



# Green Gas

The opportunity for Britain

November 2016

**ecotricity**

# Executive summary

**The 14th of March 2016 was an historic day for Britain. On that day, Energy Minister Andrea Leadsom committed the government to set in law a post-2050 goal of net zero emissions. That's very much the future of Britain that we set out in Ecotricity's 2030 Vision<sup>1</sup>.**

To get there, we are going to have to work on a new frontier – to remove the carbon emissions from our nation's heating.

This is a major challenge. In the short term, we are struggling to meet our 2020 target of 12% of our heating from renewable sources. In the longer term, we will never remove the carbon from our economy if we cannot remove the carbon from our heating, which accounts for around 45% of our total energy use.

We believe that we have found a solution that could play a significant part in this: Green Gas Mills.

Through the process of Anaerobic Digestion, our Green Gas Mills use native grasses as fuel to produce biomethane (or 'Green Gas' as we call it). The big benefits of Green Gas are that it is a fuel source that will never run out, it's virtually carbon neutral, it reduces the need to import fossil fuels from overseas or frack the countryside, and it uses existing infrastructure such as the gas grid and household heating systems.

## The potential for Green Gas in Britain

In the short term, Green Gas can immediately play a key role in helping to meet our 2020 renewable heat target. A typical Green Gas Mill at 5MW will require about 3,000 acres of grassland to supply 3,500 homes with all the gas they need. That's less than one acre per household.

The construction of 1,000 Green Gas Mills, each of 5MW capacity, would be enough to make up the current shortfall against our 12% target and would create around 15,000 jobs and pump £1.5 billion into the rural economy.

In the long term, with domestic gas demand expected to fall, each 5MW Green Gas Mill should supply almost 5,000 homes. Meaning Britain should have enough suitable land to supply the overwhelming majority of household heating using Green Gas Mills fed by grass – all without reducing Britain's agricultural production.

The construction of 5,000 Green Gas Mills, each of 5MW capacity, would be enough to supply 97% of British households and would create around 75,000 jobs and pump £7.5 billion into the rural economy. We believe this could be achieved by 2035.

This would require a massive scaling up of Green Gas and there will be challenges but it shows just how big the potential is.

## Green Gas with benefits

Green Gas Mills can decarbonise our heating and help tackle climate change. They have other benefits too; they can:

- Boost rural economies: each Green Gas Mill will generate around 30 jobs and £3 million a year in feedstock contracts for farmers
- Enhance food productivity: soil health is improved when grass feedstocks are grown in rotation with crops on arable land
- Support wildlife and biodiversity by providing a habitat rich in pollen and nectar for bees and other insects in area growing feedstock grasses
- Reduce our reliance on gas imports as North Sea production declines and obviate the need for fracking

- Use existing gas infrastructure: allowing us to simply change the gas we use from fossil fuel to grass fuelled.

We believe that Green Gas Mills are the antithesis of fracking: virtually carbon neutral, they are a genuinely renewable source of indigenous gas; they offer an inexhaustible, rather than limited, supply; and they bring enhanced local economic benefits without risks to water supply, air quality, local communities, or climate targets. In fact, Green Gas Mills bring significant environmental benefits.

We know there are concerns around ‘energy crops’ which are another way of making bio methane, if the incentives are wrong, farmers may stop growing food on arable land and move instead to growing crops as biofuel for biogas. This is a legitimate concern – Britain’s farmland is precious and needs to be protected. Energy crops are not the way to go.

The other widely discussed method of producing green gas is from food waste, but this comes with its own problems.

We have found another way to make green gas in Britain - from grass. It has none of the disadvantages of either food waste or energy crops, or fracking - and considerable advantages over all three. It’s a big opportunity for Britain.

## How can we support Green Gas Mills?

Green Gas Mills are in their infancy. We think they have great potential, but to get going and show what they can achieve we need support from policymakers. As a priority, we hope the government will:

- Maintain support to bio-methane producers through the non-domestic Renewable Heat Incentive (RHI)
- Clarify regulation and classification of permitted feedstocks under the RHI to ensure that feedstocks like native grasses, which do not threaten food production, are supported
- Avoid duplicating the regulations in place for bio-methane injection with extra rules under the RHI
- Provide further clarity post-2020 on targets for the decarbonisation of heating.

Decarbonising heating is the next big challenge as we strive to become Green Britain. We believe Green Gas Mills can play a major part in meeting that challenge. We are looking forward to proving it!

# Introduction: The new frontier for decarbonisation

**14 March 2016 was an historic day for the UK. On that day Energy Minister Andrea Leadsom committed the government to set in law a post-2050 goal of net zero emissions. It's now official: the future of Britain is a Green Britain, like the one we set out in Ecotricity's 2030 Vision<sup>2</sup>.**

The UK has made some good progress. In 2015 23% of the UK's electricity was generated by renewables<sup>3</sup>. Britain's carbon emissions have fallen by 27% over the last ten years<sup>4</sup>. We at Ecotricity have been proud to play our part; installing 80MW of renewable energy capacity through our 'bills to mills' business model, enough to power 56,000 homes.

But the UK is now approaching the next chapter of our challenge: decarbonising heating.

The UK's Chief Scientific Adviser to the Department of Energy and Climate Change Professor John Loughhead put it pretty bluntly: "perhaps the greatest challenge to meeting our long-term emissions target is decarbonising our heating system."<sup>5</sup>

Heating accounts for 45% of all energy use in the UK and is the cause of the majority of the residential emissions that make up almost a quarter of the UK's greenhouse gas emissions every year (Figure 1)<sup>6</sup>. It is simple: unless we can decarbonise heating, we will never become Green Britain.

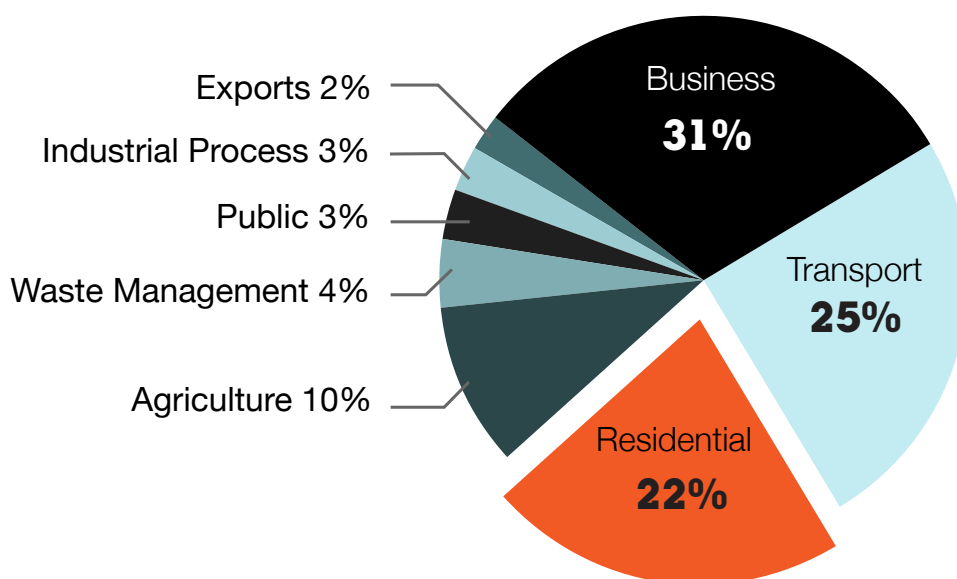


Figure 1. UK greenhouse gas emissions 2014 by end user  
Source: DECC

But we also face big challenges in the short term. As part of our overall 2020 target of reducing carbon emissions by 35% compared to 1990 levels Britain has committed to supplying 15% of our energy from renewable sources.

The good news is that the UK beat its interim 2013/2014 target of 5.4%, with 6.3% of final energy consumption coming from renewables (Figure 2). The bad news is that according to the former Secretary of State for Energy and Climate Change Amber Rudd, the UK government currently thinks that unless we accelerate there will be a shortfall of around 50TWh or 3.5 percentage points come 2020; that's enough energy to heat every household in London, Birmingham, Leeds and Bristol combined.

Amber Rudd has suggested that renewable heat could make up around 20TWh or 1.5 percentage points of that shortfall (enough to heat half the households in London).

A big challenge. But we think we have got a solution that can help us hit our targets in the short term, and transform into Green Britain in the longer term: the Green Gas Mill.

We are excited about its potential, so we have put this paper together to:

- Introduce our Green Gas Mills and explain how they work;
- Set out how they help us decarbonise our heating and meet our 2020 renewable heat and energy targets;
- Take a look at the scale of the potential for Green Gas to displace fossil fuel gas over the longer term;
- Explain the additional benefits of Green Gas Mills which go beyond decarbonising our heating;
- Highlight how the UK government can help Green Gas fulfil its potential.

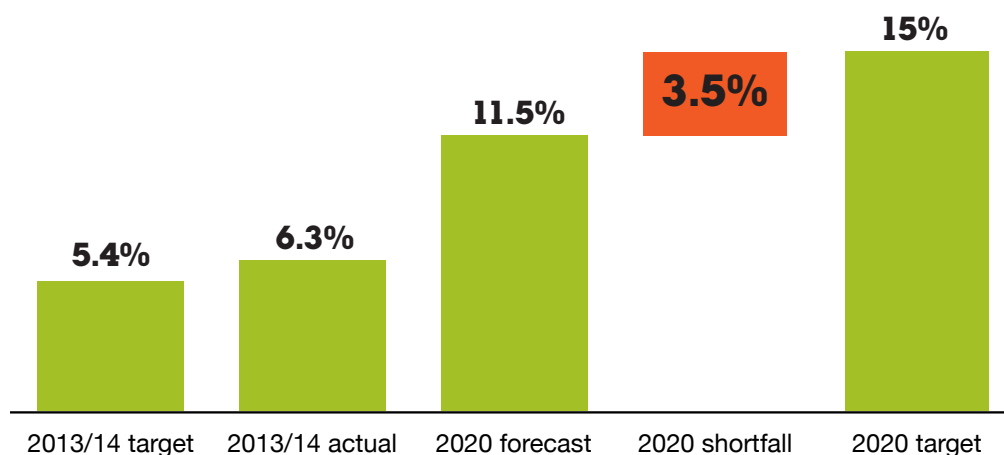


Figure 2. UK progress towards 2020 renewables target

Source: DECC

## A beginner's guide to the Green Gas Mill

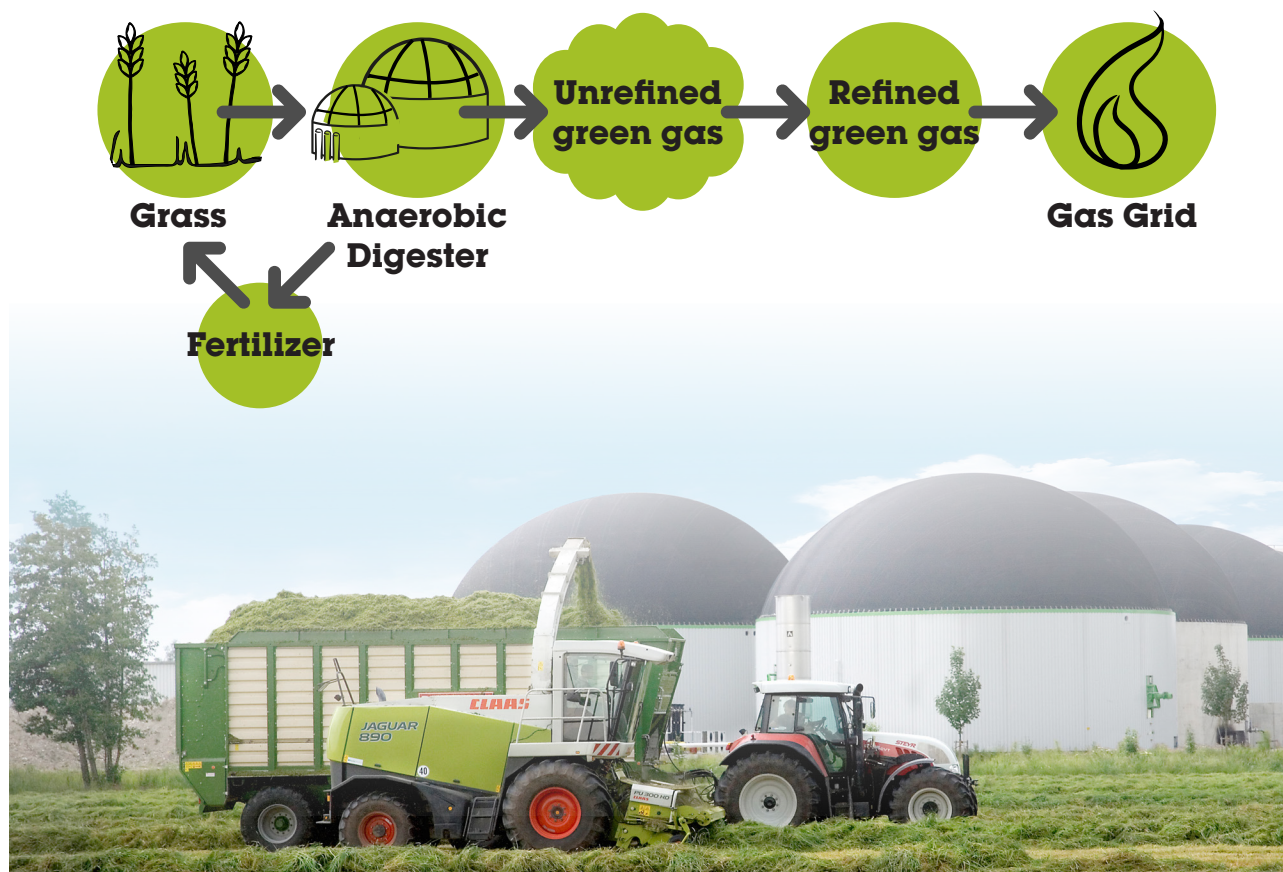
We have been working on our Green Gas Mills for a while now, and we are not the only ones. There were around 50 similar plants operating in Britain by the end of 2015<sup>7</sup>. These Green Gas Mills are potentially revolutionary: using native grasses as fuel they produce bio-methane (our Green Gas), which is both renewable and virtually carbon-neutral but can be used just like fossil fuel gas. The big difference is that bio-methane recycles existing carbon in the atmosphere which has been absorbed by the grass, rather than fossil fuel gas which releases carbon and methane which was previously safely stored underground when it is burned.

The way the Green Gas Mills work is pretty simple. We fuel them with organic feedstocks – in our case grass – which bacteria then break down in an oxygen-free environment through a process of Anaerobic Digestion (AD). From the process of AD we get two main outputs: biogas and 'waste products' which aren't actually wasted at all, but can be used as a rich source of organic fertiliser.

In many ways the process is just like a cow: the grass goes in one end, and gas and fertiliser come out the other! But in this case, rather than the gas 'escaping' like it does from cows, we collect it and use it.

Some people use the biogas to produce electricity in small on-site generators. Our Green Gas Mills go one step further. Once we have the biogas it is then ‘scrubbed’: purified and brought up to the UK’s high environmental and safety standards as bio-methane. Once it has been scrubbed it can be fed directly into the national gas network to be used for heating in gas-fired boilers or for cooking on a normal hob.

That’s the beauty of the Green Gas Mill: you can be cooking on Green Gas and you won’t even notice!



## Achieving Our Green Potential Part I: hitting our targets

**“The highest potential for additional renewable heat is from bio-methane injection into the gas grid...” – Amber Rudd, Secretary for Energy and Climate Change letter to ministers, 29 October 2015<sup>9</sup>.**

So how can Green Gas Mills help the UK meet the heating challenge? The UK’s 2020 renewable energy target includes a renewable heat sub-target of supplying 12% of heating demand through renewable energy. The latest figures for renewable heat from the Department of Energy and Climate Change show that we are currently at 4.9%, leaving a shortfall of 7.1 percentage points, or 42.5 TWh per year<sup>10</sup>.

National Grid has projected future scenarios, which highlight the possibility of a three-fold increase from 60 bio-methane connections today to up to 197 connections by 2020, and an almost ten-fold increase to 587 by 2030<sup>11</sup>. We think this represents an absolute minimum, 197 of our Green Gas Mills would generate up to 17TWh of renewable heat – leaving us only one third of the way to making up that 12% target.

## The road to carbon neutrality

Our Green Gas is virtually carbon-neutral, but we are not just trying to reduce emissions from the gas itself, but from all the processes which go into producing it, or the 'life-cycle emissions'. That can include the emissions from harvesting the grass, collecting the grass, powering the Green Gas Mills and any other process involved. Measuring this can be really tricky.

We estimate that the carbon intensity (the amount of carbon emitted with every unit of energy generated) of our Green Gas is 33gCO<sub>2</sub>/kWh. We are pretty proud of this, and as you can see it is streets ahead of the average fossil fuel gas carbon intensity of 184gCO<sub>2</sub>/kWh<sup>8</sup>.

But we think we can do better. We are working on new prototypes for the Green Gas Mills which will power and heat themselves with their own low carbon energy, rather than relying on the grid. We are looking at organic fertilisers for the grasses and using our Green Gas to power the trucks which collect the grass.

Our goal? To get as close to completely carbon-neutral as we possibly can.

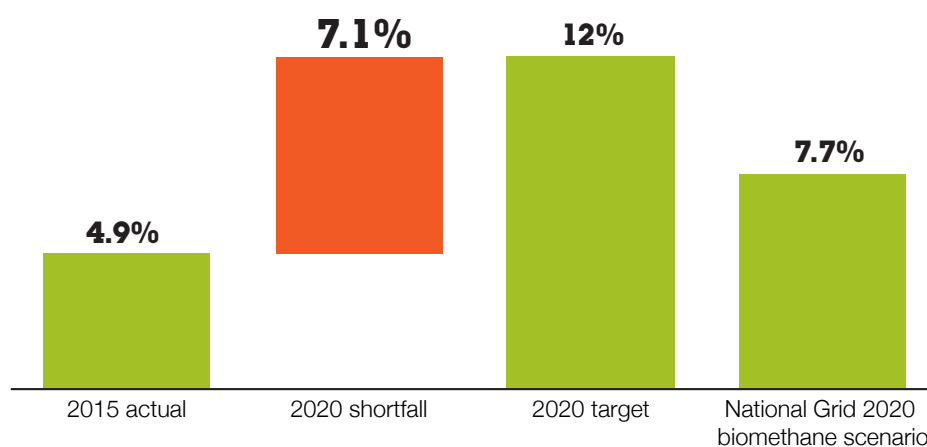


Figure 2. UK progress towards 2020 renewable heat target  
Source: DECC, National Grid

Theoretically the whole 7.1 percentage point shortfall could be met by 1000 of our Green Gas Mills. Given where we are now, this would represent a massive up scaling of bio-methane in the UK, and we are not suggesting that Ecotricity goes it alone. But we do agree with Amber Rudd that bio-methane has the highest potential for providing additional renewable heat energy to help us reach our 12% renewable heat target, and that overall 15% renewable energy target.

Why? For three reasons:

- **Distribution:** We can use the UK's existing gas infrastructure to distribute bio-methane through a highly efficient and nation-wide transmission and distribution network which provides heating for 80% of UK homes at no extra cost on our energy bills. It also means we can use people's existing boilers. This is a major advantage compared to other forms of renewable heating like heat pumps, which require installation of costly and often bulky units in people's homes.
- **Versatility:** Bio-methane is versatile and can be used for power generation, heating and cooking. Biogas from sources such as industrial or domestic waste is an important part of the emerging circular economy, but it produces gas of mixed quality which can often only be burned for power generation. The advantage of bio-methane is its superior quality which means it can be straight into the gas grid and used directly for heating homes and cooking.
- **Growth:** Bio-methane production is already growing rapidly. In 2012 the UK did not have a single bio-methane gas mill, however by the end of 2015 it had 50 mills producing an estimated 2.5TWh of renewable heat energy<sup>12</sup>, enough to supply heat to 190,000 homes. And the speed and scale of the expansion is accelerating as the industry brings costs down and experience brings economies of scale and operational learning.

# Achieving Our Green Potential

## Part II: becoming Green Britain

The UK is in a race to meet its 2020 targets, but this is just a staging post on the longer journey to a decarbonised Green Britain. Ultimately we believe that for the UK to decarbonise its heating sector we are going to have to rely on a range of technologies, from Green Gas Mills to solar heating to the electrification of heating through air and ground source heat pumps.

The key is going to be getting the balance right. Low carbon heat technologies like heat pumps are going to be important, but even National Grid's 'Gone Green' scenario includes fewer than half of all UK households with some form of low carbon heating technology installed by 2035<sup>13</sup>. We believe Green Gas can help fill the gap.

To illustrate how, we have put together three scenarios to set out in theory how far we could go in decarbonising our heating through the use of Green Gas Mills by 2035 (Table 1). These are not predictions. They are not about what we think is probable. They are about what is possible, ranging from what we think is a bare minimum to the very ambitious. Ultimately these scenarios are about highlighting how far we could go and providing the context for a discussion about how much Green Gas Mills could achieve.

	Low ambition	Middling ambition	Maximum Green Gas
<b>Green Gas Mills</b>	1000	2500	5000
<b>Green gas generated (TWh)</b>	42.5	106.3	212.5
<b>UK households supplied (%)</b>	20%	49%	97%
<b>Estimated carbon saving (mn tCO<sub>2</sub>)</b>	6.6	16.6	33.2
<b>Revenues generated per year (£mn)</b>	1500	3750	7500
<b>Employees</b>	15000	37500	75000

Table 1. Green Gas Mills 2035 scenarios  
Source: Ecotricity calculations, Energy Savings Trust, DECC

# Beyond decarbonisation: Green Gas with benefits

The great thing about Green Gas Mills is that not only can they decarbonise our heating, but there are a range of other benefits for Britain, both at a local and national level. We see four big ones.

## 1. Boosting the rural economy and supporting our farmers

Green Gas Mills bring significant economic benefits to local rural communities. Each Green Gas Mill creates around 30 jobs in cultivating and collecting feedstock, operation and maintenance, and site management. Through contracts for the grass feedstock, we estimate each Green Gas Mill will contribute £1.5 million per year, or £30 million in their operating lifetime, to the local rural economy.

This would be a huge boost to our rural communities at a critical time. According to the Department for Environmental, Rural Affairs and Farming (DEFRA) recent years have seen incomes per farm either stagnant or falling across the board: these are tough times for Britain's farmers (Figure 3)<sup>14</sup>. Farmers are already on the path to Green Britain. The National Farmers Union (NFU) estimates that one in three farmers and growers have already invested in some form of renewable energy production.

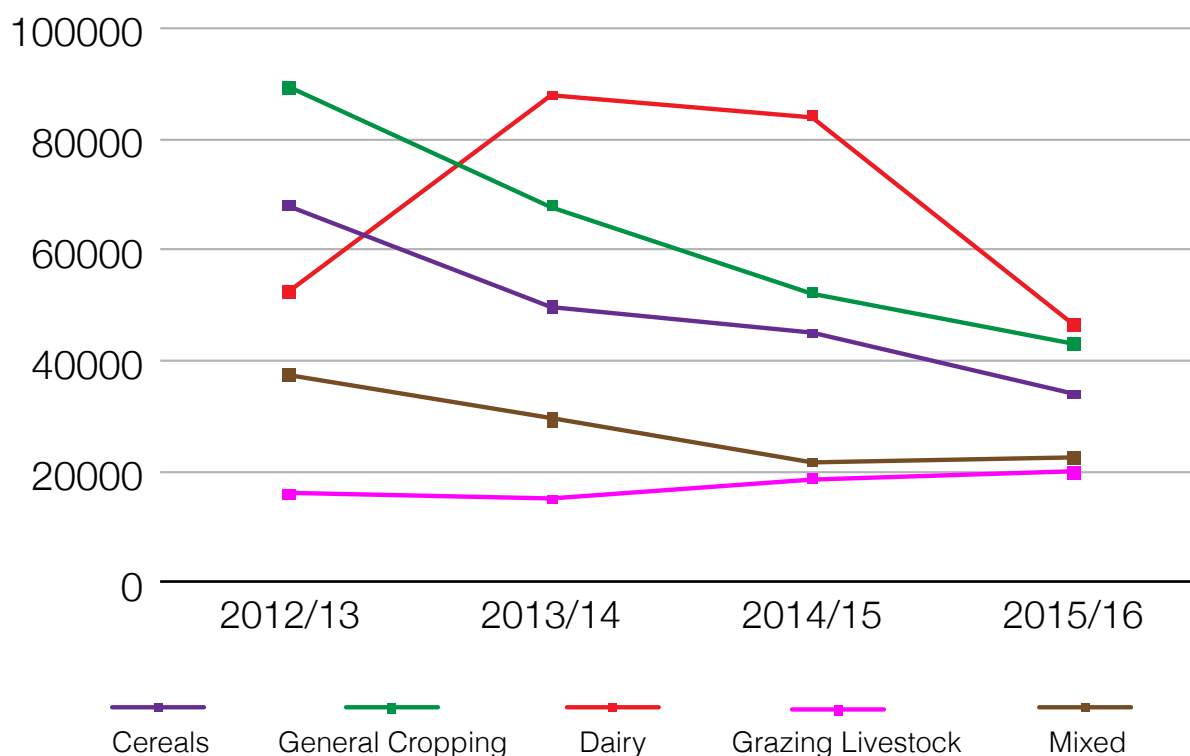


Figure 3. Average income per farm (£/farm)  
Source: DEFRA

## 2. Enhancing the food productivity of arable farmland by improving soil health

The varieties of native grass species we use in our Green Gas Mills can enhance the food productivity of arable farmland and improve soil health when used in crop rotation cycles whilst breaking disease and fungal cycles which can persist in the soil<sup>15</sup>. Deep-rooted grassland is able to create and restore healthy organic matter to the topsoil in a way that can't be replicated by simply adding organic topsoils or manures. In addition, our Green Gas Mills produce organic fertiliser as a co-product of Anaerobic Digestion, which can reduce costly and environmental damaging reliance on synthetic fertilisers. Ultimately this can also help turn lower quality land

suitable for growing feed for livestock into more productive land suitable for growing food crops for humans. Growing grass crops on arable land creates an absorbent matt on the surface, which has the benefit of impeding rainfall runoff, thereby providing greater community benefit from reduced flood risk.

### 3. Creating habitats for wildlife

Since 1930 it is estimated that Britain has lost 97% of its flower rich grassland with only isolated pockets remaining. This has caused the decline of many species of farmland bird and insects, particularly of bees, which play a vital role in the ecosystem. Our Green Gas Mills will help to reverse this dangerous trend by creating an economic argument for management and stewardship of species rich grassland. Just 1000 Mills would support an area of 1 million hectares (or 2.5 million acres, about half the size of Wales), maintaining land with a rich variety of wild flowers and grasses. This land will then provide pollen and nectar rich habitats for birds and insects such as pollinating bees.

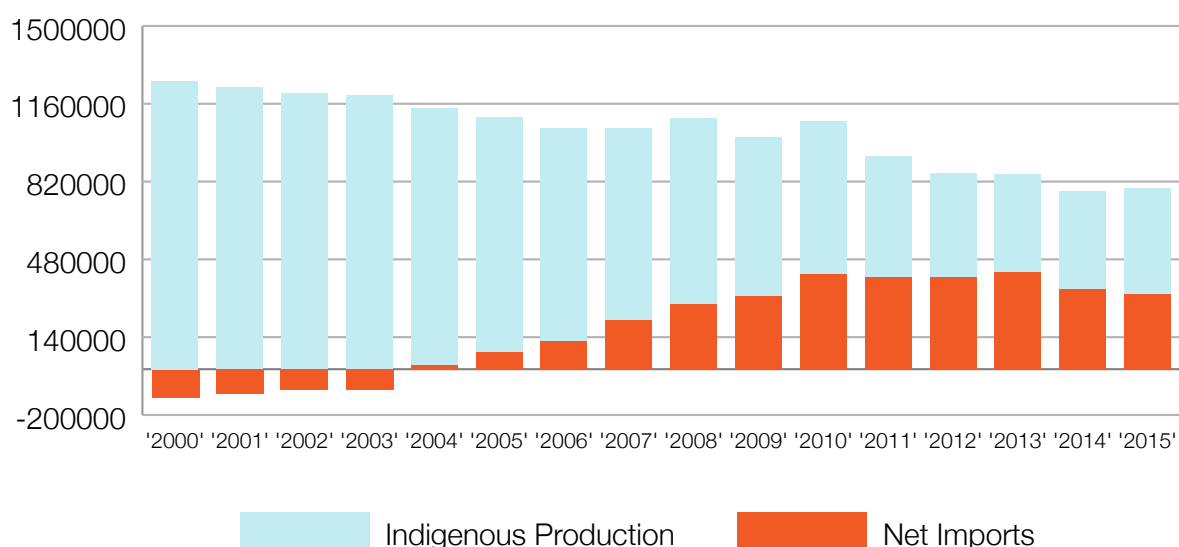


Figure 4. UK gas consumption by source (GWh)  
Source: DECC

### 4. Reducing our reliance on fossil fuel imports

While the UK's gas consumption overall is going down, the amount we are importing is going up as the North Sea runs out (Figure 4). The UK Oil and Gas Authority has projected that by 2030 the UK could be importing three quarters of all our gas. As a result more and more of the money we spend on importing fossil fuels will be going abroad making us better customers for the Netherlands, Norway and Qatar, rather than staying at home and benefiting the British economy<sup>16</sup>. Rising payments for fossil fuel imports have in recent years contributed to a current account deficit, which hit £32.6 billion (7% of GDP) in Q4 2015 – the highest level the Office for National Statistics has on record since the Second World War<sup>17</sup>.

So there you have it. Not only can Green Gas Mills put us on the road to Green Britain, but they can help our farmers, boost our food productivity, generate jobs, foster our wildlife and reduce our reliance on fossil fuel imports.

# Green Gas Mills: doing good by doing it right

**“The Government’s policy is that the primary purpose of agricultural land should be for growing food.”<sup>23</sup> – DECC 3 March 2016**

There have been concerns raised about biogas and bio-methane that if we get the incentives wrong too many farmers will stop growing food on their arable land and move to growing crops as fuel instead. Critics have for example pointed out that in 2014 almost a fifth of all maize grown in the country was for Anaerobic Digestion, and took up around 0.7% of England’s total arable land<sup>24</sup>.

We think that they are right to be concerned – the UK’s farmland is precious and needs to be protected and improved for the sake of food production and the necessary environmental gains.

But we also think that if we put the right protections in place we can both fulfill the potential we have in this country for bio-methane, and keep growing the food we need. That is why Ecotricity is committed to never using energy crops and to making sure our feedstocks never contribute to a reduction in food crop production.

That means we focus foremost of growing grass on marginal or under-utilised grazing land and on arable farmland of reduced quality (i.e. often only capable of growing feed crops for livestock).

Firstly, the amount of marginal or under-utilised grassland is growing. For example, the area of grassland used for grazing cattle has almost halved since 1990 due to changes in farming methods and agricultural subsidies that have led to reduced beef and dairy herds. We are hopeful that as people opt to eat less meat to reduce their carbon footprints this will accelerate the availability of land.

Secondly, we can grow grass temporarily on arable farmland for two to four years as a break-crop in rotation with food crops. As we explained above, this can help to increase overall food production and quality by improving soil health and reducing disease.

What we need is a regulatory framework, which protects land which should be used for growing food for humans, but where appropriate allows us to maximise production on under-utilised farmland and improve its quality by growing feedstock for AD, like in our Green Gas Mills. In addition, the improvement in soil quality from the Green Gas Mills process will increase the amount of farmland that is suitable to grow crops for human consumption. As part of our recommendations for how Britain can fulfill our Green Gas potential, we set out some areas we think are important.

## Green Gas: the antidote to fracking

One area where we think that Green Gas Mills can catch the public imagination is as a virtually carbon-neutral alternative to fracking. DECC’s own public attitudes tracker has found that despite the government’s attempts to push fracking, more people in the UK object to fracking than support it (31% to 19%)<sup>18</sup>. Opposition is even stronger (53%) among those who say they know more about fracking<sup>19</sup>.

As the government is finding out, despite their attempts to push ahead regardless, the strength of local resistance has been testimony to just how unpopular fracking really is<sup>20</sup> – and why the government has sought to take the decision over whether fracking goes ahead out of local hands<sup>21</sup>.

But what is perhaps most interesting is that among those who support fracking the top three reasons people give are: needing to use all available energy sources (35%); reducing dependence on conventional fossil fuels (34%); and reducing dependence from other countries for UK’s energy supply (32%). We believe our Green Gas Mills can help us meet all three of those objectives without risk of environmental damage, threat to our water supplies or negative impacts on local communities from diesel fuelled trucks loaded with chemicals pounding up and down the roads<sup>22</sup>.

The message we want to get out is this: Green Gas is the antidote to fracking.

# How can we support Green Gas Mills?

The bio-methane story in the UK is just beginning, but it is already under threat from possible government plans to cut support, despite it being one of the few technologies which can help meet the challenge of hitting our 2020 targets and decarbonising our economy in the longer term. The government's goals of protecting food production and minimising the costs on bills is important, but the policy response risks throwing the baby out with the bathwater.

To ensure that bio-methane can play its full role in helping the UK meet its renewable heat target for 2020 we believe that the government should take the following steps:

- Maintain support for bio-methane producers through the non-domestic Renewable Heat Incentive (RHI);
- Clarify regulation and classification of permitted feedstocks under the RHI to ensure that while there are appropriate restrictions on those which may have a detrimental impact on UK food production, these are clearly differentiated from other feedstocks like native grasses which do not threaten food production;
- Ensure that policy supports the use of sustainable grass feedstock grown temporarily on arable farmland as a break-crop in rotation with food crops;
- Avoid duplicating the regulations and standards in place for bio-methane injection with extra rules under the RHI;
- Provide further clarity on targets for the decarbonisation of UK heating post-2020.

If the government can commit to these points, then we and other bio-methane producers are ready to show how we can help the UK decarbonise and meet its renewables targets, and how we can do so in partnership with Britain's rural communities.

With 2020 just around the corner, it is time to get going.

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“

Green gas should clearly play its part in our energy mix. With the government set to miss its legally binding targets on renewable heat - this looks like an answer.

”

**Baroness Lynne Featherstone,  
Liberal Democrat Energy and Climate  
Change spokesperson**

“

As the UK ratifies the Paris climate agreement, we must not start up a new fossil fuel industry by backing fracking. We welcome every effort to help people heat their homes without relying on fossil fuels. Energy produced from agricultural and food waste will play an important part in a low-carbon future, and experiments in the use of other renewable and widely available biodegradable materials, such as in Ecotricity's Green Gas Mills, could be a step in the right direction. We look forward to seeing how the Mills can work to generate energy, support farmers and encourage positive uses for marginal and fallow land without compromising food production.

”

**Tony Bosworth, Friends of the Earth  
Energy Campaigner**

“

As long as it's not competing with food production, green gas like this project can be really helpful in getting UK on to a cleaner and lower carbon path. Agriculture need not simply be part of the problem in tackling climate change, but shows innovation can mean it's part of the solution, and improve wildlife habitat at the same time.

”

**Doug Parr, Chief Scientist and Policy  
Director of Greenpeace UK**

“

The sooner we can stop using gas from fossil sources, the greater our chances of avoiding runaway climate change. Right now, we're still very dependent on gas to heat our homes – and we need as much of it as possible to come from biological sources, rather than from fossil fuels. So it's really good to see Ecotricity's latest Green Gas initiative in this incredibly important area.

”

**Jonathon Porritt, environmentalist**



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