How Green is Ecotricity's "Green Gas from Grass"?

biofuelwatch

Summary

Ecotricity has recently been granted planning consent for the UK's first biomethane plant using grass as the main feedstock. The company claims that such "green gas from grass" can replace 97% of natural gas for domestic heating and hot water by 2035, and remove the "need" for fracking, whilst helping restore biodiverse flowering grasslands. This report critically examines Ecotricity's claims.

It calculates that replacing current domestic natural gas use with biomethane made from grass would require an area of around 10.2 million hectares, which is 59% of the UK's entire agricultural land. This area is equivalent to 92% of existing grassland in the UK, most of which is used for grazing. Such a large-scale grass-to-biomethane programme would therefore all but end livestock grazing and make the UK almost entirely dependent either on meat or dairy imports, or on animal feed imports for domestic factory farming. The greenhouse gas emissions from indirect land use change will be very considerable, and could be far greater than the CO_2 emissions saved by burning less natural gas.

This, however, is not the only climate-related concern: firstly, upgrading biogas to biomethane requires the CO_2 contained in the biogas (which comes from carbon in grass) – up to 45% of the total volume – to be emitted straight into the atmosphere, without burning. Secondly, and more worryingly, both biogas digestion and upgrading to biomethane are associated with methane leaks. Depending on the scale of those leaks, biomethane could have a seriously adverse climate impact. Little data exists about actual methane leakage rates from such plants. Biogas and biomethane plants using grass, i.e. a non-waste feedstock, do not require an environmental permit and there is no requirement to reduce or prevent methane leakage, nor to monitor it.

Finally, the report looks at Ecotricity's biodiversity claims. Grasslands could in theory be managed for wildlife while supplying a biogas/biomethane plant. Maximising yields, however, will require sowing "optimised" rather than diverse grass mixtures, using herbicides and fertilisers, and cutting grass more often and at different times than is beneficial for wildlife. Those claims by Ecotricity thus cannot be substantiated either.

Background

Ecotricity has until now been primarily an onshore wind power company, as well as a "green energy" distributor. It has installed 71 wind turbines across the UK, with another 27 being currently erected[1].

Since 2015, the UK government has stopped subsidies for new onshore wind turbines and made it far harder for developers to obtain planning permission for them in England and Wales. This makes it difficult if not impossible for a company like Ecotricity to continue investing in wind power. It is therefore not surprising that the company has been looking to invest in new forms of "green energy", which are more likely to attract government support. Ecotricity believes that "green gas from grass" offers it a new market, and the UK a new type of low-carbon, sustainable energy.

The company has recently been granted planning permission to produce 5 million cubic metres of biomethane from grass at

Sparsholt College in Winchester[2]. This would provide enough gas to heat 3,740 homes[3]. Ecotricity claims that, with 5,000 plants of this size, it could "generate enough gas to power around 97% of Britain's homes" from plants which "will cut carbon emissions, reduce our reliance on fossil fuels, support local farmers, create wildlife habitats and improve the environment".

This briefing critically examines Ecotricity's claims.

What is the technology used to make Ecotricity's "green gas"?

The technical term for Ecotricity's "green gas" is biomethane. Biomethane is produced in two stages[4]:

First, feedstock is anaerobically digested inside a biogas fermenter or digester. Those are large tanks inside which bacteria ferment the carbohydrates contained in biomass to biogas. Biogas can be made from wastes, such as sewage sludge or food waste, or from purpose-grown plants. The main biogas feedstock across the EU is maize, which is associated with high levels of soil erosion and compaction, agrochemical use and water pollution, as well as flooding[5]. Ecotricity, however, is looking to use grass mixed with forage rye as its feedstock.

Biogas is mainly composed of methane and carbon dioxide, with traces of other gases. Biogas made from grass contains around 55% methane and 45% carbon dioxide[6]. It can be burned in plants producing heat and/or electricity, but it cannot be fed into the gas grid.

Before biogas can be fed into the gas grid – or, for that matter, be used in LPG cars or converted to liquid transport fuels – it must be upgraded until it contains around 97% methane, i.e. until it resembles natural gas. Upgrading involves removing pollutants, especially hydrogen sulphide, and removing the carbon dioxide[7], which will be emitted to the atmosphere[8].

How much land?

Biofuelwatch has found a single peer-reviewed study which focusses on the potential for producing biomethane from grass in Ireland. According to that study, it would be possible to produce biomethane with an energy content of 103.7 Gigajoules (=28.81 Megawatt hours) from one hectare of Irish grassland per year. A plant the size of Ecotricity's Winchester plant will thus need grass from 1,701 hectares of land – a figure very similar to that cited in the company's planning proposal (1,670 hectares).

The important question, however, is not how much land one relatively small Ecotricity plant will require, but how much land would be needed to replace natural gas for home heating and hot water with "green gas from grass" across the UK.

According to Government figures[9] total domestic demand for natural gas across the UK[10] amounted to 292,417 Gigawatt hours, which is just over 1 billion Gigajoules. ***Based on the figure from the Irish grass-to-biomethane study, 10.2 million hectares of land would be needed to replace all natural gas used for domestic heating and hot water with biomethane.***

It is important to note that domestic use accounts for just 36.88% of natural gas use in the UK, and 12.74% of the UK's total primary energy use in 2015[11].

The above figure – 10.2 million hectares – is more than twice what Ecotricity predicts: it claims[12] that 5,000 biomethane plants the same size as that planned at Sparsholt College could by 2035 replace 97% of natural gas used for home heating and hot water, and that 1,000 of those plants would "support an area of 1 million hectares", i.e. that 5 million hectares in total would be needed. This estimate is not compatible with the findings of the single peer-reviewed study, nor with the figure contained in Ecotricity's own planning application, according to which 1,000 such plants would require around 1.7 million hectares of land.

Moreover, Ecotricity's forecast relies heavily on the assumption that domestic gas use will significantly decline between now and 2035. This would indeed happen if the trend of the past decade was to continue: between 2005 and 2014, UK domestic gas use declined by 36%[13]. There were two reasons for this decline: energy efficiency and solar roof investments on the one hand, and fuel poverty on the other hand. Government subsidies for energy efficiency and solar roofs have been all but abolished since 2014, especially in England and Wales. Unless such subsidies are restored, projections of future falls in domestic gas use rely largely on the expectation that ever more people will become too poor to heat their homes.

What would 10.2 million hectares of grass for biomethane mean for UK agriculture?

The UK's total land area used for agriculture is 17.15 million hectares[14], so ***replacing current natural gas use for domestic heating and hot water with grass-based biomethane would require more than 59% of the UK's entire agricultural area.*** It would mean cultivating grass for heating on an area equivalent 329% of the land used to grow cereals across the UK.

Grassland accounts for 72% of agricultural land in the UK, and the 10.2 million hectares needed to realise Ecotricity's vision would require 92% of it.

Replacing natural gas for domestic heating and hot water with biomethane from grass would thus require an end to almost all livestock grazing in the UK – and this at a time when meat and dairy consumption are increasing across the UK[15]. Growing enough grass to heat our homes would therefore make the UK almost completely dependent either on meat and dairy imports, or on factory farming inside the UK with virtually all animal feed imported from abroad.

At present, the UK imports just over half of the food and animal feed consumed in the country. ***According to a recent peer-reviewed study[16], 70% of the agricultural land area used for feeding the UK's population is located abroad, as are 64% of the greenhouse gas emissions associated with food and feed production for the UK. Ecotricity's plans would greatly exacerbate this situation.***

Would Ecotricity's "green gas" be climate friendly?

As with all other bioenergy, the upfront CO_2 emissions of burning biomethane are no smaller than those from burning fossil fuels (per unit of energy), but they do not have to be accounted for, based on the assumption that new plant growth will re-sequester all the CO_2 emitted from burning the biomass. This assumption is far less problematic for grass than it is for wood, given that grass will regrow within months, not decades. It is, however, worth noting that the ***ignored CO_2 emissions include all of the CO_2 contained in the biogas (up to 45% of the total volume), which is emitted straight into the atmosphere without burning during the upgrading to biomethane.***

What is most problematic, however, is that under UK legislation, not just the upfront CO_2 emissions but also the most important life-cycle greenhouse gas emissions associated with land-based biogas and biomethane production are ignored. In the case of biogas made from land-based feedstocks (as opposed to waste), producers have to account for greenhouse gas emissions from fossil fuel use, e.g. for agricultural machinery or transporting the feedstock, and those from fertiliser use, although they can improve their greenhouse gas balance by selling the biogas residue (digestate) as a fertiliser, as Ecotricity plans to do[17]. Two major sources of emissions, however, are ignored: greenhouse gas emissions from indirect land use change, and methane emissions from biogas digesters and biomethane upgraders.

Indirect land use change emissions:
Many studies which focus on biofuels for transport show that indirect land use change emissions are generally far higher than the direct ones – and that they commonly result in biofuels being no better for the climate than the fossil fuels they replace[18].

As we have seen above, a grass-based biomethane programme large enough to replace domestic natural gas use in the UK would result in a major increase in meat and dairy imports and/or animal feed imports, which would result in more greenhouse gas emissions abroad. Worldwide, industrial livestock production, including production of the animal feed used in factory farms, is a major contributor to deforestation, especially in tropical and subtropical forests in Latin America. It also accounts for a significant share of global agro-chemical use. Industrial livestock production is thus a major contributor to greenhouse gas emissions as well as biodiversity losses. It is also associated with large-scale land-grabbing and pesticide poisoning, especially in the global South, and with water and soil pollution worldwide[19]. Increasing the UK's reliance on intensive livestock farming overseas in order to replace 36% of our natural gas use is thus likely to increase rather than reduce overall greenhouse gas emissions.

Methane emissions:
Even if the vast amount of grass silage needed to replace natural gas with biomethane was entirely "carbon neutral", any climate benefits could be more than wiped out by methane leaks, since one molecule of methane has 28 times the global warming potential of one molecule of carbon dioxide over a century[20]. Methane is such a powerful greenhouse gas that researchers have calculated that the greenhouse gas emissions from natural gas are the same as those from burning coal if just 1.22% of the methane leaks into the atmosphere[21]. Methane leaks from fracked gas have been estimated to be as high as 12% in the US[22].

Very little data about methane losses during biogas digestions and upgrading exist. According to a presentation published by "Green Gas Grids", an initiative by the European Biogas Association, methane leaks from biogas plants vary from 0.1% to 6%[23]. Methane leaks from biogas digesters are additional to those from biomethane upgrading. The highest methane leaks were reported in 2003, from a Swedish upgrader using the same technology which Ecotricity plans to use[24]: 10%[25]. The author acknowledged that this was due to a mechanical fault and that the plant was designed for a maximum of 2% methane leakage. This, of course, would still be a considerable source of greenhouse gas emissions. A recent Technical Review, also published in Sweden[26] suggests that a methane leakage rate of 1-1.5% is "achievable" using Ecotricity's chosen technology.

Yet if 1.22% of methane leaks from natural gas are enough to cancel out the ~50% difference in CO_2 emissions between burning gas and coal, then even a combined 1.5% methane leakage rate from biogas production and upgrading would make any claims of greenhouse gas savings from biomethane highly questionable. In a worst-case scenario of up to 10% leakage from a faulty plant, biomethane would almost certainly have a worse climate impact than the fossil fuels it might replace.

Worryingly, there are no requirements to monitor methane emissions from biogas digesters or upgraders in the UK. Plants such as the ones Ecotricity seeks to use do not even require an enviornmental permit.

Flowering meadows for biomethane?

Ecotricity claims that its "green gas" will help to reverse the decline in flower rich grasslands and, as a result, in farmland birds and insects, particularly pollinators. This is an attractive vision: Between 1930 and 1983, 97% of wildflower rich grasslands were lost in England and Wales[27], and 90% have been lost in Scotland[28]. Reversing a significant proportion of those losses would make a significant contribution to conserving biodiversity in the UK, and would increase numbers of pollinators, other insects, birds and some mammals.

Could biomethane from grass play a role in making this possible, even if it was produced on a much more modest scale than what Ecotricity proposes?

Unfortunately, there are good reasons to doubt this:

The yields assumed in the study on potential biomethane from grass in Ireland are based on intensive grassland farming, not on flowering meadows. To achieve such yields, grasslands would be seeded primarily with ryegrass species, not flowers. They would need to be sprayed with herbicides at the start and twice more during 8-year rotations, after which the land would be ploughed and reseeded. Lime and fertilisers would be applied, though the residues from biogas production can be used as a fertiliser, something Ecotricity aims to do. Grass would be cut two or three times a year. Such practices maximise yields – but are not better for wildlife than intensively grazed grasslands.

As public guidelines[29] for restoring species-rich grasslands in the UK highlight, ones that are not grazed would generally be cut just once a year, and not before mid-July, up to 10% of the area would be left uncut every year, and plants would need to be protected from fertilisation to avoid those that thrive with low nutrient levels to be outcompeted.

If ungrazed grasslands were primarily managed for biodiversity, grass could of course be used for biogas, albeit with lower yields, though it could equally be used as animal feed. Friends of the Earth Germany has successfully tested such a model on a very small scale in Germany[30], however an economic evaluation shows that such a model would not be viable if it relied primarily on biogas subsidies – it would need to (also) be financed through measures to protect biodiversity and organic agriculture.

Clearly, Ecotricity cannot expect farmers to enter into supply contracts for a biomethane plant while at the same time foregoing higher yields, and thus higher income, to enhance biodiversity. There are no reasons to expect such grasslands to be any better for biodiversity than the vast majority of species-poor permanent grasslands across the UK.

References

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2. planningapps.winchester.gov.uk/online-applications/applicationDetails.do?activeTab=documents&keyVal=O175QBBPJEM00

3. The figure is slightly lower than what Ecotricity claimed in the planning application. It is based on the mean average gas demand 13.1 MWh per household per year across the UK: www.gov.uk/government/uploads/system/uploads/attachment_data/file/532535/National_Energy_Efficiency_Data-Framework__NEED__Main_Report.pdf

4. Biomethane can also be produced from landfill gas, however this briefing looks only at biomethane made from biogas, i.e. from anaerobically digested biomass.

5. Runaway Maize, Subsidised soil destruction, Soil Association, June 2015. https://www.soilassociation.org/media/4671/runaway-maize-june-2015.pdf

6. What is the energy balance of grass biomethane in Ireland and other temperate northern European climates? Beatrice M. Smyth et.al., Renewable and Sustainable Energy Reviews, April 2009

7. A detailed description of upgrading technologies, including Pressure Swing Adsorption, which is Ecotricity's favoured technology can be found here: www.iea-biogas.net/files/daten-redaktion/download/publi-task37/upgrading_rz_low_final.pdf

8. Carbon capture is not proposed by Ecotricity. Capturing CO_2 from upgrading plants would involve significant costs and energy inputs. This environmental permit for a waste-derived biomethane plant confirms that CO_2 is indeed emitted straight into the atmosphere during upgrading: gov.uk/government/uploads/system/uploads/attachment_data/file/487013/Decision_Document.pdf

9. gov.uk/government/uploads/system/uploads/attachment_data/file/540923/Chapter_4_web.pdf

10. Note that Ecotricity speaks about "Britain" while the Government figures cited here are for the UK, which means that they exclude Northern Ireland. At the time of the 2011 Census, Northern Ireland had just over 700,000 households. Given that there are 25.8 million households in the UK, the difference is relatively small.

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29. E.g. https://www.ruralpayments.org/publicsite/futures/topics/all-schemes/agri-environment-climate-scheme/management-options-and-capital-items/species-rich-grassland-management/

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