Guidance on Sustainability Analysis of Irish Bioenergy Pathways using Life Cycle Assessment Methods

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About the Irish Bioenergy Association

IrBEA is an industry association with over 180+ members representing the bioenergy industry on the island of Ireland. IrBEA seeks to increase understanding of issues related to biomass supply chains used to generate energy in the form of heat, electricity and transport. The main objectives of the association are to influence policy makers, to promote the development of bioenergy, and to promote the interests of its members. Improving public awareness, networking and information sharing, and liaising with similar interest groups are other key areas of work in promoting biomass as an environmentally, economically and socially sustainable energy resource. Overall direction is provided by the CEO together with the President and Vice President who work closely with the management committee which comprises 15 members from all parts of the bioenergy industry. IrBEA operates a group structure where different parts of the bioenergy industry collaborate on topics such as transport biofuels, wood energy, biogas/AD, domestic biomass fuels, energy crops and biomass power generation. www.irbea.org and www.bioenergyfutureireland.com

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Executive Summary

IrBEA (The Irish Bioenergy Association) has undertaken this work to better understand the potential impacts for solid and gaseous biomass projects of changes under the recast Renewable Energy Directive (RED).

The proposed changes extend the existing EU sustainability criteria for bioenergy to cover biomass and biogas for heating and cooling and electricity generation. An 80% GHG saving requirement versus the fossil fuel equivalent is applied to biomass-based heating/cooling and electricity after 1/1/21. This increases to 85% for operations starting after 1/1/26. As the RED is currently drafted this would apply to all solid biomass projects with a fuel capacity of $20MW_{th}$ and above, and all biogas projects with an electrical capacity of $0.5MW_{e}$ and above.

Life Cycle Assessment (LCA) is a very useful tool to consider the environmental aspects of a product, which is defined very broadly to include all manner of services and processes. In terms of the LCA of bioenergy, the most common approach is to carry out partial LCAs focusing on greenhouse gases (GHGs), allowing comparison between bioenergy products and the fossil fuel products they are displacing.

Biomass may be considered to be carbon neutral, as the carbon it contains and which is released when burnt, has recently been absorbed from the atmosphere and so it is part of the global cycle of biogenic carbon and has no overall effect on the amount of atmospheric carbon dioxide in circulation. However, bioenergy, derived from biomass, cannot be assumed to be carbon neutral. In developing new policies and assessing the environmental impact of existing and emerging bioenergy pathways, it is necessary to assess the GHG emissions using an appropriate LCA method to support policy decisions.

The most applicable LCA method for suppliers and users of bioenergy in Ireland is the method set out in the proposed recast RED. The RED GHG reporting methodology is a partial LCA methodology and is compliant with ISO 14040 standards. The aim is to enable meaningful reporting of GHG emissions without it being overly onerous. It is recognised that the methodology is imperfect and expected over time that it will be revised in response to the availability of new information and scientific understanding. It includes process emissions from cradle to grave, nitrous oxide emissions from soil as well as GHG emissions and removals arising from land use change and improved agricultural management.

There is a great deal of policy uncertainty for the renewable energy sector at present both at EU level and national level. The recast RED is at an advanced stage of development, but still subject to debate and subsequent change by the EU parliament. The default values for bioenergy products and their fossil fuel comparators are subject to the emergence of new data and supporting analysis from the EU Joint Research Centre. There is also a good deal of uncertainty and flexibility in how particular member states may transpose this into national policy or integrate it into specific policy instruments.

From the stakeholder consultations undertaken, it is apparent that there is a gap in knowledge of the proposed requirements and any potential impacts of the recast RED for the Irish bioenergy sector and 2021 implementation is still somewhat distant from a business planning perspective. The industry is reliant on state bodies such as DCCAE, DAFM, SEAI or the EPA, or independent research groups to analyse and assess the sustainability of different forms of bioenergy and to carry out consequential LCA for developing a more complete understanding of the impacts for the Irish bioenergy sector.

There are 17 Irish entities currently certified for RED compliance under the existing criteria, using voluntary certification schemes for transport biofuel production. The verifiers and/or auditors are mainly global certification service providers, and the voluntary RED compliance scheme of choice so far has been the ISCC. These existing certified operators will have little difficulty continuing to comply with RED under revised criteria, as they are all using residues. The ongoing administration and audit cost burden of compliance is significant and there may be scope for efficiencies by having locally-based GHG verification and audit compliance service providers.

For solid biomass pathways, the 20MW fuel-capacity threshold for application of RED sustainability criteria is only likely to be relevant to a small number of operators in Ireland. There is the possibility to apply a lower threshold in national policies, as for example the 1MW threshold in the UK's Renewable Heat Incentive (RHI). An Irish RHI is under development and the sustainability criteria and other details associated with this are not in the public domain at the time of writing. Simplified tools have been developed in the UK for sustainability reporting and compliance, and the possibility exists to adapt these to the Irish context.

The precedent for transport biofuels has been to integrate the UK and Irish implementation of sustainability quite closely, exemplified in the joint development of the "UK and Ireland Carbon Calculator". Many bioenergy products are supplied via UK ports and Ireland and Northern Ireland share a common electricity market, so collaboration makes sense. However, the future harmonisation of UK schemes with EU legislation is one of many uncertain aspects looking forward. It is prudent to ensure integration of any national initiatives with EU-led voluntary schemes.

Until the legislation is final, and there is real industry demand to fund certification requirements, it is not clear which if any of the existing or emerging international certification schemes may be suited to the Irish context. The certification schemes currently used for RED compliance may evolve and meet industry requirements under the recast RED, or new voluntary schemes may emerge such as the Sustainable Biomass Partnership. Biograce II has been used in this analysis as a useful open-source tool for indicative pathway assessment and awareness-raising, but there is no obligation or incentive for the original BioGrace consortia to fund and maintain the tools as the RED evolves and adapts to future market requirements.

Analysis of a typical solid biomass fuel pathway was undertaken, where wood chip is sourced from forest residues and chipped for direct use in a 1MW biomass boiler for space heating purposes. This pathway should easily comply with the proposed requirement to decrease GHG emissions by >85% versus the fossil fuel heating comparator.

The lack of default values for willow short rotation coppice (SRC) in the recast RED is a gap in the Irish context, where willow plantations are an established part of the domestic bioenergy supply chain.

Where biogas is concerned, the proposed threshold of 0.5MW electrical capacity and above means that a majority of existing or planned biogas projects will be impacted, regardless of what further measures transpire in national legislation. IrBEA believes a higher fuel capacity threshold should be set for biogas plants.

A national 'GreenGasCert' certification initiative is presently under development, supported by IrBEA and other stakeholders. It is building on the expertise of a similar certification scheme in Germany. This is intended to address a market need for tradable certificates to guarantee the origin of biogas (for example prior to grid injection), but should also separately address the requirement for RED compliance certification of GHG reductions.

Analysis of a typical biogas pathway, where a mix of farm manure and bio-waste are supplied for anaerobic digestion and subsequent supply of heat and electricity, was undertaken. The analysis shows that projects using Irish feedstocks should have little technical difficulty in meeting proposed GHG reduction thresholds. Because of the nature of co-digestion and likely variability from project to project, there are less possibilities to use default values present in the recast RED.

The lack of default values for grass silage to biogas pathways in the recast RED is a gap in the Irish context. Where no default values exist, actual project data verification will be required, leading to a more complex and costly compliance burden.

1 Introduction

IrBEA (the Irish Bioenergy Association) represents the bioenergy industry on the island of Ireland.

The association identified a knowledge and skills gap around sustainability criteria and life cycle assessment (LCA) of bioenergy supply chains among its' industry members and sector stakeholders. The association is particularly interested in the potential impacts for solid and gaseous biomass projects of major changes under the recast Renewable Energy Directive (RED)[1]. IrBEA received funding under the SEAI (Sustainable Energy Authority of Ireland) RDD programme to help address that need for specialised training and knowledge dissemination.

1.1 About the Irish Bioenergy Association

IrBEA is an industry association with over 150 members representing the bioenergy industry on the island of Ireland. IrBEA seeks to increase understanding of issues related to biomass supply chains used to generate energy in the form of heat, electricity, and motion. The main objectives of the association are to influence policy makers, to promote the development of bioenergy, and to promote the interests of its members. Improving public awareness, networking, and information sharing, and liaising with similar interest groups are other key areas of work in promoting biomass as an environmentally, economically, and socially sustainable energy resource. A small executive team manages the association, with overall direction provided by the management committee which comprises 15 members from all parts of the bioenergy industry.

1.2 Project Objectives

The project objectives are:

- To enable the bioenergy industry to use leading opensource tools and know-how to assess the sustainability of proposed supply chains and conversion processes
- To support awareness and capacity building around sustainability legislation and reporting requirements for industry
- To equip bioenergy industry stakeholders to credibly answer questions posed by media, members of public or other stakeholders (e.g. planning authorities, lenders, investors) about the sustainability of local bioenergy supply chains.

1.2.1 Specific Actions

The project will address a skills and industry information gap in the bioenergy sector by providing:

- High quality 2-day workshop to provide industry stakeholders with the knowledge and understanding to assess the carbon-footprint and life cycle impact of their products and processes
- Providing guidance on sustainability criteria and appropriate LCA methods for assessing GHG reductions in the Irish context
- Providing examples of local bioenergy pathways of relevance to the emerging Irish bioenergy sector

1.3 Project Deliverables

1.3.1 LCA Training Workshops

IrBEA ran a 2-day training workshop on the 20th and 21st June 2017. The course was delivered by Anna Evans, a UK-based LCA practitioner.

The need for relevant industry training was fully demonstrated through an oversubscription and waiting list for each of the workshop days (maximum 20 attendees on day 1 and maximum 16 attendees on day 2).

[1] COM(2016)767 final/2: Proposal for a Directive of the European Parliament and of the Council on the promotion of the use of energy from renewable sources (recast)

1.3.2 LCA Guidance and Examples

IrBEA appointed Tom Bruton (BioXL Sustainable Energy Consultants) and Anna Evans to consult with IrBEA members and stakeholders about the relevance of LCA and prepare the most relevant guidance and examples based on industry need.

This document contains the primary outputs of this project task.

2 About Life Cycle Assessment

The ISO 14040[2] standard defines LCA as a technique for assessing the environmental aspects and potential impacts associated with a product[3] by compiling an inventory of relevant inputs and outputs of a system; evaluating the potential environmental impacts associated with those inputs and outputs; and interpreting the results of the inventory and impact phases in relation to the objectives of the study.

The flexibility of the approach to LCA given in the ISO standard allows an assessment to cover an entire industrial sector or the functioning of a firm as a whole or just a single product or service. Ideally, an LCA should cover the full range of environmental impacts and cover the entire life cycle of the product, in other words, from the 'cradle to the grave', and consider all inputs and outputs as well as the full range of environmental impacts. However, due to factors such as cost, time and the lack of good data, partial LCAs are frequently carried out.

The main applications of LCA are awareness-raising, product comparisons, product improvement and policy development. The approach to carrying out LCAs is standardised but the actual method used is determined by the purpose of the assessment and the question to be answered. This means that the outcomes of an assessment for policy purposes may appear to give very different results from an assessment for reporting purposes. The differences may cause confusion and distrust of the methodology. However, both results will be correct and the reason for the differences lies with the choice of system boundaries, the method of partitioning emissions between the main and co-products, the emissions factors and Global Warming Potential (GWP) multipliers used. It is a requirement that all these choices are transparently documented and the approach justified in relation to the goal of the assessment. The goal of an assessment will determine the scope, which in turn will determine the assessment methodology.

2.1 LCA stakeholders

Apart from those involved in the bioenergy sector who are likely to be interested in LCA for assessment of GHG reduction and compliance with RED, there are many other applications of LCA, and opportunities for sharing of skills and experience across the various stakeholders.

For example, many building products require an EPD (Environmental Product Declaration) and the IGBC (Irish Green Building Council) is working with stakeholders in the building industry to develop an Irish certification scheme which is compliant with European legislation.

Many food companies are also interested in LCA of their products. At a national level the Bord Bia Origin Green voluntary scheme allows food suppliers to undertaken a broad sustainability assessment (across the environmental performance of the manufacturing process, raw material sourcing and social sustainability).

A grouping called LCA Network Ireland has been established previously, hosted initially by UCDs School of Biosystems Engineering.

[2] "Environmental Management – Life Cycle Assessment" BS EN ISO 14025, 14040, 14044, 14046, 14047, 14048, 14049, 14067, 14071, 14072 British Standards Institution, London, United Kingdom, 2002-2014. https://www.iso.org/standard/37456.html

[3] The term 'product' refers to either goods or services providing a given function

2.2 LCA Applied to Bioenergy

In terms of the LCA of bioenergy, the most common approach is to carry out partial LCAs focusing on GHGs. The focus on GHGs reflects concerns regarding global warming and climate change. Ideally, full and detailed LCAs should be carried out covering all environmental impacts and considering social and economic issues. However this sort of comprehensive study would require a large body of supporting data which in many cases may not be available. A comprehensive study of all possible impacts would also involve a significant set of supporting assumptions, which would be challenging to define and properly document for the purposes of transparency.

There is currently no internationally agreed methodology. This is because the ISO standard is not prescriptive but incorporates choice but provides limited guidance on the desirability of different choices. Hence different countries and organisations have made different choices, all of which are compliant with the ISO standard. This is an area which still needs to be effectively addressed as it means bioenergy sold into different markets internationally may have to be reassessed and may not comply with the local requirements.

The major GHGs associated with fossil and bio energy which are generally used for GHG accounting are carbon dioxide, methane and nitrous oxide. The comparative GHG impact associated with bioenergy and fossil energy, used for the same purpose, is the typical way of deciding whether there is a benefit to using bioenergy. The impact of both the fossil and bio energy is carried out using LCA as set out in the 14040 series of ISO standards.

The most applicable assessment method for Irish bioenergy is the method set out in the existing and proposed recast RED. The RED GHG reporting methodology is a partial LCA methodology and is compliant with the ISO 14040 series of standards. The aim is to enable meaningful reporting of GHG emissions without it being overly onerous. The methodology is regularly revised in response to the availability of information and scientific understanding. It includes process emissions from cradle to grave, nitrous oxide emissions from soil as well as GHG emissions and removals arising from land use change and improved agricultural management.

The Joint Research Centre[4] is responsible for developing the RED GHG reporting methodology and the calculation of the typical and default GHG values contained in the RED annexes. These are subject to periodic revision. The most recent revision was issued in July 2017 and has not been incorporated in the case studies presented here. The datasets are subject to further revision and as the results are indicative in any case, the impact of the dataset changes is minor.

[4] https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/definition-input-data-assess-ghg-default-emissions-biofuels-eu-legislation-version-1c-july

3 Policy Context

3.1 Carbon Neutrality

Carbon neutrality is a term generally used to refer to the achievement of zero net carbon emissions by compensating for GHG emissions with an equivalent amount of sequestration or offsetting. Biomass may be considered to be carbon neutral as the carbon it contains and which is released when burnt, has recently been absorbed from the atmosphere and so may be considered to be part of the global cycle of biogenic carbon and have no overall effect on the amount of atmospheric carbon dioxide in circulation. Fossil fuels however, contain carbon which has been locked up underground for millions of years and burning them is considered to increase the level of carbon dioxide in the atmosphere and this is not balanced out by photosynthesis.

3.1.1 Bioenergy and Carbon Neutrality

The term carbon neutrality, used with respect to bioenergy, may cause confusion and misunderstanding. Bioenergy, though based on biomass, cannot be universally assumed to be carbon neutral. If the biomass in question would otherwise decompose, no process or transport energy is used, there is no change in land use and the biomass burnt is replaced on a one for one basis, then the carbon dioxide released in energy production may be recaptured and the bioenergy may be carbon neutral. However, if these assumptions don't hold true, as is most often the case in current practice, then energy from biomass may not be carbon neutral.

There are many sources and forms of bioenergy leading to great variation in the supply chain. Energy used in the supply chain may have a significant effect on the carbon emissions attributable to bioenergy. Fossil energy may be used in land preparation, management, harvesting, transport and conversion processes. The magnitude and significance of these emissions will vary depending on the type of bioenergy and the processes involved. Coal, if used for drying biomass, and electricity for pelletisation, if largely derived from fossil fuels, may be major sources of GHG emissions from processing.

3.1.2 Land Use Change Effect

Replacing by replanting or natural regeneration the biomass used for energy, may eventually recapture the carbon dioxide released. However, how long this takes will depend on what type of biomass it is. It may be immediate or take several decades. It can be argued that changing from growing an annual food crop to a perennial bioenergy crop, direct land use change (LUC), will result in a reduction in atmospheric carbon dioxide. The positive effect will be the longer-term sequestration of carbon by the bioenergy crop compared to the annual food crop, however, the loss of land for growing food may result in forest land elsewhere being converted to cropland, which is an indirect land use change (ILUC). This may cause deleterious changes in the carbon stock and potentially lead to the release of more carbon into the atmosphere than that sequestered by the bioenergy crop. Land use, land-use change and forestry (LULUCF)[5] is an inventory sector defined by the Intergovernmental Panel on Climate Change (IPCC) that covers anthropogenic emissions and removals of GHGs resulting from changes in terrestrial carbon stocks. It covers the carbon in living biomass (above and below ground), dead organic matter (dead wood and litter) and organic soil carbon for specified land categories (forest land, cropland, grassland, wetland, urban land and other land).

3.1.3 Carbon Neutrality and Climate Change

Fossil carbon dioxide emissions arising in the supply chain may be offset by planting more trees or removed through carbon capture and sequestration (CCS). However, there are other GHGs associated with fossil and bioenergy, particularly methane (CH_4) and nitrous oxide (N_2O). These gases also need to be taken into account when considering the effect of energy use on climate change. Methane has a GWP of roughly 25 times that of carbon dioxide and nitrous oxide around 300 times[6]. Methane may come from the incomplete combustion of both fossil and bio fuels. If nitrogen fertilisers are used to produce a bioenergy crop, then not only is the production of the fertilisers, such as ammonium nitrate, energy intensive and the associated emissions

[5] https://www.ipcc.ch/ipccreports/sres/land_use/index.php?idp=294

[6] IPCC Fourth Assessment Report: Climate Change 2007 2.10.2 Direct Global Warming Potentials https://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html

attributable to the biofuel, but application to the land causes the release of nitrous oxide, a much more powerful GHG than carbon dioxide.

3.2 Proposed EU RED Sustainability Criteria

IrBEA members are primarily concerned with EU sustainability criteria, and the need for compliance with GHG reduction targets for bioenergy pathways proposed under the recast Renewable Energy Directive (RED) for solid and gaseous bioenergy applications.

IrBEA and other stakeholders are also interested in certification of gaseous bioenergy for trading purposes (e.g. MWh of verified biomethane injected into the grid). This is not a primary consideration of this current project or the RED sustainability criteria.

The primary changes proposed under the recast RED are as follows:

- Article 26 of RED extends the existing EU sustainability criteria for bioenergy to cover biomass and biogas for heating and cooling and electricity generation.
- Article 27 provides a clarification on the mass balance system and adaption to cover biogas co-digestion and injection of biomethane in the natural gas grid.
- A new risk-based sustainability criterion for forest biomass is introduced, as well as LULUCF[7] requirement for carbon accounting of carbon impacts of forest biomass used in energy generation.
- The GHG saving performance requirement applying to biofuels is increased to 70% for new plants from 1/1/21. A 50% threshold will apply for installations commissioned on or before 5/10/15. A 60% threshold is to apply for units commissioned between 5/10/15 and 1/1/21.
- An 80% GHG saving requirement is applied to biomass-based heating/cooling and electricity after 1/1/21. This increases to 85% for operations starting after 1/1/26.
- The proposed sustainability and greenhouse gas saving criteria do not apply to small biomass-based heating/cooling and electricity installations, with a fuel capacity below 20 MW. Member States can set lower thresholds if they wish.
- The threshold for application of sustainability criteria and GHG savings to gaseous fuels is proposed at 0.5MW or above electrical capacity. Member States can set lower thresholds if they wish.
- A revised Annex V includes updated default values for biofuels and bioliquids.
- A new Annex VI is added to include a common greenhouse gas accounting methodology for biomass fuels for heat and power, including default values.
- Article 7 sets Member States a decreasing maximum permissible share of biofuels and bioliquids produced from food or feed crops starting from 2021, with the aim to address ILUC (Indirect land use change) emissions.
- Article 25 mandates increasing yearly target for advanced biofuels, and their contribution to reach at least 3.6% of overall fuel supply by 2030.
- In Annex IX the feedstocks (mainly for advanced biofuels) which should be considered for meeting the new fuel-suppliers' obligation target are listed. New to the list in Part B is molasses. Every two years the Commission shall evaluate the feedstocks allowing for the possibility to add but not remove feedstocks from the list.
- A minimum market obligation of 6.8% "low-emission and renewable fuel" by 2030 is placed on all fuel suppliers (currently part of the Fuel Quality Directive[8]).
- The introduction of national databases for traceability of fuels and to mitigate the risk of fraud.

[7] Land use, land-use change and forestry (LULUCF) is defined by the United Nations Climate Change Secretariat as a "greenhouse gas inventory sector that covers emissions and removals of greenhouse gases resulting from direct human-induced land use, land-use change and forestry activities."

[8] Directive 2009/30/EC "... as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions..."

These proposals have not been passed by the EU parliament and are subject to ongoing redrafting and possible amendments by EU parliament committees including the Environment, Public Health and Food Safety Committee (ENVI).

3.2.1 AEBIOM View

The European Biomass Association (AEBIOM) of which IrBEA Is a member has set out a position[9] on the current RED draft.

Of note is the request to keep the GHG threshold at 70% for both biofuels and biomass-based heating/cooling and electricity. This would allow a default-based compliance method for most pathways, rather than a costly actual GHG calculation and audit. It would also mean consistency across feedstocks for both transport and electricity/heating/cooling applications.

AEBIOM is also of the view that sustainability rules should be harmonised at EU level with no possibility to define additional national criteria, and that these rules should be set for the period 2020-2030. This is to give reasonable certainty and confidence to economic operators in the bioenergy sector.

AEBIOM agrees that the 20MW fuel-capacity threshold proposed for solid biomass would capture most of the solid biomass supply chain across the EU. Its' research data indicates that this threshold would encompass 12% of EU installations, but these consume 80% of total biomass.

3.2.2 EBA View

The European Biogas Association (EBA) of which IrBEA is a member has also set out a position[10] in relation to biogas and the RED draft.

EBA disagrees that the 0.5MW electrical capacity threshold proposed for gaseous biomass fuels is appropriate. EBA advances that it should be redefined as a 2MW fuel capacity threshold.

The rationale for the lower threshold is that it avoids putting a disproportionate burden on small producers, most of them being farmers or cooperatives of farmers; and that the potential impacts to sustainability from small plants are low, as their total combined production is small.

The rationale for changing from a threshold based on electrical capacity to one based on fuel capacity is that it will not put operators with flexibility to opt for either electricity or biomethane grid injection at a disadvantage compared to plants with no gas upgrading.

EBA also suggests that the eventual target of 85% GHG reduction will exclude some promising production pathways, and that the targets should commence at 70%, as for transport biofuels and increase in line with an innovation curve that improves over time. The rationale here is that the industry is going from no GHG reduction requirements to 80% in one move; and that having this high a threshold will be a major barrier for solid biomass gasification pathways.

Further feedback of note by EBA is that the limited number of default pathways (3) in Annex VI of the RED is not sufficient; that there are a lot more pathways and that the onus should not be placed on small industries to develop their own GHG calculations for different pathways.

3.2.3 Implementation at National Level

It is unclear at this point how different aspects of the recast RED will be transposed into national legislation, and what that means specifically for sustainability criteria.

The Department of Communications, Climate Action and Environment (DCCAE) is expected to be the lead actor, but RED implementation cuts across many other arms of government and state agencies. DCCAE

[9] http://www.aebiom.org/wp-content/uploads/2017/07/11-points-to-ensure-a-sustainable-future-for-bioenergy.pdf

[10] http://european-biogas.eu/wp-content/uploads/2017/06/EBA-position-on-biomass-sustainability-in-Renewable-Energy-Directive_ENVI-1.pdf

develops bioenergy strategy, including its role within future delivery of renewable heat and renewable electricity.

SEAI is expected to be the implementing body for RHI, but it is not known if that will extend to GHG reduction certification.

The EPA is the Competent Authority for GHG permitting under the Emissions Trading Scheme (ETS) in Ireland. This has some similarities to the requirements under RED, and the same threshold – i.e. all combustion installations above 20MWth and there would be obvious synergies for solid biomass installations.

The precedent with transport biofuels is that Irish operators have relied on voluntary EU certification schemes outside Ireland, by either national government agencies, industry associations or other adhoc groups. NORA is the state agency responsible for registration of sustainable biofuels placed on the Irish market, see below.

Brexit (the UK departure from the EU) also has an impact on the implementation of RED. Many bioenergy products are supplied via UK ports. The precedent for transport biofuels has been to integrate the UK and Irish implementation of sustainability quite closely (c.f. below joint development of the UK and Ireland Carbon Calculator). There is also a possibility to harmonise the UK and Irish schemes for solid biofuel supply. With the emergence of Brexit, the future harmonisation of UK schemes with EU legislation is one of many uncertain aspects looking forward. It is prudent to ensure closer integration of any national initiatives with EU-led voluntary schemes.

3.3 The Role of Bioenergy in GHG Mitigation

The impact of bioenergy on GHG mitigation is not straight forward. Generally speaking, if compared to the fossil energy equivalent, then there are GHG savings associated with using bioenergy. However, it is unwise to assume that all bioenergy systems are beneficial and it essential that any proposed project is assessed using appropriate LCA. LCA can inform process choices and help to ensure the best possible options are selected. It has to be stressed that GHG savings for bioenergy are context and feedstock specific. This is because many factors vary from place to place and at different points in time.

A quantitative assessment of the impacts on GHG emissions associated with six scenarios for the supply and consumption of biomass for energy within the EU region, undertaken by Matthews et al 2015[11] , concluded that the contributions made by bioenergy towards net GHG emissions savings in 2030 is generally beneficial. However, the detailed contributions are variable, depending on the scenario. The contribution of bioenergy towards GHG emissions savings is higher for scenarios emphasising bioenergy supply from domestic sources and lower for scenarios emphasising consumption of imported forest bioenergy and/or the relatively unconstrained use of bioenergy sources.

The study considered:

- Changes in carbon sequestration (increases or decreases over time) on agricultural land and in forest areas, due to the production of additional bioenergy
- Biogenic carbon emissions and indirect GHG emissions due to the combustion of the bioenergy
- Emissions avoided due to displacement of counterfactual energy sources
- Changes in GHG emissions (increases or decreases) due to the diversion of certain agricultural biomass sources from non-energy uses to use as bioenergy
- Changes in GHG emissions (increases or decreases) due to the diversion of wood from use for material wood products, to use instead as forest bioenergy, including impacts on GHG emissions occurring when materials are disposed of at end of life
- Changes in GHG emissions (increases or decreases) due to any co-production of additional material wood products in conjunction with the supply of the additional forest bioenergy, including the displacement of counterfactual materials and impacts on GHG emissions occurring when materials are disposed of at end of life.

[11] Matthews et al, 2015, Carbon impacts of biomass consumed in the EU: quantitative assessment Final report, project: DG ENER/C1/427 Part A: Main Report

The purpose of the study being to inform EU bioenergy policy means the LCA methodology adopted in this study is considerably different from that adopted in the RED. The RED approach is designed for ease of reporting (attributional LCA) and takes into account only a limited range of factors whereas a more comprehensive approach (consequential LCA) is necessary for informed policy making. Hence the results for GHG savings for different bioenergy pathways may not be the same for both methods.

There are further factors affecting climate change such as albedo, ozone precursors, aerosols and black carbon which may be taken into account when assessing bioenergy for global warming impacts for policy development[12]. Over time, scientific understanding changes and more or different factors may be taken into consideration. It is therefore necessary to be aware of the goal and scope of the assessment, the time period and location to fully understand the outcomes of an assessment. Justification of choices and transparency are key requirements in LCA.

[12] Berndes et al, 2016, Forest biomass, carbon neutrality and climate change mitigation, From Science to Policy

4 Biomass Sustainability within Irish National Policy

The biomass sector is in a state of change in Ireland. There has been limited development of the sector since 2008. At present, there are consultations ongoing regarding future support mechanisms for both RES-E and RES-H.

4.1 Sustainability and a Renewable Heat Incentive

A Renewable Heat Incentive (RHI) is proposed for renewable heating solutions which is widely expected to incentivise biomass heating, and biomethane production for grid injection, as well as other renewable heating technologies.

UK RHI Sustainability

In the UK RHI scheme, sustainability requirements were introduced from 5/10/15. From this point onwards, any RHI accredited project involving the generation of heat (or heat and power) from biomass or biogas were required to meet a minimum GHG emissions limit and specific land criteria.

Suppliers must demonstrate that the greenhouse gas emissions generated from the cultivation, processing and transport of their biomass fuel are at least 60% lower than the EU fossil fuel average for heat, when used in a boiler which achieves an average of 70% seasonal efficiency. The emissions limit is ≤34.8g CO2 per MJ.

There is an additional requirement for independent audit if the installation size is > 1 MW_{th}, whereas self-declaration is accepted below this.

There are two schemes approved by the Department for Business, Energy and Industrial Strategy (BEIS) for biomass suppliers to demonstrate compliance with (national) sustainability criteria:

Sustainable Fuel Register (SFR) www.sfregister.org – mainly for non-wood biomass feedstocks

Biomass Suppliers List (BSP) biomass-suppliers-list.service.gov.uk – for woody biomass feedstocks

It is not known what the thresholds for the RHI support scheme may be, or indeed if they will be banded in terms of MW, or MWh.

It is not known what sustainability criteria over-and-above the EU RED proposals, if any, are to be included. If the 20MW_{th} threshold for solid biomass is applied, then the number of solid biomass installations impacted is expected to be low (<5 installations).

One of the design options considered in the second round consultation paper[13] was "Differentiation of tariffs for biomass technologies based on the sustainability of the biomass fuel used". An option also being considered is to adopt an approach like the UK (See inserts on UK RHI Sustainability and the UK RO scheme).

For grid injection of biomethane, it is not decided finally how this might be implemented in practice. Apart from meeting sustainability criteria and EU RED compliance, it is expected that there will be a practical commercial requirement for GOO (Guarantee of Origin) certification, which can be aligned with assessment of GHG reduction for RED compliance.

(See below on Green Gas certification project).

4.2 Sustainability and a Future RES-E Support

The DCCAE held a first-round consultation for RES-E supports in July 2015[14]. A further consultation round is pending.

[13] http://www.dccae.gov.ie/en-ie/energy/consultations/Pages/Renewable-Heat-Incentive-Consultation.aspx

There is no consideration of sustainability in the document, or the suggested consultation questions. It is clear however that the definition of renewable electricity would be aligned with the RED requirements, and that at a minimum, RED sustainability criteria would apply.

The consultation relies on the 2014 Draft Bioenergy Plan[15] to provide direction on biomass for electricity, and makes reference to the plan as follows:

"The draft Bioenergy Plan notes that biomass will continue to play a role in electricity generation but is expected to make a more significant contribution to the heat and transport sectors. The role of biomass in electricity generation will need to be considered in the development of this support scheme."

The Draft Bioenergy Plan predates the EU Commission making any concrete proposals on sustainability criteria for solid or gaseous biomass, and so is not considered within the initial development of the RES-E supports.

4.3 Green Gas Certification Project

The Green Gas Cert project was launched in April 2017 and is being developed by a team lead by the IERC (International Energy Research Centre), with support from stakeholders including the Renewable Gas Forum Ireland (www.renewablegasforum.com), the German Biogas Research centre and others. IrBEA is a member of the Renewable Gas Forum Ireland and a stakeholder in this project.

The main purpose is:

- To develop a biogas registry for energy transactions
- To certify biogas as eligible for the registry (i.e. via GOO or guarantee of origin certification)
- To develop a methodology for GHG emissions reductions calculation tailored for Ireland

Much of the work is based on the successful experience in Germany, see www.biogasregister.de .

More information about the project is available at www.greengascert.ie.

4.4 CER Requirements

To build and/or to operate, a generation project must hold an Authorisation to Construct or Reconstruct a Generating Station and/or a Licence to Generate Electricity. The CER is responsible for assessing and for granting or refusing to grant these licences. The conditions imposed in the Authorisation and in the Licence to Generate must be met by the generator and compliance is monitored by the CER on an ongoing basis.

The CER may request additional environmental information as explained in the guidance[16]:

"We also have environmental responsibilities. However, it is anticipated that compliance with planning permissions as granted by local authorities and IPC licence requirements as issued by the Environment Protection Agency will in most cases be sufficient. During our assessment of your application, you may be required to

UK RO Sustainability

Generators >50kW participating in the UK Renewable Obligation (RO) scheme are required since 1/12/15 to prepare an annual sustainability report which is compiled by a third-party auditor/verifier in accordance with ISAE 3000 or equivalent standard.

There are two tools available to download from Ofgem's website (www.ofgem.gov.uk) which will help the operator with the GHG emission calculations: the UK Bioliquid Carbon Calculator (for bioliquid supply chains) and the UK Biomass and Biogas Carbon Calculator (for solid biomass and biogas supply chains)

[14] http://www.dccae.gov.ie/en-ie/energy/consultations/Pages/Renewable-Electricity-Support-Scheme-Consultation.aspx

[15] http://www.dccae.gov.ie/en-ie/energy/topics/Renewable-Energy/bio-energy/Pages/Bio-Energy.aspx

[16] CER 12043; Application for an Authorisation to Construct or Reconstruct a Generating Station, Guidance Notes for Applicants; version 8

submit additional information."

Some stakeholders have been asked to supply evidence of GHG reduction versus fossil fuel in their proposed solid biomass supply chain. The licensing process applies only above 1MWe, so this is not a consideration for smaller-scale biogas plants.

Further information on the process and license holders is available at: http://www.cer.ie/electricity-gas/electricity/licences

4.5 Other Planning/Licensing Requirements

The EPA is generally responsible for licensing and enforcement of emissions legislation in Ireland.

GHG permits are issued to larger industrial sites, with a rated capacity of 20MWth or above to enable participation in the EU Emissions Trading Scheme (ETS)[17]. The methodology for assessing GHG emissions is limited to carbon dioxide emissions associated with fossil fuel, and does not include LCA of a combustion plant that would be compatible with RED II.

The Industrial Emissions Directive (IED) legislation[18] is primarily concerned with SOx, NOx and dust emissions from larger scale combustion plants >50MWth.

The Medium Combustion Plant (MCP) Directive[19] regulates emissions of sulphur dioxide (SO2), nitrogen oxides (NOx) and dust from the combustion of fuels in plants with a rated thermal input equal to or greater than 1 MWth and less than 50 MWth.

Local Authorities may either expect or request an assessment of GHG reductions in relation to a planning application, or any Environmental Impact Assessment (EIA) that may accompany same. The requirement for this and the level of detail considered would depend very much on the feedstock source and type. As the recast RED criteria become applicable, it is likely to become a material planning consideration.

4.6 NORA and the Biofuel Obligation Scheme Sustainability

The National Oil Reserves Agency (NORA, see www.nora.ie) administer the biofuels obligation scheme. They require oil suppliers in Ireland to provide sustainability certification for any biofuel placed on the market, and require producers of biofuel to provide evidence of certification of their production process.

In 2015 NORA decided to integrate the reporting procedures with the UK Renewable Transport Fuel Obligation (RTFO) and specifically to implement an updated "UK and Ireland Carbon Calculator" which was developed by the RTFO and E4tech.

A detailed guidance for sustainability reporting procedures has been produced, and is available at http://www.nora.ie/_fileupload/457-X0070%20Guidance%20January%202017.pdf.

[17] http://www.epa.ie/climate/emissionstradingoverview/etscheme/
[18] http://www.epa.ie/licensing/industrialemissionslicensing/
[19] Directive (EU) 2015/2193

5 Voluntary RED Certification Schemes

There are currently 16 different voluntary GHG certification schemes recognised by the EU commission, which are primarily focussed on certification under existing RED requirements for transport biofuels.

A full list is available at http://ec.europa.eu/energy/en/topics/renewable-energy/biofuels/voluntary-schemes

An investigation of certification bodies shows that there are few if any Irish stakeholders verifying or auditing biofuel or biomass supply chain participants for GHG emissions presently. Most of the verifiers/auditors are global verification providers.

For subsequent certification and publication, most Irish operators are using the ISCC (see below) and some are also using REDCert (See below). A summary of the most prominent voluntary certification schemes and their application to-date in Ireland is given below. The Sustainable Biomass Partnership (SBP) is not currently a recognised voluntary scheme but also included due to the interest of Irish stakeholders in this particular scheme.

5.1 BioGrace

Both BioGrace[20] I and BioGrace II were co-funded by the Intelligent Energy Europe (IEE) programme. The main project purpose was to develop user-friendly tools for the calculation of GHG emissions, in compliance with RED. BioGrace I applies to liquid biofuels and bioliquids. BioGrace II applies to solid and gaseous biomass for electricity, heating or cooling applications.

Currently the BioGrace voluntary scheme is managed by the Institute for Energy and Environmental Research (IFEU), one of the former project partners. The EU commission recognition of BioGrace as a voluntary RED-compliant certification scheme is valid for a 5-year-period, that is until June 2018.

There is no process within the BioGrace scheme for generating a certificate or a register where RED compliance certificates are published. There is also no obligation for the original BioGrace consortia to fund and maintain the tools, particularly as the RED evolves and adapts to future market requirements. For this reason in practical terms it is a very helpful calculation tool, which would need to be subsequently verified by a certification body.

It has a valuable role for operators to sense check their biomass fuels and prepare information for a GHG audit. It may help reduce the admin and cost burden of subsequent RED certification. It is helpful for assessing potential policy impact of RED-compliance and used by IrBEA for this current analysis.

5.2 ISCC

International Sustainability and Carbon Certification (ISCC) is a global sustainability certification scheme. A certification body would typically use the ISCC repository to publish a record of a valid compliance certificate.

This is primarily used for RED compliance within the EU. It is the leading choice for Irish entities involved in biofuels production or supply of raw materials for biofuel production at present. There are 15 valid certificates (as of 10/7/17) in ROI or Northern Ireland. See Appendix 1 for an extract from the ISCC database.

Most certificates are based on default GHG calculations based on RED. Carbery Food Ingredients' is one example of an exception to this – their certification is based on actual GHG calculations.

A certificate does not publish actual GHG reduction values, but simply verifies compliance with RED.

As all the certified entities are using residues, they would typically meet the 35% GHG reduction requirement with ease, and should be well placed to meet more demanding GHG reduction targets of 50% (for existing plant) or 60% (for new plant) from 1/1/18.

[20] http://www.biograce.net/

5.3 REDCert

REDcert was founded in 2010 by leading associations and organizations in the German agricultural and biofuel sector and approved as a certification system on by the Federal Agency for Agriculture and Food (Bundesanstalt für Landwirtschaft und Ernährung – BLE) to fulfil the requirements of the German Biomass Sustainability Ordinances.

In 2012 the activities were expanded to cover the EU RED requirements for biofuels, and RED Cert is a recognised voluntary scheme by the EU Commission. More details can be found at https://www.redcert.org/en/redcert-eu-uk.html.

There are 2 valid certificates issued for operators in ROI and none in Northern Ireland as of 10/7/17. Both of the certificated sites are at the same location, but cover different activities. Athnua Ltd is a "First Gathering Point" and Pure Oil is certified for waste collection and treatment of oils/fats. See Appendix 2 for extract of RED C database.

5.4 2BSVS

2BSVS[21] was established by operators in the French biofuel industry to develop GHG calculation tools and a certification repository for compliance with RED. It is a widely recognised scheme, with currently 577 certificates published mainly for French and southern European entities.

Approved subscribers can access standard excel templates for calculation of GHG emissions from individual biofuel production pathways.

There are no Irish entities certified under the 2BSVS scheme.

5.5 Sustainable Biomass Partnership

The Sustainable Biomass Partnership (SBP)[22] is not a recognised voluntary scheme under the current RED but also included due to the interest of Irish stakeholders in this particular scheme, and the likelihood of the SBP and other schemes becoming compliant under future RED requirements.

The origins of the SBP are as an industry-led scheme developed by major European power producers: DONG Energy, Drax, E.ON, ENGIE (formerly GDF SUEZ), RWE, Vattenfall and HOFOR. There are no Irish certified bodies as yet, but the recently announced Bord na Mona Bioenergy. Bord na Mona Bioenergy is expected to be a biomass supplier of some scale, is working closely with one of the first and leading certification providers for the SBP, Nepcon[23].

6 Likely Impact on Irish Bioenergy Pathways

There is no unique Irish bioenergy pathway or technology that cannot be deployed in another EU country.

Particularly in relation to solid biomass, it is a tradable commodity that can be imported or exported. In an open economy such as the Irish one and as part of the EU single market, all pathways must remain open to market actors, provided the sustainability criteria are complied with.

It has been seen already from the certification of transport biofuels that production facilities and feedstock suppliers/traders require full harmonisation and ease of trading with other EU countries.

Still there are certain feedstocks and pathways that will be of relevance for Irish production facilities, and the purpose here is to comment on those likely pathways and how they are treated under the proposed default RED GHG reduction targets.

Example pathways are also prepared using the most recent Biograce II tool and updated input data. The most up to date version of Biograce II input data is the additional data available in version 4d, which was issued in

[21] https://en.2bsvs.org/
[22] https://sbp-cert.org/
[23] www.nepcon.org

April 2015[24]. These example pathways do not include therefore any revisions by the Joint Research Committee to default values issued since 2015.

These pathways are intended to be indicative in any case and for use as a support for policy and awareness-raising. They are not suitable to be used for any certification purpose.

6.1 Solid Biomass Fuel Pathways

There is a matrix of default values for solid biomass fuel pathways given in the Annexes to the draft RED.

There are a few short rotation coppice (SRC) crops assessed, including poplar and eucalyptus, which are not common pathways in the Irish context. Willow coppice is not included, which has historically been the SRC crop planted to-date.

Other feedstocks of Irish interest are not assigned default pathways, such as chicken litter or spent mushroom compost. These may fall under one of the agri-residues categories, but it seems likely that the specific supply paths of these fuels have to be calculated.

The typical and default values for the most relevant Irish pathways (for domestic fuels) have been extracted from the draft RED for information (see Table below).

The most likely scenario in an Irish context is the following subset of Annex VI default values:

- **Case 2:** refers to processes in which a boiler fuelled with wood chips is used to provide the process heat to the pellet mill. Process electricity is purchased from the grid.
- **Case 3:** refers to processes in which a CHP, fuelled with wood chips, is used to provide heat and power to the pellet mill.
- **1 to 500 km transport distance:** This covers anywhere in Ireland and many parts of the UK

Table 1: Woody Biomass Fuels GHG Emissions in Likely Irish Pathways

Biomass fuel production system	Transport distance	GHG emissions (gCO2 eq./MJ)	
		Typical	Default
Woodchips from forest residues	1 to 500 km	5	6
Woodchips from industry residues	1 to 500 km	4	5
Wood briquettes or pellets from forest residues (case 2)	1 to 500 km	16	19
Wood briquettes or pellets from forest residues (case 3)	1 to 500 km	6	7
Wood briquettes or pellets from wood industry residues (case 2)	1 to 500 km	9	11
Wood briquettes or pellets from wood industry residues (case 3)	1 to 500 km	3	4

Table 2: Agri Residues GHG Emissions in Likely Irish Pathways

Biomass fuel production system	Transport distance	GHG emissions (gCO2 eq./MJ)	
		Typical	Default
Agricultural Residues with density <0.2 t/m3	1 to 500 km	4	4
Agricultural Residues with density > 0.2 t/m3	1 to 500 km	4	4
Straw pellets	1 to 500 km	8	10

[24] http://www.biograce.net/img/files/2015-05-26-115740BioGrace-I_GHG_calculation_tool_-_Changes_from_version_4c_to_version_4d.pdf

The default values above only include the fuel up to point of supply. The draft RED requirement is to consider the efficiency in use i.e. the combustion process, in addition to the fuel production system.

Excluding the efficiency in use, it is apparent that the default values will allow almost all heating applications to comply easily with the draft RED requirements (80% reduction by 2021 and 85% by 2026).

An exception is the pathway of wood briquettes or pellets (case 2), where electricity is imported from the grid. The use of actual values would be required to show the impact of sourcing electricity from the Irish grid on the actual gCO_2eq/MJ. The 2012 data used in BioGrace version 4d gives a GHG intensity for electricity in Ireland which is 12% higher than the EU28 average, so the Irish pathway in this case would be slightly higher than the default.

6.1.1 Example Pathway Using BioGrace II

The BioGrace II tool has been used to consider a typical Irish scenario, where wood chip is sourced from forest residues and chipped for direct use in a 1MW biomass boiler for space heating purposes.

The result of this calculation are included as Appendix 4 based on the BioGrace II template.

Main assumptions:

- Transport distance 1-500km (used 300km)
- Thermal efficiency 90%
- Useful heat supply 80^{o}C
- Moisture content 50% (wet basis)

The results show that this typical pathway will easily comply with the requirement to decrease GHG emissions by >85% versus the fossil fuel heating comparator.

Main results:

- 5.3 gCO_2eq/MJ of forest residue chips
- 5.9 gCO_2eq/MJ heat generated
- 93% reduction in GHG versus the fossil fuel comparator (80 gCO_2eq/MJ heat)

These results are illustrative only. It can be expected that such a scenario would apply default values (6 gCO_2eq/MJ of forest residue chips) to demonstrate RED compliance.

Any actual values calculated would be subject to more detailed individual case assessment that may vary from the default JRC assumptions, considering inter alia: the amount of diesel required for forest residue collection and chipping; the actual transport distance for forest residues and chipped wood fuel; loss of material in handling, seasoning or chipping etc..

6.2 Biogas to Electricity Pathways

There is a matrix of default values for biogas to electricity pathways given in the Annexes to the draft RED. Compliance with RED and calculation of GHG reductions is substantially simplified for operators that can apply default scenarios and default values to their process.

The typical and default values for the most relevant Irish pathways have been extracted (see Table below) and some analysis on the potential compliance with RED requirements based on default calculations is carried out.

Grass silage is a relevant biogas feedstock in the Irish context for which default values are not currently provided. The default feedstocks for which values are provided include wet manure, whole maize crop and biowaste.

The most likely scenario in an Irish context is the following subset of Annex VI default values:

- **Case 2:** refers to pathways in which the electricity required in the process is taken from the grid and the process heat is supplied by the CHP engine itself. This is based on the precedent under REFIT 3,

where the gross production is exported to the grid and subsidized.

- **Close digestate:** All of the plants in Ireland to-date are closed tank digestate storage
- **Feedstock:** several existing and proposed installations in Ireland involve codigestion of biowaste and wet farm manure

Table 3: Default Values - Biogas for Electricity (From RED Annex VI)

Biogas Production System	Technological option		% reduction Default vs fossil electricity
Electricity from wet manure	Case 2	Close digestate	219%
Electricity from biowaste	Case 2	Close digestate	68%

Table 4: Fossil Fuel Comparators (from draft RED Annex V)

Fossil Fuel Comparator for electricity (g CO2eq/MJ)	183
Fossil Fuel Comparator for heat (g CO2eq/MJ)	80

The fossil fuel comparator is a critical variable for setting GHG reduction targets. The FFCs in RED Annex V are based on the methodology in a 2014 EU commission publication[25]. For electricity, the FFC was based on the following power mix: 50% natural gas fired CCGT plants (with gas sourced from a mixture of sources, from short/long distance as well as LNG), 25% coal fired IGCC plants, and 25% conventional coal. For heat, the FFC was based on natural gas, as this is likely to remain the dominant fossil source of heat in the EU up to 2020.

The reductions in GHG emissions associated with likely Irish scenarios suggest that Irish operators who produce electricity or CHP from either manure, or a mix of manure and biowaste will have little difficulty complying with the initial 80%, or the 85% GHG reduction threshold proposed under RED.

The default values for biogas for electricity (From RED Annex VI) are shown in the table above. It is noteworthy that the use of wet manure entails a GHG credit which will ensure the threshold values are easily met if that is the predominant feedstock. If biowaste only is used for electricity (no CHP) then the 68% default value will not be compliant with GHG criteria under the recast RED.

In practice, very few plants will use either wet manure or biowaste exclusively, and will have to carry out a mass balance and allocate GHG emissions to their feedstock mix. For CHP plants, the allocation of emissions to the useful heat offtake will also have to be taken account of.

6.2.1 Example Pathway Using BioGrace II

The BioGrace II tool has been used to consider an example Irish scenario where co-digestion of farm manure and biowaste occurs to produce heat and electricity in a CHP engine.

The result of this calculation are included as Appendix 5 based on the BioGrace II template.

The following main assumptions have been made:

[25] Staff Working Document SWD(2014) 259; State of play on the sustainability of solid and gaseous biomass used for electricity, heating and cooling in the EU

- 5,000 t/year of wet manure at average moisture content of 94%
- 5,000 t/year of biowaste at average moisture content of 75%
- Transport distance 50km per 40 t truck for all feedstocks
- Closed digestate storage tank(s)
- CHP 33% electrical efficiency; 40% thermal efficiency
- Specific biogas yield 0.6 MJ Biogas/MJ input

The results show that this typical pathway will comply with the requirement to decrease GHG emissions by >85% versus the separate fossil fuel comparators for heat and electricity.

Main results:

- 10.1 gCO_2eq/MJ of biogas produced (including from the fuel in use)
- 26.8 gCO_2eq/MJ electricity generated
- 85% reduction in GHG versus the electricity fossil fuel comparator (183 gCO_2eq/MJ electricity)
- 9.5 gCO_2eq/MJ heat generated
- 88% reduction in GHG versus the heating fossil fuel comparator (80 gCO_2eq/MJ heat)

These results are illustrative only. With conservative assumptions around transport, moisture content and biogas yield, it is possible to achieve compliance with draft RED sustainability criteria.

In this co-digestion example, it is necessary to carry out actual calculations, as the default based on biowaste alone would only have a 68% default GHG reduction value.

Any actual values calculated would be subject to more detailed individual case assessment that may vary from the default assumptions, considering inter alia: the amount of diesel required for transport of feedstocks; the allocation between heat/electricity, assuming a useful heat load; changes to the efficiency of anaerobic digestion; variations in feedstock type and composition etc..

6.3 Transport Biofuel Pathways

The focus of IrBEA stakeholder consultations has not been on transport biofuel, as the existing requirements under RED are already known and implemented where applicable (c.f. certified parties in Appendices 1 & 2).

At present the EU Fuel Quality Directive (FQD)[26] is a primary driver of sustainability assessment using LCA methods in the fuel sector. The FQD requires a reduction of the greenhouse gas intensity of the fuels used in vehicles by 6 % by 2020. This target is likely to be achieved through the use of biofuels, electricity, the use of less carbon intense, often gaseous, fossil fuels and a reduction of flaring and venting at the extraction stage of fossil fuel feedstocks.

The greenhouse gas intensity of fuels is calculated on a life-cycle basis, meaning that the emissions from the extraction, processing and distribution of fuels are included. Direct life-cycle greenhouse gas emission reductions are calculated from a 2010 baseline of fossil fuel greenhouse gas intensity.

The recast RED is expected to replace the elements of the FQD which consider GHG reduction in the fuel supply chain. The recast RED will place increasing GHG reduction thresholds on both existing and new plant. The existing liquid biofuel production facilities should have little difficulty complying with the proposed 50% threshold for installations commissioned on or before 5/10/15. New projects as they come onstream will have to consider the sustainability of the proposed supply chain as the need arises.

[26] Directive 2009/30/EC ".. as regards the specification of petrol, diesel and gas-oil and introducing a mechanism to monitor and reduce greenhouse gas emissions.."

7 Analysis and Conclusions

LCA is a very useful tool to support environmental aspects of a product, which is defined very broadly to include all manner of services and processes. The main applications of LCA are awareness-raising, product comparisons, product improvement and policy development. The flexibility of the approach to LCA given in the ISO 14040 standard allows an assessment to cover an entire industrial sector or an enterprise as a whole or just a single product or service. In terms of the LCA of bioenergy, the most common approach is to carry out partial LCAs focusing on GHGs, allowing comparison between bioenergy products and the fossil fuel products they are displacing.

Biomass may be carbon neutral, as the carbon it contains and which is released when burnt, has recently been absorbed from the atmosphere and so it is part of the global cycle of biogenic carbon and has no overall effect on the amount of atmospheric carbon dioxide in circulation. However, bioenergy, derived from biomass, cannot be assumed to be carbon neutral. Energy used in the supply chain may have a significant effect on the carbon emissions attributable to bioenergy. In developing new policies and assessing the environmental impact of existing and emerging bioenergy pathways, it is necessary to assess the GHG emissions using an appropriate LCA method to support policy decisions.

The most applicable assessment method for suppliers and users of bioenergy in Ireland is the method set out in the proposed recast RED. The RED GHG reporting methodology is a partial LCA methodology and is compliant with ISO 14040 standards. The aim is to enable meaningful reporting of GHG emissions without it being overly onerous. It is recognised that the methodology will need revising over time in response to the availability of new information and scientific understanding. It includes process emissions from cradle to grave, nitrous oxide emissions from soil as well as GHG emissions and removals arising from land use change and improved agricultural management.

There is a great deal of policy uncertainty for the renewable energy sector at present both at EU level and national level. The recast RED is at an advanced stage of development, but still subject to debate and subsequent change by the EU parliament. The default values for bioenergy products and their fossil fuel comparators are subject to the emergence of new data and supporting analysis from the EU Joint Research Centre. There is also a good deal of uncertainty and flexibility in how particular member states may transpose this into national policy or integrate it into specific policy instruments.

From the stakeholder consultations undertaken, it is apparent that there is a gap in knowledge of the proposed requirements and any potential impacts of the recast RED for the Irish bioenergy sector. The fact that the changes are proposed in 2021 is a short horizon from a policy perspective, but a somewhat distant event from the commercial reality of day to day operations for industry stakeholders. There is not much appetite for navigating the detail of the RED/JRC LCA methodology, or indeed the skills to assess whether it is fit for purpose from a broader policy perspective than RED compliance. The industry is reliant on state bodies such as DCCAE, DAFM, SEAI or the EPA, or independent research groups to fully analyse and assess the sustainability of different forms of bioenergy and to carry out consequential LCA for developing a more complete understanding of the impacts for the Irish bioenergy sector.

There are 17 Irish entities currently certified for RED compliance under the existing criteria, using voluntary certification schemes. These are almost all for originators, collectors, traders and processors of residues for transport biofuel production. The verifiers and/or auditors are mainly global certification service providers, and the voluntary RED compliance scheme of choice so far has been the ISCC. These existing certified operators will have little difficulty continuing to comply with RED under revised criteria, as they are all using residues. The ongoing administration and audit cost burden of compliance is significant and there may be scope for efficiencies by having locally-based GHG verification and audit compliance service providers.

For solid biomass pathways, the 20MW fuel-capacity threshold for application of RED sustainability criteria is only likely to be relevant to a small number of operators in Ireland. There is the possibility to apply a lower threshold in national policies, as for example the 1MW threshold in the UK's Renewable Heat Incentive (RHI). An Irish RHI is under development and the sustainability criteria and other details associated with this are not

in the public domain at the time of writing. Standardised and simplified tools have been developed in the UK for sustainability reporting and compliance, and the possibility exists to adapt this to the Irish context.

The precedent for transport biofuels has been to integrate the UK and Irish implementation of sustainability quite closely exemplified in the joint development of the "UK and Ireland Carbon Calculator". Brexit also has an impact on the implementation of RED. Many bioenergy products are supplied via UK ports and of course Ireland and Northern Ireland share a common electricity market, so collaboration makes sense. However, the future harmonisation of UK schemes with EU legislation is one of many uncertain aspects looking forward. It is prudent to ensure closer integration of any national initiatives with EU-led voluntary schemes.

Until the legislation is final, and there is real industry demand to fund certification requirements, it is not clear which if any of the existing or emerging international certification schemes may be suited to the Irish context. The certification schemes used for existing RED compliance may evolve and meet industry requirements under the recast RED, or new voluntary schemes may emerge such as the Sustainable Biomass Partnership. Biograce II has been used in this analysis as a useful open-source tool for indicative pathway assessment and awareness-raising, but there is no obligation for the original BioGrace consortia to fund and maintain the tools, particularly as the RED evolves and adapts to future market requirements.

Analysis of a typical solid biomass fuel pathway was undertaken, where wood chip is sourced from forest residues and chipped for direct use in a 1MW biomass boiler for space heating purposes. This pathway should easily comply with the proposed requirement to decrease GHG emissions by >85% versus the fossil fuel heating comparator.

The lack of default values for willow short rotation coppice (SRC) in the recast RED is a gap in the Irish context, where willow plantations are an established part of the domestic bioenergy supply chain.

Where biogas is concerned, the proposed threshold of 0.5MW electrical capacity and above means that a majority of existing or planned biogas projects will be impacted, regardless of what further measures transpire in national legislation. IrBEA agrees with the European Biogas Association position that a higher fuel capacity threshold should be set for biogas plants. The lack of default values for grass silage to biogas pathways in the recast RED is a gap in the Irish context.

A national 'GreenGasCert' certification initiative is presently under development, supported by IrBEA and other stakeholders. It is building on the expertise of a similar certification scheme in Germany. This is intended to address a market need for tradable certificates to guarantee the origin of biogas (for example prior to grid injection), but should also separately address the requirement for RED compliance certification of GHG reductions.

Analysis of a typical biogas pathway, where a mix of farm manure and bio-waste are supplied for anaerobic digestion and subsequent supply of heat and electricity, was undertaken. The analysis shows that projects using Irish feedstocks should have little technical difficulty in meeting proposed GHG reduction thresholds. Because of the nature of co-digestion and likely variability from project to project, there are less possibilities to use default values present in the recast RED. Where no default values exist, actual project data verification will be required, leading to a more complex and costly compliance burden.

Appendix 1: Irish Extract of ISCC database

Extract from ISCC database of Irish (ROI & NI) entities with valid certificate of RED compliance (as of 10/7/17).

Certificate Holder	Scope*	Raw Material	Issuing Certification Body
Green Biofuels Ireland Ltd, New Ross, Ireland	BP	UCO, Animal Fat (Cat 1)	ASG
Carbery Food Ingredients, County Cork, Ireland	PO, EP	Food waste	ASG
College Proteins, Nobber, Co. Meath, Ireland	PO	Animal fat (cat 1)	SGS
BioGen Distributors Ltd., Downpatrick Northern Ireland	CP	UCO	SGS
Dublin Products ltd, Dunlavin, Ireland	PO	animal fat/ tallow (Cat 1,2,3)	ASG
Foyle Food Group, Derry, Northern Ireland	PO		GUTCert
Cork Oil Collectors, Co. Cork, Ireland, Ireland	CP	UCO	ASG
Walco Foods, Ballycarnane, Waterford Ireland	CP, TR	UCO, Animal fat (Cat 1,3)	GUTCert
Mitchell Taylor Exports Ltd, Dublin, Ireland	CP	UCO	Scape
Bolton Biofuels Ltd, Co. Kildare, Ireland	TRS		ASG
Natures Oils Ltd, Castledermot Co Kildare, Ireland	CP	UCO	ASG
Galavan Supplements Ltd, Clonroche, Ireland	CP, TR	UCO, FFAs (rape, soy)	Scape
Linergy Ltd, Dungannon, Northern Ireland	PO	Animal fat (Cat 1)	SGS
Anglo Beef Processors Ireland, Waterford, Ireland	PO	Animal fat (Cat 1)	SGS
Irish Biofuels Production Ltd, Wicklow, Ireland	BP	UCO, Animal Fat (Cat 1)	SGS

* BP = Biodiesel plant, CP = Collecting Point (for waste/residue material not grown/harvested on farms/plantations), EP = Ethanol plant, PO = Point of Origin, TR = Trader, TRS = Trader with storage

Appendix 2: Irish Extract of RED C certification database

Extract from RED C database of Irish (ROI & NI) entities with valid certificate of RED compliance (as of 10/7/17).

Certificate holder	Location	Certified as	Issuing certification body
Pure Oil	Wexford	Collector of waste/residues Waste Oil/Fat Treatment	sc@pe international ltd
Athnua Ltd	Wexford	First Gathering Point	sc@pe international ltd

Appendix 3: Acknowledgement of Stakeholder Contributions

We would like to thank the following for taking the time to respond to our queries and provide feedback on this project.

Name	Organisation
Ciara Beausang	UCD School of Biosystems Engineering
Thomas Flynn	Agribiogas ltd
Padraic O'Neill	Envirovalue
Noel O'Loughlin	Designer Group
Lisa Tighe	HDS Energy
Fred Tottenham	Mott MacDonald
Peter Lefroy	Energia
Shane Malone	Byrne Ó'Cléirigh / NORA
Nick Rackard	Rackard Steam & Biomass
PJ McCarthy	RGFI/Green Gas Cert
Tom Oldfield	Orbas Consulting / LCA Ireland Network
Noel Gavigan	IBEC
Mark Coyne	Veolia
Michael Murphy	Ormonde Organics
Patrick Madigan	Bord na Mona
Matthew Clancy	SEAI
Elisa Colpo	Nepcon UK & Ireland

Appendix 4: BioGrace II Calculations for Forest Residues for Biomass Heating

Appendix 5: BioGrace II Calculation – Biogas CHP