Data requirements and principles for calculating the life cycle GHG intensity of novel transport fuels and invitation to submit data

1) SCOPE AND PROCESS

Council Directive (EU) 2015/652 laying down calculation methods and reporting requirements pursuant to Directive 98/70/EC of the European Parliament and of the Council provides a list of average life cycle greenhouse gas intensity default values for fuels other than biofuels and electricity[1] to be used by suppliers for calculating and reporting the greenhouse gas intensity of fuels they place on the market.

The **Fuel Quality Directive (FQD)[2] Article 7a paragraph 6 empowers the Commission to adopt greenhouse gas intensity default values, where such values have not already been established prior to 5 October 2015 via a delegated act no later than 31 December 2017, for fuels in the following two categories:**

a. Renewable liquid and gaseous transport fuels of non-biological origin (REFUNOBIOs); [3]

and

b. ***Carbon capture and utilisation for transport purposes (CCUFs).***

This document sets out generic data requirements and principles necessary for the calculation of such new greenhouse gas emission default values.

Member State authorities and/or economic operators working with technologies for *Renewable liquid and gaseous transport fuels of non-biological origin* and/or *Carbon capture and utilisation for transport purposes* not covered in Council Directive (EU) 2015/652 and wishing to have default values calculated for their technological pathways, are invited to submit suggestions accompanied by the necessary data to the Commission not later than 31 March 2017 at ENV-98-70-Implementation@ec.europa.eu.

In general, it is anticipated that suggestions for a default value to be calculated should be based on the characterisation of a specific technology pathway developed by a specific economic operator. However, consistent with the nature and use of the default values already included in Council Directive (EU)

[1] See Annex I Part 2 (5) of the Council Directive (EU) 2015/652

[2] DIRECTIVE 98/70/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 13 October 1998 relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EEC

[3] Article 2 (10) defines these fuels like liquid or gaseous fuels other than biofuels whose energy content comes from renewable energy sources other than biomass, and which are used in transport;

2015/652, any new greenhouse gas intensity defaults to be included will be binding to all economic operators utilising a technology corresponding with a generic pathway description so that defaults will not be specific to individual operators. In the case of access to data from more than one operator on the greenhouse gas intensity of processes considered similar enough to share a default value, the information from all shall be considered in assessing the appropriate default value to be included in the delegated act.

The Joint Research Centre of the European Commission (JRC) will assess the lifecycle greenhouse gas intensity of each pathway considered. Any prioritisation regarding which pathways warrant inclusion in a delegated act will depend on:

a) availability of data on the energy and greenhouse gas intensity of a fuel pathway;

b) appropriateness of the available data to analysis of fuel production at commercial scale;

c) quality and reliability of the data available;

d) likelihood that commercial scale production will be achieved by the end of 2020;

e) volume of production expected to be achieved by the end of 2020;

f) potential contribution of the pathway in question to achieving fuel supplier greenhouse gas intensity reduction targets under Article 7a of the Fuel Quality Directive.

In calculating new default values, the JRC will have regard to the principles expressed in Article 7d(7) of the Fuel Quality Directive, which states:

> *Any adaptation of or addition to the list of default values in Annex IV shall comply with the following:*
>
> > *(a) where the contribution of a factor to overall emissions is small, or where there is limited variation, or where the cost or difficulty of establishing actual values is high, default values must be typical of normal production processes;*
> >
> > *(b) in all other cases default values must be conservative compared to normal production processes.*

2) CONTENT OF A SUGGESTION FOR A PATHWAY

Consistent with the nature and use of the default values already included in Council Directive (EU) 2015/652, suggestions for a fuel pathway to be assigned a greenhouse gas intensity value through a delegated act should be accompanied with the information required to assess a default value. The information needed to enable the Commission to consider assigning default greenhouse gas intensities to pathways includes:

a) A general description of the proposed process and produced fuel.

b) Description to the extent possible of existing or planned commercial or demonstration scale facilities for the pathway in question;

c) Details of the expected rate of deployment of the pathway in question (in the view of the applicant), with an emphasis on production potential by 2020. This should reflect realistic assessment of the rate at which any commercial facilities may achieve nameplate production capacity.

d) Information required to undertake a greenhouse gas intensity assessment for a pathway.

3) INFORMATION REQUIRED TO ENABLE A GREENHOUSE GAS INTENSITY ASSESSMENT

The Commission will only consider issuing default values for pathways for which adequate information is available to enable the JRC to make a lifecycle assessment with a high degree of confidence. Economic operators suggesting pathways to be analysed for their technologies for *Renewable liquid and gaseous transport fuels of non-biological origin* and/or *Carbon capture and utilisation for transport purposes* are therefore encouraged to make adequate data available for a lifecycle assessment to be undertaken, and to ensure that this data is of appropriate quality and verifiability to support the drawing of firm conclusions. This may require the supply to the JRC of information considered commercially confidential. In such cases, the applicant will be expected to make that information available to the JRC, on the understanding that no commercially sensitive data will be disclosed beyond the Commission. All data submitted by an applicant should be verifiable (see section 4), and the applicant should expect to respond promptly to any requests for documentation or additional information made by the JRC in the process of undertaking the evaluation. The Commission will only issue default values in cases where the JRC has confidence in the quality and verifiability of the results of any analysis.

Information submitted to the Commission by an economic operator seeking to have a default greenhouse gas intensity value awarded to a pathway should include:

a) a general description, incorporating process diagrams quantifying significant material and energy flows, products, by-products and wastes, and a definition of the proposed systems boundary;

b) a characterisation of all emissions of CO_2 or non-CO_2 climate pollutants occurring within the system boundary;

c) if electricity is exported from the process, a characterisation of the steam conditions (where applicable) at the input and output of the generation equipment, and the thermal efficiency of the generation;

d) a characterisation of the source and production process (if known) for all raw materials used in the facility.

In all cases the preferred data source shall be verifiable data obtained by actual measurement undertaken at an operational commercial facility running at full capacity. Where no commercial scale facility is operational, data may be based on assessment of a demonstration scale facility. To be considered reliable representative data, any demonstration facility based on which it is proposed to make a lifecycle assessment should be running at at least 15% of the expected capacity of a commercial facility using the proposed process. In general, data from smaller pilot facilities, or data based on stoichiometric assessment or existing lifecycle inventories of comparable processes, shall be considered to have low reliability for the purpose of assessing default greenhouse gas intensity values for the purpose of including them in Council Directive (EU) 2015/652. Where such data is the only information available, the Commission may find that it is not possible to make a reliable greenhouse gas intensity assessment at this time.

4) VERIFICATION

The principles and key requirements of verifiers and the verification process for the data presented to JRC for calculating a greenhouse gas intensity default value are the same as described in Commission Regulation (EU) No 600/2012 on the verification of greenhouse gas emission reports and tonne-kilometre reports and the accreditation of verifiers pursuant to Directive 2003/87/EC of the European Parliament and of the Council.

5) PRINCIPLES FOR ASSESSING THE UPSTREAM GREENHOUSE GAS INTENSITY OF INPUTS

In general, raw materials and energies entering the system boundary of a production facility will have an ‘embedded’ greenhouse gas intensity associated with them, which will reflect the emissions resulting from producing or using that input. Where a given input (e.g. natural gas, fossil diesel, or a biofuel) already has a greenhouse gas intensity value assigned to it within the FQD, then that will be the greenhouse gas intensity with which that input enters the production facility. Where there is no greenhouse gas intensity assigned to that material within the FQD, it may be necessary to undertake an assessment of the upstream greenhouse gas intensity for that input. Where this is necessary, there are two possible cases[4]:

[4] It is conceivable that the supply of an input is deemed to be partly elastic and partly rigid; for example if it is produced in a process along with another product of comparable value. In such cases, the JRC shall determine the appropriate treatment for assessing the upstream greenhouse gas intensity of that input. See Annex for more examples.

a) The supply of the input is *rigid*.

Rigid supply refers to the case that the overall supply of the input cannot be expected to expand to meet increased demand. This is the case, for instance, for municipal waste, as we do not expect more municipal waste to be generated even if there is demand for the material. **Where the supply of an input is considered rigid, then the greenhouse gas intensity of that input shall be assessed by considering the impact of removing a quantity of that material or energy from its current use.**

In cases where an input material is otherwise destined for final disposal as *waste*, the upstream emissions associated with the raw material will reflect only emissions resulting from collection and transport, and any credit for avoided emissions resulting from removing that material from a disposal pathway that would otherwise generate emissions (for instance, removing material from landfill or incineration without energy recovery can result in avoided emissions).

In cases where the input is an *intermediate product* of an existing process, the upstream emissions associated with that input will reflect the changes in the emissions from the existing process resulting from the diversion of the intermediate product.

In cases, where an input otherwise *would have a productive use*, the upstream emissions associated with an input will reflect not only collection and transportation, but also the replacement of the raw material or energy in question with the alternative that is foreseen. For instance, where an input material is currently combusted for energy (for example to supply energy to power the process involving the production of that material), its upstream greenhouse gas intensity would reflect the emissions resulting from the alternative source of energy that is expected to replace its original use. The alternative energy source identified for this calculation will be the energy source for which demand is most likely to increase in the event that the input is no longer available for its existing application.

b) The supply of the input is *elastic.*

Elastic supply refers to the case that the supply of the input-material or input-energy can be expanded to meet increased demand. This is the case, for instance, for natural gas, as natural gas production can be increased in response to increased demand. Where the supply of an input is considered elastic, then its greenhouse gas intensity shall be assessed through attributional lifecycle assessment of its production process. In many cases, such assessment may already be available from existing lifecycle inventories (see section 7). In practice, even when supply of an input is considered elastic in principle, in the real world increased demand for that material or energy may cause not only an increase in production, but also displacement from other uses, changes in consumption rates etc. These are the type of *market mediated* outcomes that have been considered for biofuels through indirect land use change analysis.

Processes may combine rigid and elastic sources. Production of novel transport fuels will often combine rigid sources with elastic sources: for example, municipal waste (rigid source) could be transformed to a transport fuel using grid electricity (elastic source). In general the greenhouse gas intensity of the finished fuel is the sum of the greenhouse gas intensities of each source plus the emissions from the process itself (including transport, distribution, combustion and any CO_2 sequestration).

The data supporting a suggestion for a pathway should include a suggested characterisation of any inputs as having elastic or rigid supply, and a justification for that assessment, including market data where appropriate.

For inputs with rigid supply, it is necessary to propose the alternative use(s) or disposition(s) of that material or energy. Final determination of the status of an input as having rigid or elastic supply and the identification of any replacement in its existing use shall be made by the JRC.

Construction emissions and land use changes

So-called “grey energies” involved in constructing plant and equipment will generally be neglected, as will emissions from changes in land use from these non-biological sourced processes, unless the Commission has reason to believe that they are unusually significant for a particular process (compared its output).

6) ELECTRICITY AS THE ENERGY SOURCE FOR A FUEL

Where electricity is used as an energy source for *Renewable liquid and gaseous transport fuels of non-biological origin* and/or *Carbon capture and utilisation for transport purposes*, the assessment of the greenhouse gas intensity of the electricity supplied shall follow the principles identified in Annex I, Part 2(6) of Council Directive (EU) 2015/652, and Article 3(4)(c) of Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources (RED). The greenhouse gas intensity of electricity used in this context shall therefore be assessed based on the average greenhouse gas intensity of electricity supplied in a Member State or in the European Union.[5]

7) REFERENCE DATA FOR UPSTREAM GREENHOUSE GAS INTENSITY OF INPUTS

The emissions JRC will attach to input-electricity are described in section 6. Emissions to be attached to other inputs will generally be consistent with the calculation of the default emissions in Annex IV of FQD / Annex V of RED. These values are also reported in the current version of the BIOGRACE tool[6].

[5] Article 3(4) of Directive 2009/28/EC provides for the Commission to present, by 31 December 2017, a proposal that would allow, subject to certain conditions, the whole amount of electricity used for the production of Renewable liquid and gaseous transport fuels of non-biological origin to be treated as renewable. Should such a methodology be proposed, then where the production of Renewable liquid and gaseous transport fuels of non-biological origin uses electricity that would be designated as renewable under that methodology, then for the calculation of new default values it would be appropriate for the electricity used as an input for production of those fuels to be treated as having the greenhouse gas intensity of the relevant form of renewable electricity.

[6] www.biograce.net/

8) CARBON CAPTURE AND UTILISATION

Some proposed processes capture carbon dioxide that would otherwise be released into the air, and using a source of energy transform it into a carbon-containing transport fuel. In this case, the carbon content of the fuel is not counted as an emission during its combustion.

Where carbon dioxide from a process is sold as an industrial gas for other processes, a carbon credit may only be claimed:

(a) where it can be shown that this supply of carbon dioxide results in a real reduction of overall carbon emissions, for example where gas replaces carbon dioxide produced from fossil fuel burnt for the express purpose of generating carbon dioxide.

(b) in as much as the disposition of the carbon dioxide leads to additional carbon sequestration (for example, use in glasshouses that previously had no carbon dioxide supplementation).

However, if the reduction in emissions or extra sequestration in (a) or (b) have already been claimed as reducing carbon emissions in a biofuel plant (e.g. use of carbon dioxide from bioethanol production for making more fuel using extra energy input), there is a danger of double-counting. Therefore the carbon credit may not be claimed also for the fuel that is made from the exported carbon dioxide.

9) CARBON CAPTURE AND STORAGE

Where carbon from a process is permanently stored in accordance with Directive 2009/31/EC on the geological storage of carbon dioxide, this may be credited to the process as a reduction in emissions, although any emissions associated with the storage operation will also need to be taken into account.

10) CALCULATION METHODOLOGY AND EMISSIONS FACTORS

The JRC will use the principles laid out in this document in calculating the greenhouse gas intensity of a pathway. Other methodological choices will be consistent with the methodology used in the calculation of the typical and default emissions in Annex IV of FQD / Annex V of RED.

Appendix 1: Existing methods in FQD and LCA guidelines

It is impossible to fix in advance a method that fits all possible process configurations

There are very many variants for how to make renewable or fossil transport fuels from intermediate products or by-products of existing processes. These processes will be integrated with the existing plant, each of which will be different. It is impossible to fix in advance a method that deals unambiguously with all possible configurations of plant.

Existing LCA standards

Although there are published standards for LCAs (ISO 14040/44, and the International Reference Life Cycle Data System (ILCD) handbook[7]), these do not give fixed rules for calculating GHG reductions: much is left to users to select what they consider the most appropriate method in particular cases. The results often depend strongly on these choices. This is why the LCA guidelines do not offer a consistent or unambiguous way of determining carbon intensities by economic operators or by national authorities.

Existing FQD defaults include marginal emissions calculations

The existing default greenhouse gas intensities for fossil fuels used the marginal refining emissions for fossil fuels calculated in JEC-WTWv3[8]. The marginal emission for a particular fuel means the extra emissions caused by producing one additional unit of it (or conversely, the emissions saved by producing one less unit of that fuel). For gasoline and diesel, these emissions are higher than the average emissions of all refinery products, which is the figure used for the fossil fuel comparator of RED. Similarly, the greenhouse gas intensity for LPG is the JEC-WTW calculation of the marginal emissions for using additional LPG (imported from natural gas suppliers), since LPG production from EU refineries is already fully exploited.

[7] http://eplca.jrc.ec.europa.eu/?page_id=86#

[8] JEC (2011) "Well-to-Wheels Analysis of Future Automotive Fuels and Powertrains in the European Context" Version 3c, http://iet.jrc.ec.europa.eu/about-jec/downloads

Appendix 2: Examples

Example 1: An intermediate product used to make a REFUNOBIO

In making iron from iron ore and coal (via coke), a blast furnace produces a pressurized off-gas containing diluted carbon monoxide. This blast furnace gas is an intermediate product: it is presently burnt to produce electricity (at rather low efficiency, because the off-gas has a low heating value) for running the process, but it could potentially be transformed into a liquid transport fuel. Then there would be a shortfall in electricity to run the steel mill. Let's suppose this shortfall is supplied by grid electricity. What greenhouse gas intensity should be attached to the blast-furnace gas? The greenhouse gas intensity will then be the one of the extra electricity requirement of the steel mill. This is a *difference calculation* that reflects the overall *change* in emissions resulting from an increase in production of the novel transport fuel. Blast furnace gas is an example of a ***rigid source*** *of energy* for converting to transport fuel.

Example 2: A source that is elastic because it comes from a process with variable product ratios

A so-called "complex" oil-refinery produces a variety of petrochemical products from one feedstock: crude oil. A *simple* oil refinery just separates crude into its existing constituent parts, but that does not provide the mix of products demanded by the EU market. Therefore a *complex* refinery burns additional crude in order to boost the yield of the most valuable components. If one has a good computer-model of the whole refinery, one can calculate the marginal extra crude oil use needed to produce one more unit of one particular co-product. This gives the true increase in the greenhouse gas intensity for making more or less of a particular co-product to meet a change in demand.

This is how the CONCAWE model of the EU refinery system is used to calculate the refinery emissions for gasoline and diesel incorporated in the fossil-fuel comparators used in Annex IV of FQD / Annex V of RED. As diesel, for example, is a relatively valuable product, complex EU refineries boost the diesel share of the total product slate beyond its natural fraction in crude oil. As diesel and gasoline are amongst the most valuable refinery products, their greenhouse gas intensities (per MJ product) are higher than the average emissions for all refinery products.[9]

Our problem is how one can estimate the marginal emissions in cases where there is no computer model of the process available. However, spending increasing energy and emissions on further increasing the diesel share gives diminishing returns, so complex refineries logically limit spending on increasing the yield of diesel when the extra costs would outweigh the extra income from producing a yet higher share of diesel. Of course, the same thing applies to all other refinery products. Therefore the EU refinery system evolves in the direction of keeping the marginal crude oil used to produce each product in proportion to the value of each product. This is an approximation, because we have not considered the investment cost of systems to boost yields of valuable products, or the fact that relative costs of the products change with time.

[9] Therefore simple refineries cannot function independently from complex refineries: that is why the whole EU refining industry is considered in JEC-WTW and in calculations of fossil-fuel comparators in RED and FQD

Nevertheless, it is rather a good approximation, as

- the main cost of refining is the cost of the crude oil
- the other costs are capital expenditure and operating costs, but these are also required to increase the share of high-value products
- the *relative* prices of different products vary with time much less than the base price determined by crude oil.

To make a value-based allocation of emissions it would be best to choose added-values for the products on the basis of the prices prevailing during the more recent evolution of the refineries. In the case of petrochemical plant this would be an average for the previous five years or so, so it is not necessary to disclose confidential information on current prices.

Example 3: Renewable electricity

There are various ways to use the energy in electricity to create transport fuels. But if "renewable electricity" is simply bought off the grid, without any provision for additional renewable supply, it is likely to merely be diverted from use by others. In this case renewable electricity is a rigid source so, one would calculate the GHG intensity of the electricity that replaces the renewable electricity diverted to fuel production.

The principles in this document say that only if the source of renewable electricity is 'elastic' should the carbon intensity of the renewable electricity itself be used. In other words, the **supply of renewable electricity should be additional to what would be consumed otherwise**. For example, additional renewable electricity could come from a new wind farm not connected via the grid, or renewable electricity that would not otherwise be delivered to users because of grid instability. The details of how a supplier can claim the GHG intensity for renewable electricity will vary depending on the electricity regime in different countries, but the principle of additionality should be respected.

Example 4: Municipal waste

Another potential energy source for fuels is municipal waste. As a rigid source, the carbon intensity to be attributed to the waste are the emissions that are avoided by its alternative use. For municipal waste, the 'alternative use' is likely to be landfill or incineration without energy recovery, which generate GHG emissions rather than saving them. So the emissions "saved" by the alternative use are negative, and the GHG intensity of the municipal waste would be negative. But in the case that the existing use of the municipal waste would involve generating and exporting electricity, one would need to take into account the GHG emissions from replacing any reduction in electricity export.