# Future policy framework for biomethane production

## Supergen Bioenergy Hub Response to the Call for Evidence by the Department for Energy Security and Net Zero

The UK's plans for the Net Zero transition demand greater levels of biomethane production moving forwards, and this call for evidence from the Department for Energy Security and Net Zero aimed to support the development of policy frameworks that might best enable this. More information can be found in the call for evidence document online.

This response was compiled by members of the Supergen Bioenergy Hub research community based on their expertise, experience, and research. You can download this publication from: www.supergen-bioenergy.net/outputs

### Question 1 a) Do you agree with the principles as a basis on which to develop the policy framework? b) Are there any crucial factors missing?

We agree that the principles described are a sensible basis to base a future policy framework on. Security of feedstock supply will also be important, particularly for larger facilities if competition for biomass feedstocks increases.

### Question 5 - Please provide evidence related to the outlined assessment criteria for any of the production technologies listed in Chapter 1 (or for any additional technologies not included).

The following references contain information related to the criteria for:

- Anaerobic digestion (AD) [1-9]
- Gasification [8, 9]

### Question 6 - What are the most important end-uses for biomethane in the transition to net zero by 2050, and what are the implications for the framework? Please provide supporting evidence where possible.

The best use for biomass depends on the primary objective. The main driver for biomass systems is to support decarbonisation and the transition to net zero; therefore its use should be prioritised to enable the greatest climate mitigation by focusing on applications that [10, 11]:

- enable the greatest greenhouse gas (GHG) emission savings
- cannot be decarbonised in other ways (something which will change over time)

- offer the potential for negative emissions (i.e., carbon sequestration)

This aligns with the principles laid out in the Climate Change Committee's report on Biomass in a Low Carbon Economy [12]. A harmonised approach to sustainability governance will be important for maximising the benefits from biomass use across different sectors and applications [11].

As noted in the consultation document, biomethane has many potential applications in sectors ranging from heat to transport. It can be readily used as a direct replacement for fossil fuels in many applications and we already have the technologies to produce it as scale, meaning it can be used to support near term decarbonisation. However, the main applications of biomethane may change over time as the electrification of many sectors progresses.

Negative emission technologies such as Bioenergy with Carbon Capture and Storage (BECCS) are likely to be required if we are to limit global temperature increases and meet international climate change targets [12-14]. Therefore, it seems appropriate that in the long term opporutntities to integrate biomethane production or use with carbon capture and storage (CCS) would be a priority, especially since technologies like AD produce significant amounts of biogenic $CO_2$ as a byproduct of biomethane production. However, it is also improtant to be aware of the challenges (technical, financial and otherwise) that must be overcome to allow deployment of sustainable BECCS systems at scale [13]. Additionally, the scale of negative emissions needed to support climate change mitigation depends on the extent of decarbonisation across society and to maximise potential benefits and reduce negative impacts negative emission technologies like BECCS should be deployed alongside measures to reduce emissions (e.g., through a transition away from fossil fuels) and not be relied on to support business as usual elsewhere in the economy [12, 13].

The $CO_2$ removed during BECCS processes is destined for permanent underground storage, but there are also opportunities to use this $CO_2$. The consultation document mentions $CO_2$ use in food and drink, but some technologies could allow $CO_2$ to be converted into useful chemicals or in producing materials such as plastics or cement [15, 16]. Except where these materials have very long lifetimes (e.g., cement), the main benefit comes from avoiding fossil-derived carbon in the materials rather than from negative emissions achieved through permanent carbon storage. $CO_2$ utilisation may avoid some of the challenges associated with $CO_2$ storage and transport associated with CCS and benefit distributed or small-scale systems. This is an area that likely needs further investigation.

Hydrogen has been the focus of much attention in the UK's net zero transition, and it is possible to produce hydrogen from biomethane [16]. Biomethane is a useful fuel, and so currently it tends to make more sense to use the biomethane as a fuel rather than using additional energy to convert it to hydrogen fuel. However, if CCS is implemented there is a greater driver for conversion of biomethane to hydrogen because the conversion process releases biogenic $CO_2$ and so would result in more negative emissions than biomethane production alone.

## Question 23 a) What are your views on the criteria set out in Chapter 4 for assessing feedstocks? b) Are there any additional criteria that we should consider?

We agree that cost, GHGs, air quality, land use, and water quality and quantity are sensible criteria for assessing biomethane feedstocks. However, wider sustainability impacts should not be ignored, and benefits as well as risks should be considered.

The potential for GHG emission reductions is a key driver for uptake of biomethane, but like all bioenergy systems reduced emissions are not guaranteed and so GHG calculations are critical for robust sustainability criteria. However, biomethane production also has broader social, economic, and environmental implications, and the sustainability assessments used in future policy frameworks must be holistic [11, 17, 18]. It is also important to recognise that there can be benefits (e.g., ecosystem services from perennial crops, jobs) as well as risks (e.g., land use or water quality impacts), and so ideally, policy should be designed to maximise benefits as well as addressing the risks [10, 17, 18]. To date, many bioenergy sustainability schemes have focused on a narrow range of sustainability criteria and have yet to include mechanisms to maximise the benefits achieved [17].

Previous work from the Supergen Bioenergy Hub has highlighted the need for a harmonised approach to biomass feedstock sustainability assessment and governance across all sectors using biomass, and for sustainability assessment that can improve, respond and adapt to changing circumstances, especially because of the varied and changing nature of bioenergy technologies [11, 17]. We are hopeful that this can be achieved through the implementation of the cross-sectoral sustainability framework promised in the Biomass Strategy, and we are pleased that there is an intention to look at how factors such as land use change, soil carbon, biodiversity, and social impacts can be better considered in sustainability governance. Future policy mechanisms to support biomethane should be led by the approach and scope of this framework as it develops.

Looking at approaches to greenhouse gas calculations in more detail, our previous work can provide some insights:

- Lifecycle assessment (LCA) is an incredibly important tool for supporting developing and delivering technologies, including AD, which deliver maximum GHG reductions [2, 19, 20]. However, it is also a flexible tool, and care must be taken to design a robust method and formulate the question in a way that is appropriate for the particular objective or policy measure [2, 21]. It is essential that methodologies and data sources are transparent, system boundaries and scopes are clearly defined, and all assumptions clearly stated.
- Factors such as the counterfactual scenario (e.g., what is the biomethane replacing, or what would happen to the feedstock if not used in AD), allocation method (e.g., how emissions are assigned when there are multiple products), mass balance (e.g., approach when using mixed feedstock), and whether or not fugitive emissions are measured can all have significant impacts on GHG calculations [1, 3, 22]. How lifecycle analysis methodologies deal with biogenic carbon is also an area of discussion, and something which is currently the focus of work by the UN Life Cycle Initiative [23].
- If soil carbon is included in GHG calculations, it is important to note that there are challenges associated with its measurement. There is not yet a clear protocol for the measurement of soil carbon stock changes the reversibility of soil carbon changes must be considered [24, 25]. Inclusion of soil carbon changes in LCA is critical when high carbon soils such as lowland peat are being utilised, and such cases also require careful consideration of the counterfactual for the land use. This is demonstrated by the case of biomethane dervied from maize grown on lowland peat, where the emissions associated with restoration of the peatland and continued use of natural gas are estimated to be 2 to 3 fold lower than the biomethane scenario because of the high soil carbon loss associated with growing crops on peatland [26].
- Previous research by Supergen Bioenergy Hub researchers and the UK Department of Energy & Climate Change (DECC) found that many waste and residues have the

potential to deliver extremely low and even negative GHG emissions if used in bioenergy systems, due to the mitigation of counterfactual activities that would otherwise have generated high emissions. For example, using food wastes or animal manures for AD would potentially mitigate high GHG emissions if these feedstocks would otherwise have been sent to landfill or spread on the land etc [3]. Waste and residues are currently counted as having zero upstream emissions but this is not necessarily justifiable once demand increases for their use as a feedstock.
- Cultivation, particularly agricultural inputs like fertilisers, are significant source of GHG emissions for crop feedstocks [2]. GHG methodologies requiring accurate reporting of these inputs will be needed to help incentivise more sustainable agricultural practices [1].
- Yield (e.g., how much energy or crop comes from a particular area of land) will also impact the GHG performance, as well as having land use implications

Sustainability criteria for biodiversity are important in ensuring crop cultivation and use of digestated support UK biodiversity targets. Criteria based on positive actions and aligning with current ELMs schemes, such as crop margin management, use of cover crops and farm nutrient management planning may prove the most practical and cost-effective solution to promoting biodiversity benefits.

### Question 24 - With reference to the feedstock sustainability assessment criteria in Chapter 4 (or any other suggested criteria), please provide any data on AD feedstocks that you think we should consider in future policy.

The following references contain information relating to:

- Wastes and residues [3]
- Maize [2, 26, 27]
- Grass [28]

There are also some novel biomass crops, such as cup plant, which may have potential as AD feedstocks in the future [27, 29, 30]. The Supergen Bioenergy Hub held a stakeholder workshop on Novel Crops and Forestry Species as Sources of Industrial Biomass and the findings are detailed in the workshop report. The workshop highlighted some information on species such as cup plant, but it also showed that for such novel species there are still many unanswered questions, particularly around their ecosystem impacts, and there is a lack of independently verified scientific data [30].

### Question 25 - With reference to the feedstock sustainability assessment criteria in Chapter 4 (or any other suggested criteria), please provide any data on feedstocks that are specifically used by non-AD biomethane production methods

The following references contain information relating to:

- Woody feedstocks [22, 31]
- Perennial crops such as Miscanthus [32-36] (can also be used for AD under certain conditions [37, 38]) and willow [35, 36, 39]. Perennials often have lower agricultural input needs and improved environmental performance compared to arable crops like maize. Arable crops like maize mostly rely on practices that are detrimental to biodiversity and soil carbon, but in some cases perennial crops can provide benefits.

## Question 34 - Please provide any evidence you have on the benefits and costs of detecting, monitoring, or repairing methane leakage from AD sites.

Fugitive methane emissions can have significant impacts on the GHG performance of biomethane production systems and it is therefore essential that all efforts are made to reduce fugitive emissions during the design, construction, and operation of the plants [1, 2, 40]. A recent report demonstrated that the most cost-effective approach is a combination of regular self-inspections, periodic reporting of methane emissions as part of monitoring programmes and training courses for plant operators [41].

Measurement of fugitive emissions is critical for sustainability assessment of AD and previous work from Supergen Bioenergy Hub researchers has indicated that mandatory measurement will be important for creating a policy framework that incentivises reduction or elimination of fugitive emissions [1, 2, 40].

It is also important to note that although fugitive emissions can impact the lifecycle GHG emissions from biomethane systems, biomethane systems with some fugitive emissions can still result in GHG savings compared to the fossil fuels they displace.

## Question 35 - What challenges might the biomethane industry face if future government policy sets a limit on fugitive methane emissions from biomethane production?

It is difficult to measure fugitive methane emissions from biomethane production systems accurately, and clear guidance on measuring and reporting fugitive emissions will be required to support future policy that demands measurement [1].

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SUSTAINABLE BIOENERGY SYSTEMS FOR OUR LOW-CARBON FUTURE

The Supergen Bioenergy Impact Hub works with academia, industry, government and societal stakeholders to develop sustainable bioenergy systems that support the UK's transition to an affordable, resilient, low-carbon energy future.

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