

# *Network Innovation Competition Full Submission*

## *Supplementary Answer Form*

Tick if this answer is Confidential: ☐

Tick if this answer has been provided verbally: ☐

Project code:	NGGDGN01	Question Number	5
Question date	15/8/13	Answer date	19/8/13
Submission section question relates to	2.1.2 and 6.2.2		
Topic	Environmental		
Question	Which of the two methods of assessing the level of carbon savings is most relevant (e.g. which is used by the EU in assessing the 80% reduction?)?		
Notes on question			
Answer	<p>It is not entirely clear how the EU treat BioSNG in their emission calculations, as there are multiple methodologies in existence.</p> <p>The RED methodology is currently applied to biofuels.</p> <p>However, within the DECC 2050 calculator methane emissions from landfill count towards the UK's overall level of emissions and the use of bio-energy assumes a carbon credit for the growing cycle. The BEAT 2 methodology takes both these factors into account.</p> <p>Both the RED and the BEAT 2 methodologies show strong GHG savings, especially the latter since it reflects the avoided emissions from landfilling of waste. In the long term, however, an extension of the RED methodology focussed on SNG is likely to represent a reasonable way to assess carbon intensity, as SNG would increasingly be manufactured from pure biomass sources. On this conservative basis, BioSNG which is already attractive with waste-derived fuels, would offer a progressively decreasing carbon intensity into the future.</p>		

	<p>Attached is an extract from the NNFCC report discussing the relevance of the 2 methodologies, and hence why both are presented.</p>
<p>Attachments</p>	<p><b>2. CALCULATION METHODOLOGIES</b></p> <p>GHG emissions calculations normally focus on the direct and indirect release of three prominent gases; carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O). Direct GHG emissions usually arise from the combustion of fossil fuels in any given activity, although with biomass systems, the release of CO<sub>2</sub> from carbon stock changes, CH<sub>4</sub> from decomposition and N<sub>2</sub>O emissions from cultivated soils can be important considerations. In keeping with established conventions, CO<sub>2</sub> emissions from the eventual combustion of derived fuels, such as bioSNG, are excluded from GHG emissions calculations. This is because it is generally assumed that such emissions are offset by the CO<sub>2</sub> originally</p> <p>Greenhouse Gas Emissions for Thermochemical BioSNG Page 4</p> <p>absorbed by the initial biomass during its growth. Indirect GHG emissions occur due to the supply of other products and services required by any given activity. This frequently involves extensive investigation based on the principles of life cycle assessment (LCA). Whilst LCA principles are well-established and documented in relevant standards (ISO, 1998, 2009a, 2009b), GHG emissions calculations are subject to a number of different methodologies. These have been devised and recommended for official application in a range of different circumstances. These can be characterised here as methodologies for use in policy analysis and regulatory applications. In either case, the methodologies specify how calculations should be performed and what assumptions should be made. In some instances, methodological differences have little effect on results, whereas in others very significant effects on results can be observed.</p> <p>In this project, two GHG emissions calculation methodologies were adopted; that used in the Biomass Environmental Assessment Tool (BEAT<sub>2</sub>; BEAT, 2009) and that specified in the European Commission Renewable Energy Directive (EC RED; EC, 2009). The BEAT<sub>2</sub> methodology was regarded as relevant because:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> it is already in fairly widespread use within the Environment Agency, Department for Environment, Food and Rural Affairs, and the Department of Energy and Climate Change,</li> <li><input type="checkbox"/> it evaluates overall consequences, which are relevant from a policy perspective, for all relevant biomass energy technologies in the UK, and</li> <li><input type="checkbox"/> it is generally similar to the official methodology set out in Publicly Accessible Standard (PAS) 2050 which is becoming increasingly used in the carbon footprinting of products and services.</li> </ul> <p>EC RED was considered to be relevant because:</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> it is an established regulatory methodology which is currently applied to liquid biofuels and might be applied to biomass energy generally, and</li> <li><input type="checkbox"/> it has potential for future application across the European Union.</li> </ul> <p>However, it should be noted that the BEAT<sub>2</sub> methodology is not an official or mandatory GHG calculation procedure although it has been formulated to address all biomass feedstocks and</p>

biomass energy technologies relevant in the UK for the foreseeable future. In contrast, the EC RED, which incorporates an official GHG emissions calculation methodology, does not specify, at the moment, how this would be extended from liquid biofuels to biomass feedstocks and other biomass energy technologies. Instead, it has been necessary to speculate how this might be accomplished by adopting the implicit logic of the EC RED.

Within these limitations, the main differences between the BEAT<sub>2</sub> and EC RED methodologies can be summarised as follows:

☐ Global Warming Potentials (GWPs): These are used to convert CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O emissions into comparable units, expressed as kilograms of equivalent CO<sub>2</sub>

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(kg eq. CO<sub>2</sub>), so that results can be provided and compared for total GHG emissions. GWP values are available from the Intergovernmental Panel on Climate Change (IPCC) for different time horizons which reflect the residence times of each gas in the atmosphere and their warming effects. Normally, a 100 year time horizon is normally applied. However, these GWP values have varied as scientific knowledge has improved. In its default setting, the BEAT<sub>2</sub> methodology uses GWP values from the Fourth Assessment Report (IPCC, 2007); 25 kg eq. CO<sub>2</sub>/kg CH<sub>4</sub> and 298 kg eq. CO<sub>2</sub>/kg N<sub>2</sub>O. The EC RED methodology specifies the use of GWP values from the Third Assessment Report (IPCC, 2001); 23 kg eq. CO<sub>2</sub>/kg CH<sub>4</sub> and 296 kg eq. CO<sub>2</sub>/kg N<sub>2</sub>O. Generally, this only causes relatively small differences in results.

☐ Reference Systems: These are usually invoked to address issues of avoided GHG emissions due to alternative fates for biomass feedstocks or alternative uses of land. In the case of biomass feedstocks, this mainly applies to their alternative disposal as wastes. For example, waste wood could normally be disposed of to landfill sites where, depending on circumstances, CH<sub>4</sub> may be generated and leak into the atmosphere. Using such waste wood as a source of energy would avoid these emissions and, hence, they would have to be subtracted from evaluations. Similar considerations apply when considering the alternative use of land used in the cultivation of energy crops such as short rotation coppice, miscanthus, switchgrass, etc. Reference systems are included in the BEAT<sub>2</sub> methodology but excluded in the EC RED methodology.

☐ Direct and Indirect Land Use Change: GHG emissions can arise when land is converted from a previous use to the cultivation of biomass. This is referred to as “direct land use change”, or dLUC. It has also been reasoned that there are consequences for GHG emissions when land growing, say, food crops is used for biomass cultivation, thereby leading to the displacement of food production elsewhere. Ultimately, this can result in the conversion of land with high carbon stocks, such as forests, to food crop cultivation. In effect, the GHG emissions caused by this conversion can be attributed to the original biomass crop. This is referred to as “indirect land use change” or iLUC. Whether and how the GHG emissions of dLUC and, chiefly, iLUC are taken into account has been the subject of much currently unresolved debate. The BEAT<sub>2</sub> methodology incorporates neither dLUC nor iLUC. The EC RED methodology has a specified procedure for dLUC and may eventually adopt a means of addressing dLUC. However, for current purposes, neither dLUC nor iLUC are taken into account in these calculations.

☐ Treatment of Plant and Equipment: GHG emissions are associated with the manufacture, maintenance and decommissioning of plant and equipment such as agricultural and forestry machinery, conversion plants, etc. Although it may be difficult to estimate such contributions, approximate methods are available

<sup>5</sup> In a more complex case, the landfill site might have energy recovery in which some of the CH<sub>4</sub> would be captured and used to generate electricity. This, in turn, could displace electricity generation from fossil fuels. In this instance, the subsequent benefits of GHG emissions savings would not be realised, meaning that potentially avoided emissions would be “avoided”. Hence, with such a reference system, extra GHG emissions would have to be added to the use of the waste wood as a source of energy. It should be noted that reference systems in BEAT<sub>2</sub> for wastes do, in fact, assume that disposal is via landfill with energy recovery.

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to achieve this (Mortimer et al, 1995; Mortimer and Elsayed, 2001). In many instances, such

	<p>contributions are relatively small. However, they can be more significant for certain items of equipment with short working lives, such as agricultural and forestry machinery. For completeness, GHG emissions from the manufacture and maintenance of all plant and equipment, and from the decommissioning major conversion plant are included in the BEAT<sub>2</sub> methodology. All GHG emissions associated with plant and equipment are excluded from the EC RED methodology.</p> <p>☐ CoProduct Allocation: For a number of biomass feedstocks and biomass energy technologies it is necessary to divide GHG emissions between various co-products. There are numerous ways of undertaking such co-product allocation. In the BEAT<sub>2</sub> methodology, this is achieved, in the first instance, by substitution credits, based on the GHG emissions associated with a product or service which is displaced by a given co-product, and then, if this is not readily possible, by means of price allocation (value = price x amount). In most cases, it is necessary to resort to price allocation. This is, essentially, the procedure adopted in PAS 2050. In the EC RED, co-product allocation is by energy content (energy content = calorific value x amount), although it should be noted that wastes and agricultural residues are excluded from this procedure, even if they are used subsequently (for example, in energy production).</p> <p>These main methodological differences are summarised briefly in Table 1.</p> <table><tr><th>Table 1 Summary of Main Differences between BEAT<sub>2</sub> and EC RED Methodologies Greenhouse Gas Emissions Calculation Procedure Global Warming Potentials</th><th>BEAT<sub>2</sub> Methodology</th><th>EC RED Methodology</th></tr><tr><td></td><td>IPCC Fourth Assessment Report: 25 kg eq. CO<sub>2</sub>/kg CH<sub>4</sub> 298 kg eq. CO<sub>2</sub>/kg N<sub>2</sub>O</td><td>IPCC Third Assessment Report: 23 kg eq. CO<sub>2</sub>/kg CH<sub>4</sub> 296 kg eq. CO<sub>2</sub>/kg N<sub>2</sub>O</td></tr><tr><td>Reference Systems</td><td>Included</td><td>Excluded</td></tr><tr><td>Direct Land Use Change</td><td>Excluded</td><td>Included (excluded here)</td></tr><tr><td>Indirect Land Use Change</td><td>Excluded</td><td>Excluded (currently)</td></tr><tr><td>Plant and Equipment</td><td>Included</td><td>Excluded</td></tr><tr><td>Co-Product Allocation</td><td>Substitution Credits (initially) then Price (mainly)</td><td>Energy Content (excluding waste and residues)</td></tr></table>	Table 1 Summary of Main Differences between BEAT <sub>2</sub> and EC RED Methodologies Greenhouse Gas Emissions Calculation Procedure Global Warming Potentials	BEAT <sub>2</sub> Methodology	EC RED Methodology		IPCC Fourth Assessment Report: 25 kg eq. CO <sub>2</sub> /kg CH <sub>4</sub> 298 kg eq. CO <sub>2</sub> /kg N <sub>2</sub> O	IPCC Third Assessment Report: 23 kg eq. CO <sub>2</sub> /kg CH <sub>4</sub> 296 kg eq. CO <sub>2</sub> /kg N <sub>2</sub> O	Reference Systems	Included	Excluded	Direct Land Use Change	Excluded	Included (excluded here)	Indirect Land Use Change	Excluded	Excluded (currently)	Plant and Equipment	Included	Excluded	Co-Product Allocation	Substitution Credits (initially) then Price (mainly)	Energy Content (excluding waste and residues)
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