

biogas



LILI



using biogas to boil a kettle on a normal hob - the only difference is there's no gas bill.

what is it?

Biogas is mostly methane (around 60%), with carbon dioxide (around 40%) and a little hydrogen and hydrogen sulphide. It is made by anaerobic bacteria breaking down organic matter in the absence of oxygen (when the organic matter is waterlogged – i.e. a slurry). Biogas is generated naturally in the mud at the bottom of marshes (it is called marsh gas, and often ignites). The process also occurs in landfill sites, and in the digestive system of humans and other animals (yes, farts are biogas). But we can make it ourselves from plant and animal wastes, and even human waste; soft material is better than twigs / woody material. It can be burnt to drive a generator, or on a smaller scale, for cooking or lighting gas lamps. Also, biogas engines have been developed for transport.

The equipment in which the organic matter breaks down anaerobically is called a digester, and there is also some sort of storage container for the gas produced. Raw biogas can be 'scrubbed' by passing it through slaked lime, which removes most of the CO2 and increases its calorific value.

The two main types of digesters are the continuous and the batch. Continuous digesters have a constant throughput of material, and batch digesters extract the gas from a contained batch of material, which is then emptied and a new batch added.

Biogas digesters are already widely used in developing countries, especially India and China, as firewood for cooking becomes scarce. By the end of the nineties, there were millions of small family plants in India and China. In the West, digesters tend to be larger-scale, taking animal slurries and human sewage. But they can be domestic-scale, for individuals looking to reduce their dependency on fossil fuels.

what are the benefits?

reduces CO_2 emissions and resource use: because it is a substitute for natural gas. Because CO_2 from biogas is from recently-alive plant matter (even if it was fed to animals), it is part of a cycle – i.e. the plants for the next batch of biogas take in the CO_2 given off by the previous batch. This is clearly not the case with (fossil) natural gas. Biogas doesn't need millions of miles of pipes to deliver it, and doesn't need to be liquefied and shipped across the world, with all the resources and energy that these things entail. Plus it saves trees (for firewood). Natural gas is finite, so won't last forever – and there will probably be wars for it as it runs out.

reduces methane emissions: animal manures release methane into the atmosphere – about 10% of methane emissions in the US, according to one survey. When methane is burnt it releases CO_2, but methane is a more potent greenhouse gas than CO_2, so it is a good idea to burn it rather than release it. However, it's better for organic waste to be separated and put into an anaerobic digester instead of collecting methane from landfill sites; and it would save more energy if all organic waste, including paper, was recycled instead of landfilled – plus it would prevent leaching of contaminants into groundwater and soil.



larger-scale digester on a dairy farm in Shropshire; built by Farmgas (who have built many agricultural digesters). It is about 15 years old and still operational.



small experimental biogas digester at Redfield. Waste material is put into the oil drum, neoprene cover rises when full of gas, gas is tapped into container (upside-down plastic drum with water seal) which rises as more gas enters. When full, gas can be tapped off and used with the little gas ring.

creates two renewable resources: sewage sludge and animal slurries usually end up as fertiliser anyway – so it's better to obtain fuel from it first, and prevent runoff and methane emissions at the same time – and you still get fertiliser at the end of the process. It's the missing link for those wanting to switch from fossil fuels – many people heat their homes with wood and their water with solar, and get their electricity from wind and solar – but cooking is a problem; it's too expensive with electricity, and agas are expensive, take a long time to fire up, will make your space too hot in the summer. Gas is best, and now it can be done without gas bills.

nb: as with other biofuels, we think that the feedstock (raw materials) should be waste material. We don't think it's a good idea to set aside large areas of land for growing fuels when much of the world doesn't have enough food (although the waste from food crops is fine). See BiofuelWatch. Also, large-scale digesters need to be fed by large operations like factory farms or sewage plants. These bring their own problems, such as hormones, treatment of animals, and energy-intensive transport and chemicals. We think that the best solution is usually the smallest scale possible – in this case the domestic scale.

what can I do?

setting up: batch digesters based on a container (see photo, left) are feasible on the domestic scale. Continuous digesters are popular in Asia - an inlet and outlet pit with a concrete or steel gas container. You can build your own – see our links page, or come on a LILI course.

sizing: in India, for a family of 8 with a few animals (say 8-10 cows), a 10m³ digester is recommended, with 2 m³ gas storage. But a typical small family digester will be around one cubic metre. For cooking and lighting, you don't need much; every kg of biodegradable material will yield around 0.4 m³ (400l) of gas, and gas lights need around 100l per hour. 2 gas rings for a couple of hours a day will use between 1-2 m³, so if you have some livestock, plus kitchen and human waste, you can do this easily. When it comes to driving any kind of engine (eg a generator or a pump) it's a different matter, and is way beyond the domestic-scale.

How long you leave the material in a batch digester depends on temperature (2 weeks at 50°C up to 2 months at 15°C). The average is around 1 month – so gauge how much material you will add each day, and multiply it by 30 to calculate the size of the digester.

using: the waste input must be a slurry – so add water if it's too solid. Try and keep the temperature over 30°C; it generates a little heat, but in colder countries the digester will need insulation and even a little extra heat in the winter (the heat could be provided by some of the biogas). A greenhouse is a good place for it.

safety: methane is explosive – see www.adelaide.edu.au/biogas/safety for safety considerations.

resources

- LILI course: how to make & use biogas
- LILI has a large links page; here are some:
- www.adelaide.edu.au/biogas - best introduction to the subject
- http://www.members.aol.com/wimtalk/biogas/biogas.html - make an oil drum digester
- http://www.greenfinch.co.uk/ - farm-scale digesters plus consultancy
- David House, 1978, *the Biogas Handbook*, At Home Everywhere, Aurora, Oregon

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