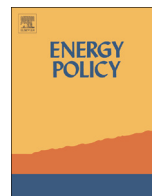




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Biomass sustainability criteria: Greenhouse gas accounting issues for biogas and biomethane facilities



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HIGHLIGHTS

- GHG accounting issues identified that affect potential compliance with legislation.
- Appropriate recognition of digestate value is a key issue for biogas industry.
- Fugitive methane emissions measurement is critical for sustainability criteria.
- Chosen fossil fuel comparator value determines the potential GHG saving.
- Rigorous analysis of GHG accounting methodology for biogas and biomethane systems.

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ABSTRACT

Biomass sustainability criteria were introduced in the UK following the EU Renewable Energy Directive. Criteria are now applicable to solid biomass and biogas, however because it is not mandatory criteria can be adapted by member states with the risk of different interpretation. Operators are required to report greenhouse gas (GHG) emissions for every MJ of energy produced. This paper provides a rigorous analysis of the current GHG emissions accounting methodology for biogas facilities to assess expected compliance for producers. This research uses data from operating CHP and biomethane facilities to calculate GHG emissions using the existing methodology and Government calculator. Results show that whilst many biogas facilities will meet GHG thresholds, as presently defined by Government, several operators may not comply due to methodological uncertainties and chosen operating practices. Several GHG accounting issues are identified which need to be addressed so the biogas industry achieves its reporting obligations and is represented objectively with other bioenergy technologies. Significant methodological issues are highlighted; including consignment definition, mass balance allocation, measurement of fugitive methane emissions, accounting for digestate co-products, fossil fuel comparators, and other accounting problems. Recommendations are made to help address the GHG accounting issues for policy makers and the biogas industry.

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Abbreviations: AD, anaerobic digestion; ALCA, attributional life cycle assessment; BCC, biomass carbon calculator; BSC, biomass sustainability criteria; CCR, carbon capture and replacement; CHP, combined heat and power; CLCA, consequential life cycle assessment; CV, calorific value; DLUC, direct land use change; DECC, Department of Energy and Climate Change; DEFRA, Department of Environment Food and Rural Affairs; DM, dry matter; EC, European Commission; E.F., emission factor; FFC, fossil fuel comparator; FIT, Feed in Tariff; FM, fresh matter; FQD, Fuel Quality Directive; FU, Functional Unit; GCV, gross calorific value; GHG, greenhouse gas; GWP, global warming potential; HHV, higher heating value; ILUC, indirect land use change; LCA, Life Cycle Assessment; LHV, lower heating value; MC, moisture content; NI, nitrogen inhibitor; OFGEM, Office for Gas and Electricity Markets; RED, renewable energy directive; RHI, renewable heat incentive; RO, renewables obligation

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1. Introduction

The Renewable Energy Directive (RED) (2009/28/EC) specifies a minimum set of sustainability criteria for biofuels and bioliquids, with a threshold of 35% savings of greenhouse gas (GHG) emissions with respect to fossil fuels they are compared to (EC, 2009a). Rules for calculating the GHG impact of biofuels, bioliquids and their fossil fuel comparators are also set in the Directive (JRC, 2014). The RED does not specify similar rules for biomass used for heating, electricity, and cooling. Nonetheless a European Commission (EC) report COM(2010) 11 (EC, 2010a), makes recommendations on sustainability criteria and GHG accounting for

solid and gaseous biomass pathways following a similar methodology to the RED and Fuel Quality Directive (2009/30/EC) (EC, 2009b). In contrast to the RED, the EC has not introduced binding criteria but has made non-binding recommendations to Member States (EC, 2014a). Out of all EU countries, the UK has adopted the most stringent of GHG savings requirements for Government supported solid and gaseous bioenergy projects (DECC, 2014b; EC, 2014a; OFGEM, 2014b).

The UK Government is committed to supporting sustainably produced biomass that delivers real greenhouse gas savings, and manages possible risks such as food security and biodiversity (DECC, 2012a). Bioenergy production is supported in the UK through different incentives and mechanisms. Biofuels production is promoted through the Renewable Transport Fuels Obligation (RTFO) (DfT, 2014). Biomass electricity is encouraged via Feed-in-Tariffs (FITs), the Renewables Obligation (RO), and Contracts for Difference (CfD) (OFGEM, 2014c). Biomethane and biomass heat generation are supported by the Renewable Heat Incentive (RHI), which is understood to be the world's first renewable heat scheme (DECC, 2013c).

As a consequence of EC policy, the UK has introduced biomass sustainability criteria (BSC) that facility operators receiving Government support are required to comply with. These sustainability controls for solid biomass and biogas go beyond those currently recommended or required in the EU and internationally (EC, 2014a). They reflect the principles of the UK Bioenergy Strategy and aim to support the development of sustainable biomass supply chains (DECC, 2012a). With the exception of FITs, each of these schemes has adopted sustainability criteria that include a requirement to meet both a GHG savings threshold and land use criteria.

1.1. Renewables obligation (RO) and contracts for difference (CfD)

Reporting requirements on the use of biomass under the RO were introduced in 2009 (OFGEM, 2014b). The RED brought in mandatory sustainability criteria for bioliquids, which were incorporated into the RO (DECC, 2011). At the same time, the reporting requirements for solid biomass and biogas were expanded to require reporting against greenhouse gas (GHG) emissions criteria and land criteria, largely based on the sustainability criteria for bioliquids. Generators of over 50 kW in size are now required to report whether the biomass they have used had been sourced from a type of 'protected land' and to provide details of the GHG emissions associated with its production and use (OFGEM, 2014b).

Following a consultation by DECC, 2012b, the UK Government decided to make the sustainability criteria mandatory for support under the RO from April 2015, for stations of 1 MW and above that use solid biomass or biogas (DECC, 2013b). GHG trajectories were tightened so that biomass power moves from 240 kgCO₂e/MWh to a more stringent GHG emission lifecycle target of 200 kgCO₂e/MWh from 2020, and tightens again to 180 kgCO₂e/MWh from 2025 (OFGEM, 2014b). There is also a requirement for an independent audit report on compliance with the sustainability criteria for stations of 1 MW and above using solid biomass and biogas.

Under the Electricity Market Reform it is intended that the forthcoming contracts for difference will follow the same approach as the sustainability criteria set under the RO. Where they differ it will be because of differences between the contractual approach taken in the CfD and the administrative approach via the RO (DECC, 2014a).

1.2. Renewable heat incentive (RHI)

In February 2013, DECC announced its intention to introduce sustainability criteria for biomass supported under the Renewable

Heat Incentive (RHI) (DECC, 2013a). These criteria are broadly in line with those under the RO but reflect the smaller-scale nature of the heat market compared with the (large-scale) electricity market and that it is predicted most of the biomass supported under the RHI will come from UK sources (DECC, 2013c). They will affect participants of the domestic and non-domestic RHI as well as producers and traders of biomass fuels. The criteria include (DECC, 2013a):

- Greenhouse gas criteria, under which biomass fuel used by RHI participants must meet a lifecycle greenhouse gas (GHG) emissions target of 34.8 gCO₂e/MJ of heat. That is 60% GHG savings against the EU fossil fuel average.
- Land criteria, which will be in line with those under the RO.

Land criteria include not sourcing biomass from land that since January 2008 was primary forest, designated for nature protection purposes, peatland, continuously forested, lightly forested area, or wetland. Since biogas crops are mainly grown on arable land the primary risk is converting grassland to cropland where a carbon stock calculation must be performed (OFGEM, 2014b). Further consideration of land criteria is outside the scope of this paper.

For biogas facilities producing heat, lifecycle GHG emissions are calculated using the conversion efficiency value, e.g. boiler efficiency. Biomethane producers are required to calculate emissions at the point of injection into the gas grid (DECC, 2014b).

Biomass sustainability criteria (BSC) under the RHI will not be grandfathered (DECC, 2011, 2104b), which means all RHI scheme participants are subject to any changes in BSC, for example a reduction in the GHG criteria. This represents a significant risk for developers and investors and is in contrast to the RO which has opted to grandfather BSC (DECC, 2013b, 2013c; OFGEM, 2014b).

1.3. Feed in Tariffs (FITs)

There is currently no sustainability reporting requirements under the FIT, despite there being over 100 accredited anaerobic digestion (AD) facilities in operation (OFGEM, 2014c, 2015).

1.4. Renewable transport fuels obligation (RTFO)

Sustainability requirements for the transport elements of the Renewable Energy Directive (RED) were implemented in the UK on 15 December 2011 (DfT, 2014). The RED is closely linked to the Fuel Quality Directive (FQD) and both directives include the same mandatory carbon and sustainability requirements that must be met if biofuel is to count towards European targets. The sustainability criteria are that (DfT, 2014):

- biofuels must achieve at least a 35% GHG emissions saving (this threshold will rise over time)
- biofuels may not be made from raw material obtained from land with high biodiversity value in or after January 2008;
- biofuels may not be made from raw material obtained from land with high carbon stock such as forests or land that was undrained peatland in January 2008 unless strict criteria are met.

Biogas is used for transport biofuels in many EU countries but this is not presently very common in the UK, therefore using biogas for transport fuel is not the focus of this paper.

1.5. Alternative methodologies for calculating GHG emissions from biogas

The EU methodology for calculating GHG emissions has been widely adopted by Governments and industry for bioenergy

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