

# Supply and utilisation of biogas and natural gas in Somerset, UK

*- An overview of the present situation, norms & legislation and available vehicles*

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# Summary of the present situation – facts & figures

## Supply

### Biogas plants

- One demonstration plant owned by Organic Power. No commercial plants running

### Gasification

- None

### Natural gas

- Widely distributed throughout the region to all towns and some villages. Not available on most farms or rural situations

## Treatment and distribution

### Upgrading plants

- None at start of Madegascar project, but Organic Power hope to install one during the life of Madegascar

### Local (biogas) grid

- None

### Regional gas grid

- Maintained by West & Wales Utilities
- There are 34,000Kms of gas pipeline covering Wales and the South West
- 2.4 Million supply points within the region

### Non Grid Transportation

- None at start of Madegascar project, but Organic Power are commissioning a trailer with a gaspack to transport biomethane from digester to gas filling station

### Gas filling stations

- None at start of Madegascar project, but Organic Power have constructed one in Wincanton which opened on 31st March 2008

## Utilisation

### Biogas & Natural gas in vehicles

- Organic Power have 4 natural gas vehicles. There are no others in Somerset

### Biogas for non transport applications

- None

### Natural gas for non transport applications

- Widely used for heating, cooking, industrial processes, power generation
- and large scale Combined Heat And Power (CHP) projects

## LPG

### Utilisation in vehicles

- Refuelling network available including the large Petrol Companies e.g Shell & B.P
- Manufacturer produced vehicles available both for private and commercial use
- Network of vehicle converters in place with kits to convert most types of vehicle.

## Available Vehicles

- None easily available, but Organic Power can facilitate both the purchase of new gas vehicles and the conversion of diesel, petrol or LPG vehicles to natural gas

# Contents

<b>Summary of the present situation – facts &amp; figures .....</b>	<b>1</b>
<b>Introduction.....</b>	<b>1</b>
<b>Supply .....</b>	<b>2</b>
Biogas production plants .....	3
Gasification .....	4
Natural gas.....	5
<b>Treatment and distribution .....</b>	<b>7</b>
Treatment of biogas (upgrading) .....	8
Biogas grid .....	9
Non grid transportation.....	10
Gas filling stations.....	11
<b>Utilisation of biogas and natural gas .....</b>	<b>12</b>
Utilisation of upgraded biogas and natural gas in vehicles.....	13
Biogas for non transport applications .....	14
Natural gas for non transport applications .....	15
<b>LPG .....</b>	<b>16</b>
Gas norms .....	17
Supply .....	17
Treatment and distribution.....	17
Utilisation of biogas and natural gas.....	17
<b>Control measures .....</b>	<b>18</b>
Supply .....	18
Treatment and distribution.....	18
Utilisation of biogas and natural gas.....	18
<b>Available vehicles .....</b>	<b>19</b>
Personal cars .....	19
Light transport vehicles.....	19

# Introduction

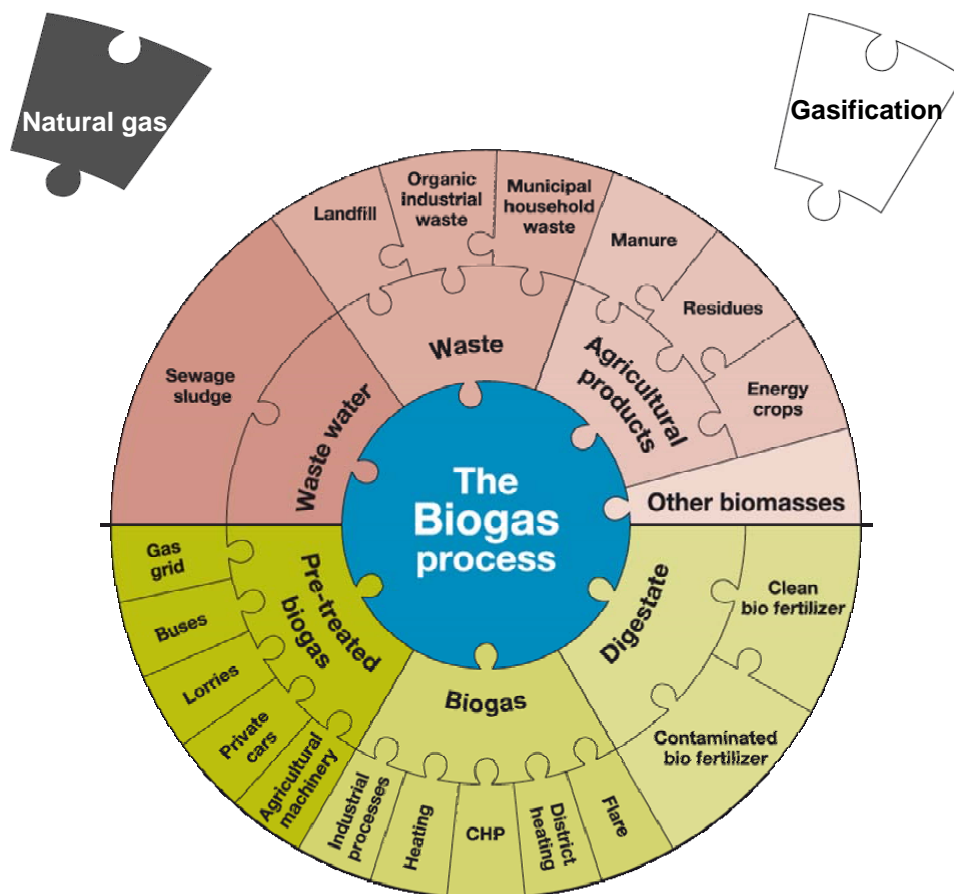
Biogas and natural gas are very clean energy sources, when combusted the amount of particles, NO<sub>x</sub>, CO etc are lower than most other fuels. Biogas is also a renewable fuel. If petrol or diesel is replaced with biogas produced from manure, the CO<sub>2</sub> emissions can be reduced with up to 180 % . The MADEGASCAR project aims at improving the conditions for a growing market for gas driven cars and light transport vehicles and also increase the supply of biogas and natural gas for these vehicles.

To expand the market for supply and use of gas as a fuel for vehicles it is of high importance to understand the present situation of use and supply of gas. This text sums the present situation of supply, treatment & distribution and the final use of biogas and natural gas in the region.

One chapter deals with norms and legislation. This chapter concern laws around biogas production plants, distribution of biogas and natural gas, and the use of gas in vehicles. The current management control measures that are used in the region to support gas vehicles are also summed in this chapter.

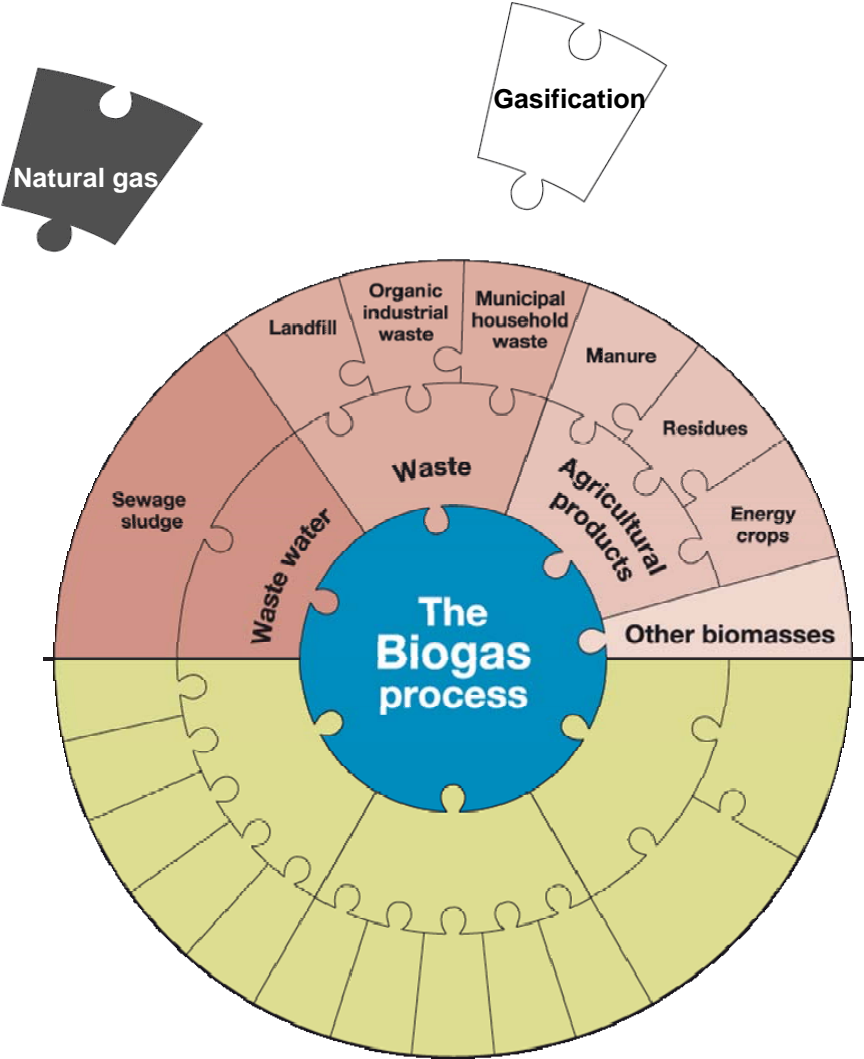
The use of LPG as vehicle fuel is also of interest for the MADEGASCAR project because of the possibility to convert these vehicles to propulsion with methane.

This text also contains an overview of the range of available gas driven personal cars and light transport vehicles in the region.



# Supply

This section handles the present supply situation of biogas, natural gas and gasification in the region.



## Biogas production plants

### Background

In the 1970s there were many farm based digesters, but the technology was not sufficiently advanced for these to have been successful, so from the point of view of farmers it will be necessary to allay their fears and rekindle their interest.

After much lobbying by Organic Power and others, the government have agreed that anaerobic digestion is the preferred method for treating the organic fraction of household waste.

Somerset County Council do not as yet have a digester, but have been considering one for many years, and with the new interest nationally may be encouraged to go ahead and build a plant. Somerset is one of the principal food processing areas in the UK and many of the commercial companies have expressed an interest in digestion.

The UK most water treatment plants have had biogas plants for many years with some success, although they have not considered the gas they produce as very valuable.

### Present situation

#### Waste Water

- Although most waste water treatment plants in the UK have anaerobic digesters, these are considered as part of the waste treatment rather than as a source of energy, and in most cases the biogas is flared.

#### Waste

- 0 Co-digestion plants. Organic Power have a small demonstration plant capable of treating about 900 cubic metres per year. The plant is used to test different feedstocks (such as cheese factory waste, chocolate factory waste, cattle slurry), so gas production is not the primary purpose
- 0 GWh in total production per year
- 0 plants upgrades the biogas to natural gas quality

#### Agricultural products

- 0 biogas plant
- 0 GWh per year

### Future perspectives

Somerset County Council have been discussing the possibility of installing a digester for many years to treat MSW. They are well aware of the technology. During the life of the Madagascar project they will be encouraged to install a plant, as will the food processing companies.

## Gasification

### Background

There is no interest in gasification in Somerset at present, although in the UK generally there is some discussion. Many consultants have promoted gasification but as yet there is no proven technology available.

### Present situation

- There are no research in the field in Somerset
- No pilot plants in Somerset

### Future perspectives

A plant might be built in Somerset during the life of Madegascar, particularly with a view to treating the very solid part of waste that is not suitable for digestion

## Natural gas

### Background

The UK has an excellent infrastructure which covers most of Somerset except farms and rural areas.

Gas is delivered to the seven reception points (called beach terminals) by gas producers operating Offshore Facilities from over 100 fields beneath the sea around the British Isles. In addition a newly commissioned terminal at the Isle of Grain allows Liquefied Natural Gas (LNG) to be delivered to the terminal by sea. After treatment, which includes checking the quality meets the safety requirements and measuring the calorific value (the amount of energy contained in the gas), it is transported through 275,000 Kilometres of iron, steel and polyethylene mains pipeline.

The National Transmission System (NTS) is the high pressure part of National Grid's transmission system and it consists of more than 6,600 Kilometres of top quality welded steel pipeline operating at pressures of up to 85 bar (85 times normal atmospheric pressure, over 1250 psi). The gas is pushed through the system using 26 strategically placed compressor stations. From over 140 off-take points, the NTS supplies gas to 40 power stations, a small number of large industrial consumers and the twelve Local Distribution Zones (LDZs) that contain pipes operating at lower pressure which eventually supply the consumer.

The twelve LDZs are managed within eight gas distribution networks. Following the sale by National Grid of four of the distribution networks, the owners of the distribution networks are now:

North West, London, West Midlands and East of England (East Midlands LDZ & East Anglia LDZ) are owned and managed by National Grid.

Scotland & South of England (South LDZ & South East LDZ) are owned and managed by Scotia Gas Networks – operating as Scotland Gas Networks and Southern Gas Networks respectively

Wales and the West (Wales LDZ & South West LDZ) is owned and managed by Wales and West Utilities

North of England (North LDZ & Yorkshire LDZ) is owned by Northern Gas Networks, who have contracted operational activities to United Utilities Operations

### Present situation

- 1 gas company delivers natural gas within the region
- The Energy value of the gas is 11 kWh per Nm<sup>3</sup>
- The total number of customers in the region is 186,400
- The amount of sold/used gas is 5,096 GWh/year

## Future perspectives

National Grid needs to expand its network of high-pressure natural gas pipelines through Somerset and Devon to meet the increasing demand for energy in the West Country and to supply the power station currently being built at Langage, near Plymouth.

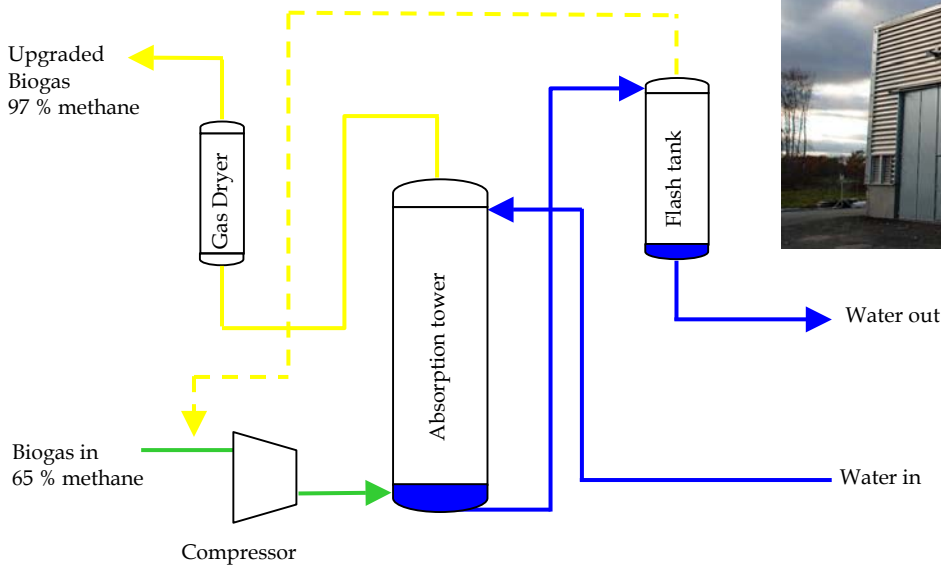
The South West Reinforcement Project involves the construction of four new pipeline sections, together with the work required to upgrade the Above Ground Installations (AGIs) along the route, and will help meet this growing need.

The first of these sections, from Ilchester to Barrington, was completed in late 2006 and work started in March 2007 on the others: Ottery St Mary to Aylesbeare (10km); Aylesbeare to Kenn (16km); and Fishacre to Choakford to Lyneham (31km).

The steel pipes are 600mm (24") in diameter and the pipelines have been designed and built to the same high standards of safety and security as the other 6,800km (4,160 miles) of high-pressure gas transmission pipelines already in operation across the UK.

## Treatment and distribution

This section handles the present situation of biogas treatment plants and distribution systems for biogas and natural gas in the region. The number of gas fuelling stations will also be found in this section.



## Treatment of biogas (upgrading)

### Background

The UK does not yet have any biogas upgrading plants.

### Present situation

- 0 upgrading plants
- Used techniques are none as yet
- 0 GWh of biogas is treated
- 0 GWh over-capacity in the existing upgrading plants

### Future perspectives

There is now a new interest in biomethane as a transport fuel in the UK. Organic Power hope to see Somerset lead the way as an example to the rest of the country, and will be installing an upgrading plant for the biogas produced by the Organic Power digester. It is hoped that biogas from other digesters in other regions can be brought to Somerset for upgrading

## **Biogas grid**

### **Background**

There is no biogas grid in the UK or Somerset

### **Present situation**

#### **Local biogas grid**

There is no biogas grid in the UK or Somerset

#### **Large (regional) gas grid**

There is no biogas grid in the UK or Somerset

### **Future perspectives**

It is unlikely that there will ever be a separate biogas grid, although there are moves to see that biomethane can be accepted into the natural gas grid.

## **Non grid transportation**

### **Background**

Most people, even those involved in the natural gas vehicle industry, are unaware of the possibility of using trailers to collect and deliver gas for vehicle use

### **Present situation**

There is no non-grid transportation of natural gas or biogas in the region although there is some transportation of Liquid Natural Gas (LNG) in other areas of the UK, for use as road fuel and to supply one off network village.

There is a good infrastructure in Somerset for delivering LPG either in bottles or from a tanker into a 'submarine' tank. The LPG is used for cooking and heating, and also for LPG refuelling stations

### **Future perspectives**

Organic Power hope to instigate a mother/daughter system of collection biogas in Somerset on a trailer, transporting it to a centre for upgrading, and then transporting it to where it can be used

## Gas filling stations

### Background

There were no gas filling stations in Somerset at the start of the Madagascar programme, however Organic Power have installed a station in Wincanton which opened on 31st March 2008.

In the UK generally there are a few gas filling stations, but the UK is one of the few countries in the world where gas filling stations have been closing. Under Madagascar we hope to reverse this trend

### Present situation

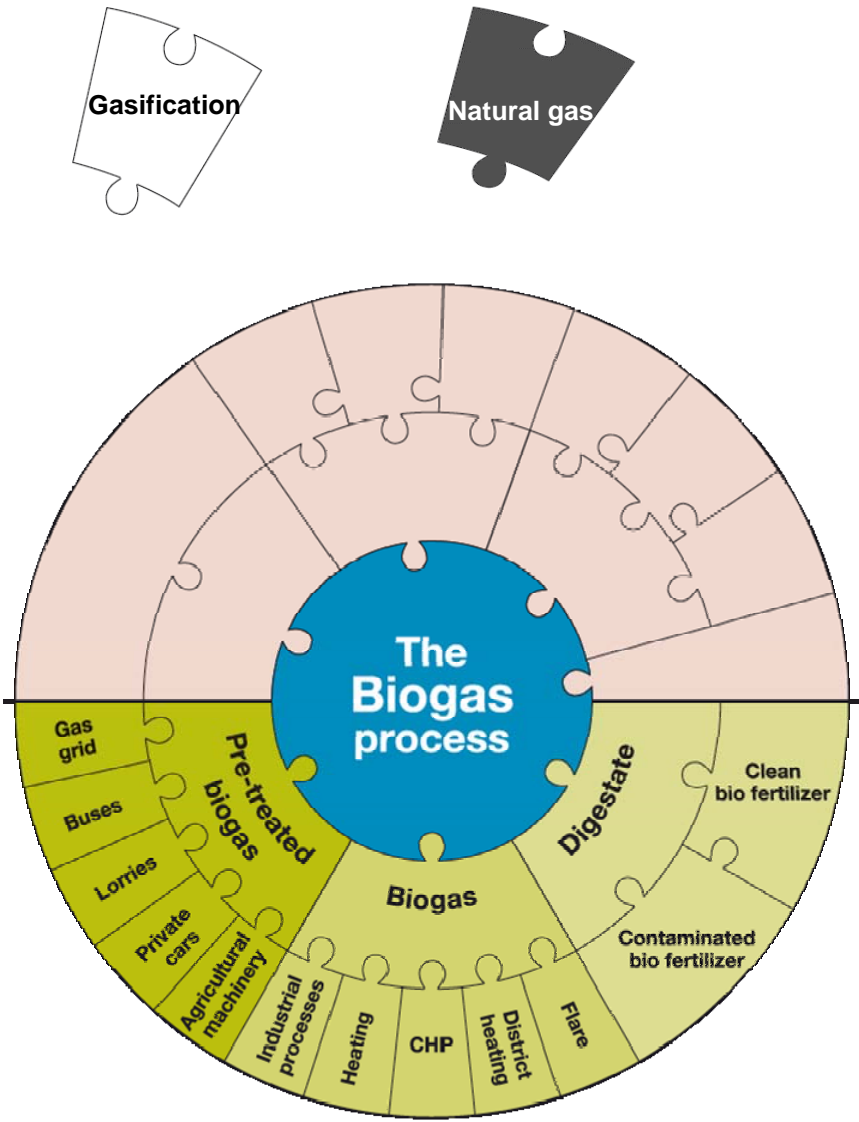
- 1 filling stations in the region
- 0 filling stations are provided with 100% biogas.
- 0 home filling stations

### Future perspectives

It is hoped to replicate Wincanton filling station in at least one other location in Somerset, under the auspices of the Madagascar programme

# Utilisation of biogas and natural gas

This section sums the use of biogas and natural gas in the region. The focus lays on use of gas for vehicles, but the use in fixed applications as heating and CHP will also be ventilated to get a better overview of the entire gas market.



## Utilisation of upgraded biogas and natural gas in vehicles

### Background

The UK was one of the early adopters of natural gas vehicles, mostly buses, but because of technological problems most of these early vehicles and gas filling stations have been abandoned. There is now renewed interest in biogas and natural gas as a vehicle fuel, possibly as a route to hydrogen which has been seen as the preferred fuel of the future by the press and the government in this country. In Somerset the only gas or biogas vehicles, and gas filling stations are the ones owned by Organic Power

### Present situation

- 4 personal cars in Somerset all operated by Organic Power (three cars and one van) all running on natural gas from filling stations outside Somerset at present, and from Organic Power's own filling station in Wincanton from 31st March 2008. There are no right hand drive gas passenger cars easily available in the UK, although most of the ones that are available as left hand drive cars should also be available by law in the UK, however Organic Power can facilitate the import of gas vehicles
- 0 buses in Somerset
- 0 heavy duty vehicles in Somerset
- 0 kNm<sup>3</sup> Natural gas in Somerset
- 0 kNm<sup>3</sup> Biogas, in Somerset

### Future perspectives

It is anticipated that many food processing and distribution companies in the Wincanton region will convert their fleets to natural gas to take advantage of Organic Power's gas filling station in Wincanton. This will be one of the primary purposes of the Madagascar marketing

## **Biogas for non transport applications**

### **Background**

Not relevant for Somerset

### **Present situation**

Heating

CHP

Power generation

District heating

### **Future perspectives**

## Natural gas for non transport applications

### Background

The use of natural gas is widespread throughout the UK.

Uses for natural gas within the UK include power generation, numerous industrial applications and to heat and provide cooking facilities in domestic properties.

### Present situation

Figures for 2006

Total Demand - 1,047,113 Gwh

Electric & Heat Generation - 332,522 GWh

Other Energy Industry Usage - 79,535 Gwh

Industry Use - 143,766 Gwh

Domestic Use - 364,555 Gwh

Other - 105,223

Losses - 12,012 Gwh

Non Energy Use - 9,500 Gwh

### Future perspectives

Estimates of gas reserves totalled up to 2,016 billion cubic metres at the end of 2006; down 1.2 per cent from 2,041 billion cubic metres in 2005. Proven reserves amounted to 412 billion cubic metres in 2006, 14.3 per cent lower than the 481 billion tonnes recorded a year earlier. The level of gas extraction was 78 billion cubic metres in 2006, the lowest since 1995. The life expectancy of gas reserves showed an increase between 2005 and 2006 from 11 to 13 years. As with oil reserves, this was a result of lower extraction rates rather than significant discoveries of new reserves.

# LPG

## Background

LPG has been very successful in the UK as it is significantly cheaper than petrol, and has received support from the government. There is a good infrastructure for filling stations, companies that carry out vehicle conversions. There 20 OEM vehicles (or conversions approved by OEMs) available in the UK

## Supply of LPG

- 30 filling stations for LPG in the region.

## Utilisation of LPG

- 128,000 vehicles running on LPG in the UK as a whole, the numbers for Somerset are not available.
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## Future perspectives

Organic Power will include the LPG industry as partners in Madagascar, with the aim of converting some vehicles from LPG to natural gas. There is also a possibility of installing natural gas filling stations where there are LPG filling stations

## Gas norms

Natural gas is a fossil fuel primarily made up of above 90% methane with quantities of ethane, propane and nitrogen and other trace elements. Natural gas is odourless and the smell is added prior to delivery into the network to aid in the detection of leaks. Natural gas is lighter than air, and so tends to escape into the atmosphere rather than collecting at ground level, reducing the risk of explosion in an open air environment. Methane has a lower explosive limit of a 5% mixture in air, and an upper explosive limit of 15%. Explosive concerns with compressed natural gas used in vehicles are reduced, due to the escaping nature of the gas, and the need to maintain concentrations between 5% and 15% to trigger explosions.

## Supply

The regulations for biogas plants are numerous and fall into several categories:

- Waste management licence
- Pollution Prevention Control licence
- Planning permission
- Transport regulations for vehicle movements relating to feedstock and digestate

The most onerous and complicated regulations relate to feedstock for anaerobic digestion plants. Any potential biogas plant operator will need to investigate whether a Waste Management Licence and Pollution Prevention Control licence will be required for their particular feedstock. At present the digestate produced from anaerobic digestion is considered a waste that needs to be disposed of, rather than a valuable resource, although there are pressure groups working towards changing this. The UK regulators are presently working on a “digestate standard” which, later this year, will allow allow the product of anaerobic digestion, if strict controls are met, to be considered as a fertiliser.

Most of the regulations are controlled by the Environment Agency and advice will need to be sought from them on a site by site basis

## Treatment and distribution

The installation and use of a gas distribution pipeline is controlled by a number of Regulations and Codes Of Practice.

In the UK, CNG refuelling facilities were constructed in accordance with the Institute of Gas Engineers Utilization Procedures, IGE/UP5/ Parts 1 and 3. These procedures have now been withdrawn and the European Standard EN 13638 is in Draft awaiting approval.

## Utilisation of biogas and natural gas

The quality of gas for vehicles is controlled by:

International Standard ISO 15403

Natural Gas - Designation of the quality of natural gas for use as a compressed fuel for vehicles

## Control measures

### Supply

40% grants to support the capital cost of refuelling infrastructure have been available, but no decision has yet been made by the UK government as to what support if any will be available this year.

### Treatment and distribution

None

### Utilisation of biogas and natural gas

Fuel duty is 13.70p/Kg until 1st October when it will increase to 16.60p/Kg. The rate on petrol and diesel will increase from 50.35p/Kg to 52.35p/Kg. The government has agreed to maintain the differential with diesel on a rolling 3 year basis. Biomethane is taxed at the same rate as natural gas, there is no concession for the fact that it is renewable, except that the duty differential will remain until 2012.

Vehicle Excise Duty (VED) is linked to carbon dioxide emissions and fuel type. NGVs pay less VED than their equivalent petrol or diesel. For example a car running on alternative fuel producing less than 100g/km CO<sub>2</sub> pays no duty.

Registered OEM gas vehicles are exempt from the London Congestion Charge Zone and the Low Emission Zone in London, provided that their emissions are less than 120g/km CO<sub>2</sub> and that they meet Euro 4 standard.

## Available vehicles

### Personal cars

Currently there are no CNG cars available to purchase new, although some second hand vehicles are still in circulation. A CNG version of the Vauxhall Zafira is expected to be available in the near future

Make:	Volvo
Model:	S60
Car Body:	Saloon
Rated Output:	103kW @ 5800rpm / 140 bhp
Fuel capacity:	18 kg / 30 litre
Cruising range:	262 / 333 km ( <i>gas/petrol</i> )
Kerb Weight:	1427 kg
Gross vehicle weight:	2050 kg
Passengers:	5 passengers

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Make:	Volvo
Model:	S80
Car Body:	Saloon
Rated Output:	103kW @ 5800rpm / 140 bhp
Fuel capacity:	18 kg / 30 litre
Cruising range:	254/ 315 km ( <i>gas/petrol</i> )
Kerb Weight:	1539 kg
Gross vehicle weight:	2140 kg
Passengers:	5 passengers

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Make:	Volvo
Model:	V70
Car Body:	Estate
Rated Output:	103kW @ 5800rpm / 140 bhp
Fuel capacity:	18kg / 30 litre
Cruising range:	248 / 322 km ( <i>gas/petrol</i> )
Kerb Weight:	1569 kg
Gross vehicle weight:	2150 kg
Passengers:	5 passengers

### Light transport vehicles

Figures given are dependant on variant, CNG cylinder configuration and type of driving conditions.

Make:	Iveco
Model:	Daily Chassis Cab
Load volume:	
Load weight:	Between 1235 and 3995kg
Rated engine output:	100 kW @ 2730-3500rpm /135bhp
Fuel capacity:	Between 220 and 302 litre CNG
Cruising range:	Between 230 and 430km
Gross vehicle weight:	Between 3500 and 6500kg
Passengers:	

Make: Iveco  
 Model: Daily Van  
 Load volume:  
 Load weight: Between 675 and 2500kg  
 Rated engine output: 100kW @ 2730-3500rpm /135bhp  
 Fuel capacity: Between 220 and 302 litre CNG  
 Cruising range: Between 390 and 590km  
 Gross vehicle weight: Between 3500 and 5200kg  
 Passengers

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Make: Mercedes  
 Model: Sprinter  
 Load volume:  
 Load weight: Between 1230 and 2675kg  
 Rated engine output: 115kW @ 5000rpm / 156bhp  
 Fuel capacity: Between 125-300 litres CNG / 100 litre petrol  
 Cruising range: Up to 470/ Up to 730 km (*gas / petrol*)  
 Gross vehicle weight: Between 3500 and 5000kg  
 Passengers

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Make: VolksWagen  
 Model: Caddy  
 Load volume:  
 Load weight: 665kg  
 Rated engine output: 80 kW @ 5400rpm / 108bhp  
 Fuel capacity: 26Kg CNG/ 13 litre petrol  
 Cruising range: 565Km combined CNG and Petrol  
 Gross vehicle weight: 2270kg  
 Passengers

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## MADEGASCAR

MADEGASCAR - market development of gas driven cars, is a project which aims at developing the market for gas driven vehicles – natural gas and biogas fuelled vehicles. Strengthening the supply and distribution infrastructure of biogas and natural gas to fuel vehicles is also a goal for the project.

## Intelligent Energy - Europe

Intelligent Energy - Europe is the EU's tool for funding action to improve the conditions for energy saving and the use of renewable energy sources in Europe

## ORGANIC POWER LTD

Organic Power is chaired by Christopher Maltin, a mechanical engineer who has been involved with clean fuels all his life. His team's pioneering and highly successful work on lead-free fuel systems for high performance engines has led to the development by Organic Power of an integrated system for producing biomethane from organic wastes. Recognised as one of the foremost experts in the field of biomethane as a vehicle fuel he has advised governments on the subject of renewable fuels. He has a long standing association with Porsche, Ferrari and Lamborghini and more recently Organic Power has been responsible for the original design concept of the biomethane powered Mercedes EcoVito

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