



# 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 (e.g. underwater). 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 biogas 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. Biogas can also be used to fuel vehicles.

The organic matter breaks down anaerobically in a digester, which includes storage for the gas produced. Raw biogas can be 'scrubbed' by passing it through slaked lime, which removes most of the CO<sub>2</sub> 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, 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, food waste 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<sub>2</sub> emissions:** because it's a substitute for natural gas. Because CO<sub>2</sub> from biogas is from recently-alive plant matter (even if it was fed to animals), it's part of a cycle – i.e. CO<sub>2</sub> 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 36% of methane released into the atmosphere by human activity. When methane is burnt it releases CO<sub>2</sub>, but methane is around 30 times more potent as a greenhouse gas than CO<sub>2</sub>, so it's good to capture and burn it rather than release it. It's better for organic waste to be separated and put into an anaerobic digester instead of collecting methane from landfill sites, as nutrients are lost in toxic leachate.

**Reduces resource use:** producing and using biogas locally means that we don't need millions of miles of pipes to deliver it, and it 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 too, plus they take a long time to get up to temperature, 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, community or domestic scale.

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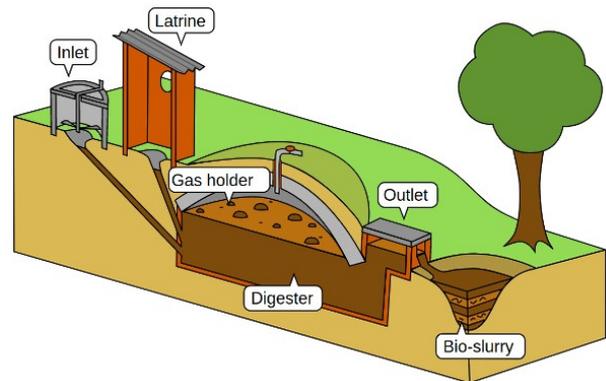


## what can I do?

**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 10m<sup>3</sup> digester is recommended, with 2m<sup>3</sup> gas storage. But a typical family digester will be c. 1 cubic metre. For cooking and lighting, you don't need much. Every kg of organic material will yield around 150 litres of gas, and gas lights need c. 100l per hour. 2 gas rings for a couple of hours a day will use 1-2 m<sup>3</sup>, so if you have 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. The average time that material stays in the digester before emptying is around one month, and in fact the minimum by law in the UK is 28 days.

We're not supporting the building of gigantic digesters to take huge amounts of maize, grown specially to feed the digesters. This doesn't mean



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

that big biogas is a bad idea. Small digesters can't manage the sheer volume of waste produced in cities. However, small and large digesters can work together in a complementary way, with small digesters helping promote the technology, support behaviour change and demonstrate localised benefits while large digesters can cope with the volumes produced on a daily basis in dense urban areas. There are a number of large digesters taking food waste from cities. In Malmö, Sweden, this happens in a very coordinated way with municipalities using the biogas upgraded to biomethane to run their buses while nearby farmers benefit from the fertiliser produced.

**Use:** the waste input must be a slurry – so add water if it's too solid. Anaerobic microbes operate at 3 temperature ranges, the most common being mesophilic – around 37-42°C. In hot climates, digesters can operate at ambient temperatures while in colder countries the digester will need insulation and heating (which could be provided by biogas) If the digester is well insulated, the parasitic load (the amount of energy used to run the system) will be between 15-30%. A greenhouse a good place for it.

## resources

- see [lowimpact.org/biogas](http://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](http://bit.ly/2RFaB4E) – cooking with biogas
- [bit.ly/35O2Vpa](http://bit.ly/35O2Vpa) – biogas in developing countries
- [bit.ly/3c9UqWo](http://bit.ly/3c9UqWo) – biogas safety



*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.*

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