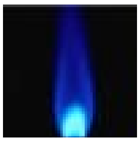
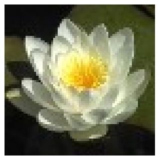


biogas



what is it?

Biogas is mostly methane (around 60%) with carbon dioxide (around 40%) and a little hydrogen and hydrogen sulphide. It's made when anaerobic bacteria breaks down organic matter in the absence of oxygen (when it's waterlogged – i.e. a slurry). The process also occurs in landfill sites, and in the digestive system of humans and other animals (yes, farts are biogas).

Biogas is generated naturally in the mud at the bottom of marshes – it's called marsh gas, and can cause little 'will-o-the-wisp' flames over the water, due to bacterially-produced gases igniting spontaneously and lighting the methane. But we can make it ourselves from plant and animal wastes, and even human waste; soft material is better than twigs / woody material. Biogas 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 organic matter breaks down anaerobically in a digester, plus there's a storage container for the gas produced. Raw biogas can be 'scrubbed' by passing it through slaked lime, which removes most of the CO_2 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. There are 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 too, for individuals looking to reduce their dependency on fossil fuels.

Biogas digester on a family farm in India; there's no reason they can't be successful in the West too.

what are the benefits?

Reduces CO_2 emissions: because it's a substitute for natural gas. Because CO_2 from biogas is from recently-alive plant matter (even if it was fed to animals), it's part of a cycle – i.e. CO_2 given off by burning biogas is absorbed by plants that will provide future biogas, and so on.

Reduces methane emissions: animal agriculture is responsible for around 40% of methane released into the atmosphere by human activity. When methane is burnt it releases CO_2, but methane is around 30 times more potent as a greenhouse gas than CO_2, so it's good 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 was recycled instead of landfilled – plus it would prevent leaching of contaminants into groundwater and soil.

Reduces resource use: 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.

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 and will make your space too hot in the summer. Gas is best for cooking, but with biogas it can be done without gas bills.

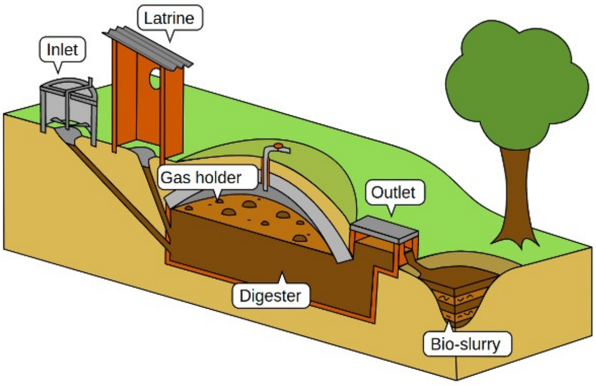
NB: as with other biofuels, we think that the feedstock (raw materials) should be waste material. We don't think it's a good idea to set aside large areas of land for growing fuels when much of the world doesn't have enough food (although the waste from food crops is fine). See Biofuel Watch. Also, large-scale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

what can I do?

Setting up: batch digesters based on some kind of drum / container 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 – read a book, see our links page or attend a course.

Sizing: in India, for a family of 8 with 8-10 cows, a 10m³ digester is recommended, with 2m³ gas storage. But a typical family digester will be c. one cubic metre. For cooking and lighting, you don't need much. Every kg of organic material will yield c. 0.4 m³ (400l) of gas, and gas lights need c. 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 (e.g. 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.

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



cross-section of a type of digester used for animal and human waste all over China and the far east.

What we're not supporting is the building of gigantic digesters to take huge amounts of maize, grown specially to feed the digesters. This doesn't mean that biogas is a bad idea, it's just a 'small is beautiful' issue, best used to take waste to produce energy and compost on the farm scale. It's the scale that's the problem not the technology. From an article on our links page:
"The fmost obvious problem is that it means taking land out of food production. A biogas plant with a capacity of one megawatt 'requires 20,000-25,000 tonnes [of maize] a year, accounting for 450-500 hectares of land'. Consider, when you read that, that the average capacity of an offshore wind turbine is four megawatts. Four hundred and fifty hectares of land or one concrete pillar in the seabed – can there be any doubt about which the better option is?"

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

resources

- see lowimpact.org/biogas for more info, training, products / services, links & books, inc:
- Al Seadi et al, *Biogas Handbook*
- Jonathan Letcher, *Farm Digesters*
- David Fulford, *Small-Scale Rural Biogas*
- bit.ly/2RFaB4E – cooking with biogas
- bit.ly/35O2Vpa – biogas in developing countries
- bit.ly/3c9UqWo – biogas safety