UK gas distribution network owners and energy suppliers
- Biomethane injection into gas grid is widespread in Europe
- 5 - 10% of domestic customer gas supply by 2020 is a reasonable target
- Biomethane project economics are attractive
  - Lots of waste feedstock available in UK
- Green Gas Certificates with gas into “back to base” dual fuel CNG trucks is highly attractive
  - UK has 6,000 km of 30 bar gas grid which goes close to 90% of truck depots

The biomethane and CNG for Trucks markets are both set to grow, delivering significant benefits and helping meet 2020 targets

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