

Biogas: The ultimate sustainable energy source and social equaliser?

Development researcher Matthew Fielding invites us to explore the lesser known alternative energy source Biogas, and what it means for the West and the developing world

With petrol prices sky-rocketing, and fuel bills soaring, it is clear that our dependency on cheap oil is coming to an end. With the passing of 'peak oil' the only way our bills are going is up. The way we create and use energy needs a rethink.

Reducing our consumption and conserving energy is one strategy on the path to a more sustainable future, but our energy needs are still real and still growing, and finding alternative sources of energy that not only do not cost the earth but do not destroy the earth is an important step towards a sustainable future.

New and improved technologies such as solar, nuclear, wind have been heralded as a solution to our energy needs, however alone they cannot fill the energy shortfall if we turned off oil, coal and gas.

I suggest we look at biogas. Biogas isn't just a replacement for natural gas, it's an entire step change to a more sustainable future.

So what's the idea behind biogas?

The basic idea is that 'waste' biomass is turned into biogas that can be used for lighting, heating, cooking, transport and running machinery at a local scale, whilst benefiting the environment through curbing soil degradation, eutrophication, desertification, and deforestation on a regional level. Biogas production also improves sanitation through the proper management of waste into the digester, a process that also creates bio-manure, which can enhance food security and improve soil sustainability.

Biogas can be produced from all types of organic matter, brown water, household waste, industrial waste, crop residues; manure, the list can go on.

Why don't you know about it? Well, the main point about biogas production is that it's essentially free and it is produced not through direct effort but through re-cycling things that are often wasted. This means that it isn't officially classed as a bio-fuel which means you can't get huge subsidies for producing it.

As most digesters are found on a rural level meaning not a lot of people see it. A country's GDP doesn't increase as a direct effect and nor does trade – it's off the map. However what it does do is increase the resilience of the individuals and communities who use it, enabling them to be more food and energy secure, and to better manage future climate or market shocks.

How do you make it?

There is a big difference between the rural and urban contexts for producing biogas. On an urban scale biogas plants are centralised, and waste is brought to them, and gas is pumped out to the users. On a rural scale a biogas digester unit normally serves one household. This unit consists of one or more airtight reservoirs into which a suitable biomass is placed. Small-scale digesters for household use are commonly made of concrete, bricks, metal, fiberglass, or plastic.

Digestion is accomplished in two general stages. First, bacteria turn biomass into a mix of volatile fatty and acetic acid. Then other bacteria metabolize these compounds into a combination of methane-rich gas – biogas. The digester has the nickname the ‘industrial cow’ due to the process using several ‘stomachs’. A by-product of this process is an odourless phosphorus- and nitrogen-laden slurry (bio-manure), which makes an excellent soil fertilizer. The price of commercial fertilizer is rising so fast that the bio manure is worth more than the gas itself.

Insert Fig 1 Here

A type of Biogas Digesterⁱ

Depending on temperature and moisture content, it takes about 6–25 days to produce a viable batch of gasⁱⁱ. This end product is about 60–70% methane and 20–30% CO₂, with small amounts of hydrogen sulphide and other impurities. The gas can be connected to a household stove for cooking, to a light fixture with a gauze mantle for lighting, or to other appliances with simple natural gas plumbing; it burns like liquefied petroleum gas.

It takes 1–2 cows, 5–8 pigs or 4 humans to supply adequate daily feedstock for a single-household digesterⁱⁱⁱ. The daily input of dung and urine from a single cow produces 1–2 kilowatt-hours of electricity or 8–9 kilowatt-hours of heat. Over a year, this is just about enough to run a refrigerator. In most African applications, a household biogas installation provides sufficient energy for cooking and some lighting.

As farmers can use biomass from most crop plants in the digester, it means that they can grow which ever crop suits their environment and the weather conditions at the time. They needn’t be locked to a specific crop, as with bio-fuels or as part of debt restructuring payment schemes.

How can this be used?

In Kenya biomass digesters have been extensively built at a household level. They replace the unsanitary pit latrines that over 3 billion people still use. These latrines are hot-spots for the spread of salmonella, E. coli and other faeces-carried pathogens. The necessity to build a new toilet to collect the waste for biogas

immediately improves sanitation.

When biogas is used for cooking less firewood is taken from forests improving the quality of the local forest resource. As less wood fuel is used less toxic smoke is produced into the home. It is this smoke from an open fire which is the attributed cause of 1-2million deaths per year, that's 3-4% of global mortality^{iv}. Biogas immediately improves this situation.

Biogas also reduces rural-urban migration trends by removing the push factors associated with degraded land and low yields. People are able to reclaim degraded land by putting back the bio-manure into the soil. This means marginal peoples can return from urban slums back into rural areas with a healthier way of life.

Biogas engenders further self-sufficiency in rural Africa because it is possible to refine biogas into biomethane. Even though biomethane is still not considered a biofuel alternative at the international level it is the only biofuel alternative that has the potential of becoming a substitute for gasoline and diesel. It conforms to the same emissions and safety standards as natural gas, and as you can see is totally renewable. When biomethane is used as a vehicle fuel it has the lowest exhaust emissions and the best energy balance of all biofuels and to produce it you don't need to grow special 'biofuel' crops as virtually any organic matter can be used in its production. What is more older cars such as the type commonly found in rural communities, can be adapted to run on biomethane relatively easily. This means that through biogas rural communities could be totally energy secure in all their cooking, lighting, transport and agricultural needs.

What's stopping biogas from taking over the World?

The problem is a shortage of land. The way we in the West live our lives is incredibly inefficient, just look at what we eat. Meat is the easiest example. The meat industry (livestock) is responsible for the majority of greenhouse gas emissions. Meat production uses up 10 times more arable land and 100 times more water than is needed to produce the same weight of vegetable protein. According to the FAO, 60% of global cereal production is converted into animal feeds which will rise further if the precipitous growth in meat demand is to be met. Imagine if that land was used to grow indigenous, nutritious vegetable proteins- how many more people could be fed?

Agricultural Subsidies

As if to compound the problem the agricultural subsidies awarded in North America and Europe ensure that western food products dominate food markets all over the world. That's why even though the US only grows 2% of the global harvest it is the third largest rice exporter globally. This is because subsidies enable rice to be produced at lower costs than in Thailand and Vietnam which it then out-competes on the global markets. And when there is a surplus that can't be sold, it is dumped, in the form of food aid – further undermining the national food market of the

recipient country.

Annual global subsidies for Meat and Dairy production equals almost 200 billion USD or 75 % of the total global amount of subsidies for food production. The purpose of these subsidies are purely nationalistic. Western governments do this in order to prop up their hugely uncompetitive domestic agricultural industries, essentially to keep their voters happy and most importantly employed.

If meat subsidies were stopped and meat production was reduced by 80%, over 200 million hectares of arable land would be released for crop and/or biogas production^v. This would solve the current suite of problems caused by a shortage of arable land. Yet we can still go further. If we were also able to remove the subsidies on bio-fuel crops and livestock feed crops we would be in a dreamland.

Biogas can be the trigger to do all of this. It is an opportunity we all can benefit from and some of us already do. In Stockholm City, brown water sludge from 700,000 residents is used to produce biogas, which runs 500 buses and over 500 taxis, 24/7.

Biogas works. Not only can it solve our energy needs, but it could also help to restructure our local and global economies, creating a fairer and greener world for all. Whilst challenging us to consider how we choose to consume our own body fuel, biogas could help us return to the natural cycles of nature, which is the foundation of a sustainable humanity.

So on the subject of trying something completely different, how does going vegetarian sound?

If you would like to get involved with biogas there will be a conference in Nairobi, Kenya in April 2012. This conference is aimed at spreading the biogas concept throughout for sub-Saharan Africa. Local participants are encouraged however we are also interested in people attending from outside of Africa who are able to support the development of biogas.

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ⁱ Accessed 08/11/2011: <http://www.i-sis.org.uk/BiogasChina.php>

ⁱⁱ According to a fact sheet from WASTE, a development NGO based in the Netherlands. Simpler digesters may take longer.

ⁱⁱⁱ UNDP–Global Environment Facility fact sheet, 2005.

^{iv} BIOGAS: A Bright Idea for Africa, Brown, V. J., *Environmental Health Perspectives*. 2006 May; 114(5):

^v This could be processed into enough biogas to power one billion cars worldwide.