

Biogas – the environmentally closed loop energy system

Biogas is the name given to the mixture of methane gas and carbon dioxide gas which is formed whenever organic materials decompose in the absence of air. This process is known as anaerobic digestion and when it occurs in nature the gases escape to atmosphere, but this natural process can be managed in an industrial plant.

To make it more efficient the industrial process requires warmth, air to be excluded, and the organic material is usually prepared before being fed into tanks which allow the gases to be captured and used. Modern industrial processes can make Renewable Natural Gas in a matter of days rather than the thousands of years which were taken to produce Natural Gas.

Renewable Natural Gas is by far the most environmentally friendly fuel in the world when compared with any other fuels. Capturing the methane which would otherwise be emitted from decomposing organic materials and preventing this from becoming a greenhouse gas which is 21 times worse than carbon dioxide in terms of climate change is actually improving the environment rather than just being "less bad" by merely replacing fossil fuels with renewable fuels. Nearly all countries now have a mission to work out schedules for sustainable development and powering vehicles from fuel made from wastes is a very obvious and direct example.

Manufacture of Biogas

Biogas can be manufactured from just about any organic material. Historically biogas has been produced from sewage sludge and animal slurries, but more recently the focus has been on producing gas from energy crops such as grass or maize, and wastes such as those which arise from food manufacturing, brewing, and household rubbish. On average 60% of the contents of a household dustbin are organic and can be used to make gas. The biogas produced by the natural process contains about 65% methane, 35% carbon dioxide and some trace gases including hydrogen sulphide. This raw biogas is mainly used in stationary engines which generate electricity. At sewage works it is used to power the machinery on site, and at landfill sites it is fed into the national electricity grid. Natural gas which is distributed using the gas grids around the world contains mainly

methane and much less carbon dioxide (usually less than 1%) than biogas. Although formed by the same natural process of rotting vegetation, natural gas was formed millions of years ago and the carbon dioxide has since been dissolved. To use biogas as a vehicle fuel the carbon dioxide needs to be removed so that the methane content is similar to that in natural gas. If the carbon dioxide is allowed to remain in the biogas mixture the operating range of the vehicle is compromised as carbon dioxide does not burn! Hydrogen sulphide also needs to be removed as this is corrosive. The process of changing biogas to natural gas standards so that the gas can be used as a vehicle fuel is known as upgrading and will form the basis of a later article in NGVA News. Upgraded biogas is also known as Renewable Natural Gas. When vehicle fuels are burnt they produce water and carbon dioxide. Renewable Natural Gas has all the advantages of low emissions as natural gas, but with the added advantage that the carbon dioxide produced is renewable carbon dioxide. It is not the same as that from a fossil fuel as the carbon in the exhaust has come from the carbon dioxide recently taken from the air by vegetation during its growth. Biogas is all part of a natural cycle and it is interesting when the term "waste" is used in that plants take carbon dioxide out of the air, use the carbon to make up their structures and release the oxygen as a "waste" as part of the growing process. Using Renewable Natural Gas made from so called organic "wastes" as a vehicle fuel has a number of other advantages in addition to the obvious air quality improvements over liquid fossil fuels. In a recently presented report from the Swedish Committee of Alternative Fuel biogas was acknowledged as the best alternative fuel today, as regards to climate, environment and health - low emissions and no net contribution to the greenhouse effect. Biogas is a system that makes the ecological circulation system truly visible.

Benefits of biogas

Compared with petrol or diesel, the

benefits of vehicles fuelled by **fossil** natural gas include:

- Considerably reduced exhaust noise levels
- Lower emissions of nitrogen oxides
- Almost zero emissions of particles or dust

Besides all the above advantages,

Renewable Natural Gas offers additional benefits:

- No net contribution to the greenhouse effect
- A renewable source of energy
- Locally produced without any dependency on foreign oil or natural gas suppliers
- Environmental improvement
- Reduces the pollution from organic wastes which account for most fresh water pollution
- Solves waste management problems
- Renewable carbon dioxide formed during manufacturing has numerous commercial uses
- Provides an "Environmentally Closed Loop Energy System"

Biogas in the UK - Organic Power Ltd., Horsington, Somerset

At the present time Organic Power Ltd. is the only company in the UK which is focussed on producing Renewable Natural Gas as a vehicle fuel. Their patented technology combines aerobic and anaerobic digestion in a series of minimum energy shaped tanks (to replace conventional cylindrical tanks) which are submerged in lagoons of water.



Set of Organic Power tanks being loaded into a lagoon

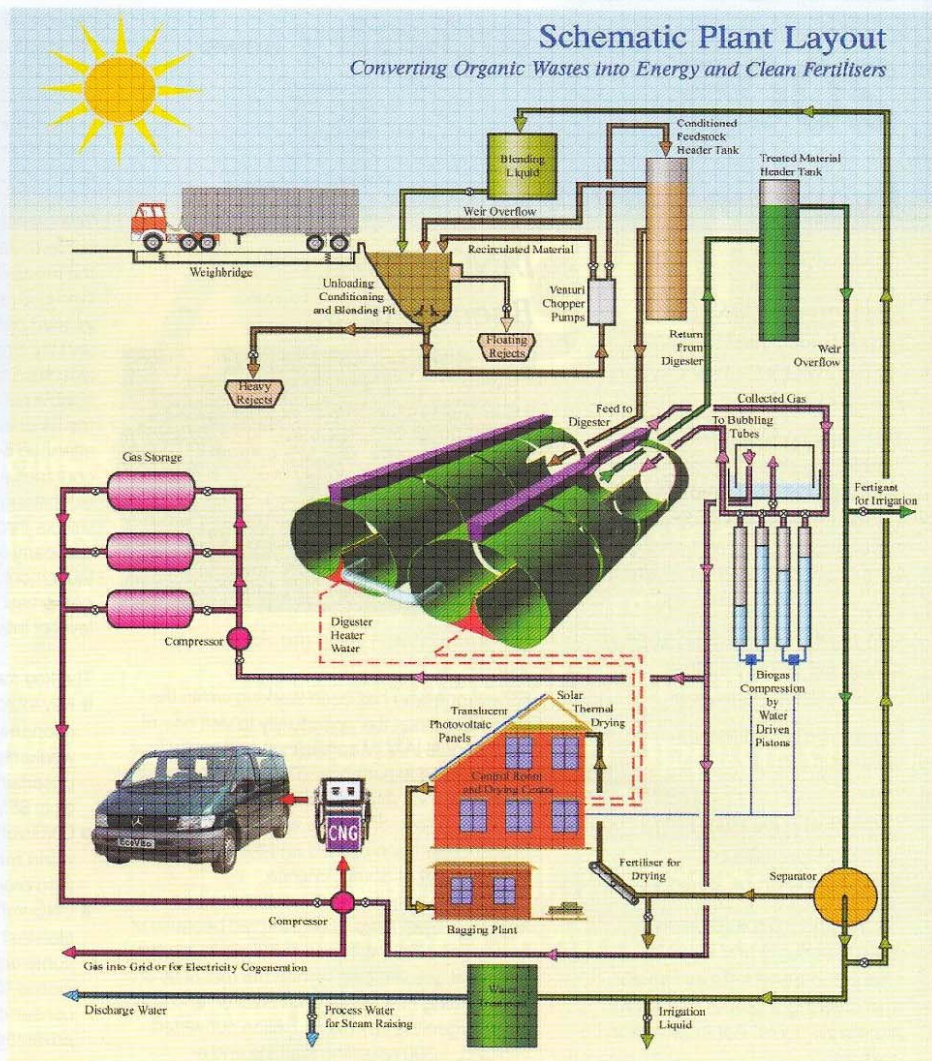
The lagoons can be heated by solar power resulting in maximum energy production and a high conversion of organic materials into Renewable Natural Gas, fertilisers and other valuable products whilst allowing the recovery of heavy metals.

Biogas in Europe

Most countries have Natural Gas vehicles however some countries also recognise Renewable Natural Gas and have specified an even lower excise duty on this fuel.

The use of Renewable Natural Gas as a transport fuel has made a major breakthrough in Sweden where the duty is zero. Its use in Sweden started as a vehicle fuel on the east side of the country where there is no natural gas. The uptake has been such that, in addition to its use as a vehicle fuel, there are now tower blocks which use Renewable Natural Gas for cooking and heating.

The countries in Europe with the highest biogas production per capita are the UK, Sweden, Denmark, Switzerland and the Netherlands. Every year over one billion tonnes of organic agricultural wastes arise in Europe which are presently a major source of pollution. Using biogas produced from organic materials in the UK and uprating this to Renewable Natural Gas could provide 20% of the UK's vehicle fuel with outstanding environmental benefits and complete security of supply.



'Schematic courtesy of Organic Power Limited

Case Study Sweden

Sweden is leading the way in Europe for the use of natural gas as a vehicle fuel and in particular Biogas. Because the population density in Sweden is low it makes it difficult to invest in large infrastructure. The distribution system for methane gas is therefore different from the rest of Europe. In the western part of Sweden there is an available distribution system (imported mostly from Denmark). In the rest of Sweden methane gas is distributed from a number of BioGas plants where methane is produced locally at plants normally owned and operated by the municipalities.

Much growth in the use of NGVs has been achieved through joint ventures between the key stakeholders such as Volvo Car Corporation, Volvo Truck & Bus, Scania, infrastructure providers Fordonsgas and Sydcraft Gas, municipalities and the Government. Consequently large growth is being seen in the number of natural gas

company cars, municipal fleet vehicles, buses and taxis. There are currently around 4500 natural gas vehicles in total on the roads in Sweden, of which 40% run on Biogas.

Committed local and regional authority initiatives also drive growth – free parking, CNG taxi lanes and 80% of authority fleet targeted to be clean vehicles by 2008. The Swedish National Energy Administration have allocated 1.5 Million Euros for the national organisation and co-ordination of CBG/CNG infrastructure development and the Swedish Government has proposed a 20% lower taxation on company cars when choosing clean fuel vehicles (CNG, CBG) and support for 30% of the investment in plants upgrading Biogas to vehicle fuel. The Swedish tax system has encouraged the use of biogas as a vehicle fuel through permanent tax relief on Biogas and a moderate tax level on natural gas.

There are more than 230 biogas plants in Sweden and about 130 of these are located at sewage water treatment plants. 60% of the total Swedish biogas production comes from these plants. The other main source for biogas in Sweden is landfills which accounts for 30% of the biogas production. One of the main reasons for the increasing interest in co-digestion plants is the EU directive on landfills that has resulted in a Swedish tax on organic waste that is disposed into landfills and the ban of organic waste in landfills by 2005.



Biogas Bus in Uppsala, Sweden