Renewable Fuels Agency

Carbon and Sustainability Reporting within the Renewable Transport Fuel Obligation

Technical Guidance Part Two Carbon Reporting – Default Values and Fuel Chains

Renewable Fuels Agency

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Year Four of the RTFO
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*Note this Guidance may be superseded part way through the obligation year if a new RTFO Order to implement the requirements of the EU Renewable Energy Directive is introduced during the period

The RFA is the UK's independent sustainable fuels regulator. Further information about biofuels in the UK can be found online.

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1 Introduction

This document provides detailed information on the process for calculating the carbon intensity of a batch of biofuel for the purposes of carbon and sustainability (C&S) reporting under the RTFO. It is intended as a supplement to Part One of the C&S Technical Guidance. It can be used by parties who wish to carry out more detailed calculations (and who do not wish to rely upon the high level default values supplied in Part 1 of the Guidance). Such calculations can be performed using the Carbon Calculator tool or the accompanying detailed carbon intensity data spreadsheet and carbon intensity templates spreadsheet available online.

As the RED has not yet been transposed into the RTFO, this Guidance should be regarded as being 'RED-ready' rather than fully RED compliant. This Guidance is valid for the fourth year of the RTFO (from 15 April 2011) but is likely to be superseded by an updated Guidance when the RED is implemented in the RTFO, which will include some important changes. These changes are flagged throughout this document where relevant.

This part of the Guidance explains how to calculate a carbon intensity using the following information collected about the biofuel production activities:

- Use of qualitative information to calculate a carbon intensity (Chapter 2);
- Use of actual quantitative data (Chapter 3) to:
  - Edit pre-defined (default) fuel chains;
  - Make adjustments to the structure of existing fuel chains;
- Use of quantitative and qualitative data to construct a new fuel chain (Chapter 4).

This document does not provide any guidelines on land-use change (LUC) calculations. If LUC has taken place, users should follow the guidelines laid out in Annex H of Part One of the Technical Guidance. In this pre-RED implementation period, it is still possible to report 'unknown' in relation to LUC status and not provide any calculation of emissions from LUC. However, following RED-implementation, it will no longer be possible to report unknown and the methodology in Annex H will have to be used.

2 Using qualitative information to calculate a known carbon intensity

This chapter sets out how to adapt default fuel chains with qualitative information to better represent carbon intensity of an actual fuel chain.

A number of *selected default options* have been defined to enable transport fuel suppliers to use qualitative data to calculate the carbon intensity of their biofuels based on default fuel chains. In practice, this means that the default values for each of a number of fuel chains can be adapted using qualitative information on certain sources of GHG emissions that characterise different ways of producing the biofuel. For example, the mode of transport (truck, ship, rail, etc.) or the fuel used in a biofuel plant (coal, natural gas, fuel oil, etc.). When companies have qualitative evidence to demonstrate that a batch of fuel is produced in a certain way they can use the appropriate selected default value as described below.

The input data lying behind these selected default options are being harmonised across the EU through the BioGrace project[1] and have been published on the Commission's Transparency Platform[2]. Where EU agreed input data is available, it has been incorporated into this guidance. Where it is not available, suppliers can use additional input data defined by the RFA. Suppliers should note that post-RED implementation, it will no longer be possible to use RFA-defined input data. If the required default option is not available, suppliers will instead have to use data from peer-reviewed literature or use actual data to replace the default input data.

2.1 What selected default options are available?

The following qualitative parameters can be changed by transport biofuel suppliers to calculate the appropriate selected carbon default values:

[1] www.biograce.net

[2] http://ec.europa.eu/energy/renewables/transparency_platform/transparency_platform_en.htm

- Type of nitrogen fertiliser: this selected default option can be used to calculate emissions from crop production.
- Type of phosphorus fertiliser: this selected default option can be used to calculate emissions from crop production.
- Transport mode (e.g. truck, ship, rail, etc.): this selected default option can be used to calculate emissions from transport of any type of product.
- Type of fuel used to provide heat (e.g. diesel, coal, heavy fuel oil, natural gas, etc.): this selected default option can be used to calculate emissions in the conversion processes.

Table 2 summarises the selected default options and the modules they influence.

Table 2 Selected default options

Stage	Module	Input	Options
Cultivation	Crop production	Nitrogen fertiliser emissions factor	Ammonium nitrate (AN), ammonium sulphate (AS), urea, calcium nitrate (CN), urea ammonium nitrate liquid (UAN), nitrogen-phosphorous-potassium (NPK) fertiliser (urea-triple superphosphate (TSP)-muriate of potash (MOP))
Cultivation	Crop production	Phosphorus fertiliser emissions factor	TSP, rock phosphate, mono ammonium phosphate (MAP)
Cultivation	Crop production	Potassium fertiliser emissions factor	Potassium chloride

Cultivation	Crop production	NUTS2 regional cultivation data (see specific note below)	For the regions where this is available, the cultivation emissions for the region for a particular feedstock can be loaded
Conversion	Drying and storage	Fuel emissions factor	Diesel, heavy fuel oil, coal, natural gas
Conversion	Conversion	Fuel emissions factor	Coal, natural gas, heavy fuel oil, biomass, lignite
Transport & distribution	Transport	Transport mode fuel efficiency	Truck (by geographic region), rail (by geographic region), shipping

Note on NUTS2 cultivation emissions:

It is also possible to use regional cultivation data in the place of actual data. For most European feedstocks used in biofuel production, cultivation emissions have already been calculated for most regions of size level 2 in the Nomenclature of Territorial Units for Statistics (NUTS). These were calculated because there is a criterion in the RED which specifies that if the typical cultivation emissions for a particular feedstock for a particular NUTS2 region are higher than the disaggregated default for that feedstock provided in the RED Annex V, actual data should instead be used in the calculation of the cultivation emissions. As this regional cultivation data has already been accepted by the Commission and published on the Transparency Platform[3], the RTFO Administrator is making it possible for suppliers to use this data as a selectable default for 'regional' cultivation data[4].

The cultivation emissions for different NUTS2 regions can be selected as a default in the Carbon Calculator (please see the Carbon Calculator Manual for further instructions on this). If calculations are performed separately in a spreadsheet, and the regional cultivation emissions are taken directly from Member State country reports, users should take care with the units provided in the country reports. For the purpose of these calculations, users

[3] The country reports are available here: http://ec.europa.eu/energy/renewables/transparency_platform/emissions_en.htm

[4] Note, this is only applicable to European feedstocks.

will need the emissions from cultivation as the quantity of GHG emissions *per unit of biomass feedstock*. However, many country reports provide emissions from cultivation as the quantity of GHG emissions *per unit of biofuel.* To convert from *units of biofuel to units of biomass feedstock*, it will be necessary to divide by the conversion efficiency of the production of the biofuel from the feedstock (including allocation of any emissions to co-products). However, some country reports do not provide the additional information needed to do this. In such a case it will not be possible to use the NUTS2 level emissions as a selectable default for regional cultivation data. Similarly, in the Carbon Calculator, if this additional information is not available in the country report or has not yet been clarified by the Member State, the emissions from cultivation in that particular NUTS2 region are not included as a selectable default in the Carbon Calculator.

2.2 How can selected default values be used?

To make use of one of the selected default options outlined in Table 2:

- Select the option desired.
- Follow the procedures outlined in the next chapter to establish the carbon intensity of the batch of fuel.

3 Editing pre-defined fuel chains with actual data

This chapter describes how to calculate the carbon intensity of an actual fuel chain by editing an existing default fuel chain. There are two mechanisms by which the default fuel chains can be edited:

- Through the use of actual quantitative data and selected default options (Section 3.2).
- Or by making changes to the structure of the fuel chains (e.g. adding extra modules or deleting existing modules) (Section 3.3).

Please note the following:

a) An existing default fuel chain can only be edited when the type of feedstock is known. Furthermore, for the default fuel chains with processing options (wheat to ethanol, palm to FAME biodiesel, palm to hydrotreated vegetable oil (HVO) and palm to co-processed hydrotreated vegetable oil (CHVO)), the processing characteristics should also be known.

b) Some pre-defined fuel chains will be removed from the Guidance and the Carbon Calculator following RED-implementation – these are listed in section 2.1 of the Technical Guidance Part One.

c) There are two fuel chains (waste animal[5]/vegetable oil and waste wood DME) for which not all the input data is available. If a supplier wishes to include some actual data for these two fuel chains, actual data will also need to be provided for all of the inputs to the modules for which the data is missing.[6]

[5] This includes all tallow, except category 3 tallow

[6] For waste animal/vegetable oil, the input data that is missing is the data for the conversion module. For waste wood DME, all the input data is missing. This data is missing is because neither the RFA nor the BioGrace project has managed to calculate the same disaggregated default values as that published by the Commission in the RED, when using the input data the Commission has made available. Until this issue is clarified with the Commission, users will need to provide actual data for all inputs to these modules, if they do not wish to use the aggregated default value for the fuel.

3.1 Structure of default fuel chains

The default fuel chains are constructed by arranging common 'modules' into a series of sequential stages. Figure 1 shows the common modules (and their corresponding stages) which make up every fuel chain and Table 3 describes each of these modules. Figure 2 illustrates how they can be arranged into a fuel chain.

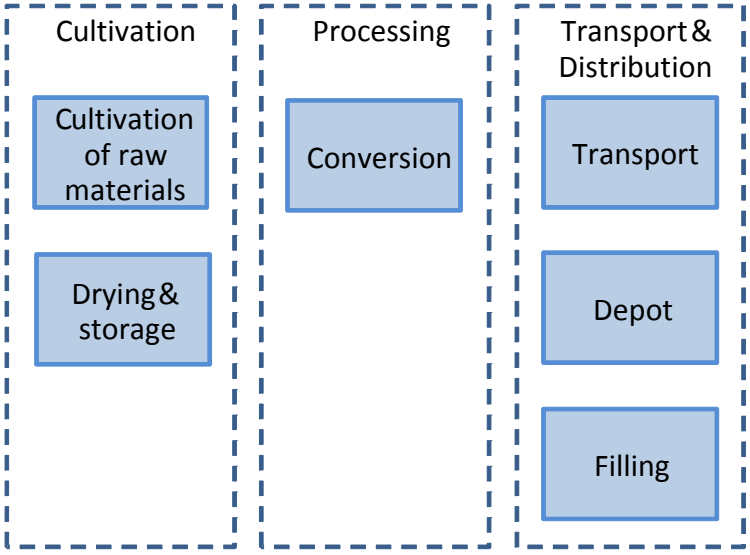

Figure 1 Modules used to define a biofuel fuel chain

Table 3 Description of the modules constituting a biofuel fuel chain

Module Name	Description
Cultivation of raw materials	Growing a biofuel feedstock (e.g. palm, wheat, soy, etc).
Drying & storage	Drying and storage of biofuel feedstocks (where this is done outside of a biofuel conversion plant).
Conversion	Any process which changes the physical nature of a feedstock or a biofuel (e.g. oilseed crushing, fermentation etc). The process will typically also result in the production of co-products (e.g. soy meal).
Transport	Transport of a primary, intermediary or final product (e.g. transport of liquid biofuel from a biofuel conversion plant to a refinery).
Depot	Road fuel depot station.

Filling	Road fuel filling station.

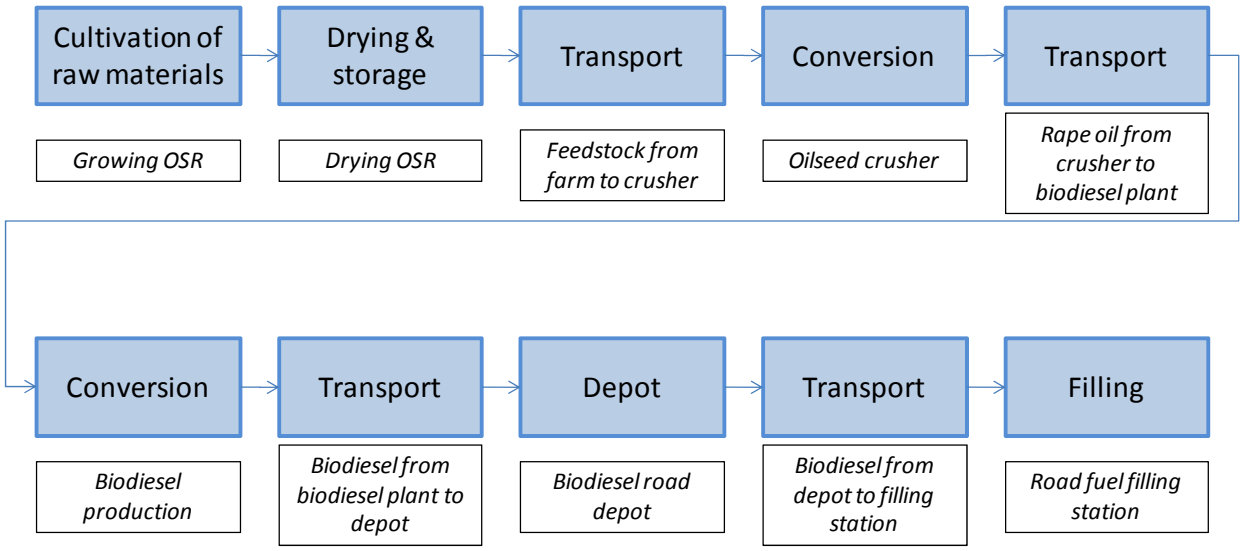

Figure 2 Example fuel chain defined using common modules (OSR = oilseed rape)

3.2 Editing a default fuel chain with actual data or selected default options

Actual data can be provided for two types of input data:

- input data to modules (i.e. data on type and amount of product consumed, process yields, etc.);
- co-product related data (i.e. data on type and amount of co-product produced, etc.).

Section 3.2.1 considers the validity of actual data. Then Section 3.2.2 considers the use of actual input data in modules. Finally, Section 3.2.3 outlines how to edit default fuel chains with co-product related actual data.

3.2.1 Rules governing the use of actual data

Validity of actual data over time

The actual data which can be used to edit a default fuel chain does not have to be 'real-time' data (e.g. companies will not be required to assess conversion plant characteristics such as yield and natural gas use at the exact moment that a particular batch of biofuel is

processed). Instead, all actual data in all modules can be based on characteristics averaged over a 12-month period.

Actual data for crop production

It will be permissible for evidence in support of actual data provided for crop production to take the form of a statistically accurate survey of farm level data. Such surveys would be considered valid for one crop-growing season and should be based on:

- data specific to an individual field or,
- average data for all fields of a particular crop grown on a farm (e.g. if a farmer has the following two fields of wheat, the average crop yield of 11.2 t/ha could be reported, rather than the individual crop yields: Field 1: 20 ha, 200 t; Field 2: 32 ha, 384 t). Note: this approach can also be used outside of a surveying context.

Compulsory linkages

There are several input fields within a carbon intensity calculation which are interdependent – for example, the yield of many crops is influenced heavily by the amount of nitrogen which has been applied. To avoid the possibility of default values being used in an inappropriate fashion a number of 'compulsory linkages' have been defined – these are listed in Table 4.

If actual data is used for one of the two inputs listed in Table 4, actual data must also be used for the other input. It is possible to have actual data which is equal to the default value; however, the reporting company must have evidence to support this claim.

Table 4 Compulsory linkages for all fuel chains, by module

Input one	Input two
Crop production	
Crop yield	Nitrogen fertiliser application rate
Nitrogen fertiliser application rate	Soil N_2O emissions
Drying & storage	
Moisture removed	Fuel for heating or electricity

Conversion	
Efficiency	Any co-product yield
Efficiency	Fuel or electricity use
Electricity or heat exported	Fuel use

3.2.2 Editing a fuel chain with actual module input data or selected defaults

Table 5 Procedure for editing a default fuel chain with actual data or selected default option

Step 1:	Select the appropriate default fuel chain to be edited based on the biofuel feedstock type and other characteristics if relevant (e.g. type of fuel used in conversion process). If the Carbon Calculator is used, upload the default fuel chain as explained in the Carbon Calculator user manual. If the calculations are performed using an Excel workbook, refer to the Excel carbon intensity templates spreadsheet.
Step 2:	Refer to the compulsory linkages sub-section above to establish whether there are compulsory links between the actual data to be used and any other data inputs. If there are such links, actual data must be used for both data inputs.
Step 3:	In the appropriate module within the default fuel chain, complete all the data input fields in the module being edited using the available actual data. If the Carbon Calculator is used, the remaining fields will automatically be filled with default input values. If an Excel workbook is used, complete the remaining fields in the module using default input values obtained from the Excel detailed carbon intensity data spreadsheet. Unless actual data is used for **all** sources of emissions in a conversion module (fuel, and electricity consumption and input of chemicals and the yield of any co-products produced), the total conversion emissions must be multiplied by a factor of 1.4[7]. This is

[7] The conservative factor is only removed from those conversion modules for which actual data is provided for all sources of emissions. If there is more than one

	the factor added to the conversion module of all RED default values to ensure they are conservative in order to reduce the risks of companies reporting carbon intensity values lower than what they are actually achieving. NOTE: Default values for emission factors can also be found in the detailed carbon intensity data excel spreadsheet. NOTE: If the actual data which is known is not a specific data point, but is the carbon intensity of an entire product which is the output of a module (e.g. wheat with 300 kg CO_2e/tonne or rapeseed oil with 850 kg CO_2e/tonne), it is not necessary to fill in the data input fields for the entire module. Instead, the known carbon intensity value should be inserted directly into the 'Fuel Chain Summary' table – see Step 5[8]. This can be done both in the excel spreadsheet and using the generic module in the carbon calculator (please see the Carbon Calculator manual for more information).
Step 4:	If the Carbon Calculator is used, the software automatically calculates the total emissions of the module being edited and the contribution of that module to the overall fuel chain. If an Excel workbook is used, the user has to perform all the required calculations as described in the Excel carbon intensity templates spreadsheet for the relevant module. The numbers and letters used in the formulae are references to specific cells. Calculations should be performed working from the top left, to the bottom right of the module. The total calculated at the bottom of the module represents the total emissions of that module. To calculate the contribution of the module to the overall fuel chain, this total should be divided by all yields of downstream modules and multiplied by all allocation factors of the module being edited and of all downstream modules.
Step 5:	If an Excel workbook is used, the 'Fuel Chain Summary' table (which can be found in the Excel detailed carbon

conversion module, actual data will have to be provided for each conversion module for the conservative multiplier to be removed from all of these conversion modules.

[8] In this situation, default values for the other upstream stages are not required as these should have already been taken into account in the carbon intensity of the product which has been purchased.

	intensity data spreadsheet) should now be updated with the new total for the module being edited: identify the appropriate module in the 'Fuel Chain Summary' table, and replace the associated value with the 'Contribution to overall fuel chain' field from the module which has just been recalculated.
Step 6:	The new fuel chain carbon intensity can be calculated by summing all the rows given in the 'Fuel Chain Summary' table (for the specified process characteristics if relevant) – including the new value for the module which has been recalculated. In the Carbon Calculator, the new fuel chain carbon intensity will appear by clicking on the Fuel Chain module (see the Carbon Calculator User Manual for more information).
Step 7:	For reporting to the RTFO Administrator, the fuel chain carbon intensity value must be converted to carbon intensity per MJ – using the standard energy content values (lower heating values specified in the Excel detailed carbon intensity data spreadsheet). In the Carbon Calculator, the fuel chain carbon intensity is automatically converted to carbon intensity per MJ – this value can also be read from the Fuel Chain module (see the Carbon Calculator User Manual for more information).

3.2.3 Providing actual data on co-products

The impact of co-products must be taken into account when calculating the carbon intensity of a renewable fuel. The approach taken depends on the co-product and its use (the default fuel chains already indicate how to address the main co-products):

- Crop residue co-products (including straw, bagasse, husks, cobs and nut shells) are **not taken into account** in the carbon intensity calculations.
- Electricity generated in a CHP (combined heat and power / co-generation) plant is taken into account using a **system expansion approach** where the fuel used is one of the following:
  - a fossil fuel;

- a biomass fuel which is **not** a co-product of the fuel chain being analysed; or
- an agricultural residue which **is** a co-product of the fuel chain being analysed.

- For all other co-products, the **energy allocation method** is used, including electricity generated in a CHP plant fuelled by co-products that are not agricultural residues (e.g. DDGS).

Table 6 describes the procedure for editing a fuel chain with actual data on co-products.

Table 6 Procedure for editing a default fuel chain with actual data on co-products

Approach	Description of approach	
System Expansion	**Step 1:**	Identify the amount of excess electricity being co-generated with the amount of heat used in the module[9].
	Step 2:	Determine the carbon intensity of electricity produced in a power plant burning the same fuel as the co-generation unit (identified in Step 1) by looking up the correct value in the Excel detailed carbon intensity data spreadsheet. If the Carbon Calculator is used, in the 'Conversion' module, in the table named 'Co-products', the user should select from the drop down list in the second column (named 'Use') the electricity from the same fuel as the co-generation unit. See the Carbon Calculator User Manual for further explanation.

[9] In accounting for that excess electricity, the size of the cogeneration unit shall be assumed to be the minimum necessary for the cogeneration unit to supply the heat that is needed to produce the fuel.

	Step 3:	Give the biofuel a credit which is equal to the amount of excess electricity produced (per tonne of biofuel), multiplied by the carbon intensity of the power plant produced electricity (per tonne of electricity). This credit should be negative (i.e. reduces the carbon intensity of the biofuel). This is automatically carried out if using the Carbon Calculator.
Allocation by energy content	**Step 1:**	If the Carbon Calculator is used, fill out the 'Co-products' table in the 'Conversion' module with the name and yield of the products exported from the conversion plant (other than the main products). The allocation factor is then automatically calculated. Please refer to the Carbon Calculator User Manual for more information. NOTE: For new co-products not specifically named in the Carbon Calculator, users should select 'other' and then insert the yield and energy content of the co-product in the relevant boxes. If an Excel workbook is used, calculate the energy content (in terms of lower heating value) of the products exported from the conversion plant – expressed per tonne of the biofuel product. NOTE: energy contents for existing co-products are provided in the Excel detailed carbon intensity data spreadsheet and should be used unless actual data is available[10].

[10] Some of the co-product energy contents are taken from the BioGrace spreadsheet on the EU Transparency Platform and some are additionally provided independently by the RTFO Administrator. The excel workbook called 'detailed carbon intensity data' that accompanies this Technical Guidance clearly identifies which standard values are from BioGrace and which are RFA defined. Following implementation of the RED into the RTFO, suppliers will only be permitted to use the values published on the EU Transparency Platform. If the required piece of data is not available from this source, suppliers would then have to use peer reviewed literature data or actual data in its place.

	Step 2:	Calculate the total energy contained in all products exported from the plant (including the biofuel and the co-products) – expressed per tonne of the biofuel product.
	Step 3:	Divide the energy of a tonne of biofuel product by the total energy of all exported products (from Step 2) – this is the allocation factor, the proportion of emissions which should be allocated to the biofuel.
	Step 4:	Multiply the emissions which occurred in this module and all upstream emissions by this allocation factor.

Example of allocation by energy content

An oilseed rape to biodiesel plant is producing biodiesel and glycerine.

Step 1: Energy content of exported products

Biodiesel: 1 kg of biodiesel = 37.2 MJ/kg of biodiesel

Glycerine: 0.11 kg glycerine/kg biodiesel x 16.0 MJ/kg of glycerine = 1.7 MJ/kg of biodiesel

Step 2: Total market value of products exported from plant

Total energy = 37.2 + 1.7 = 38.9 MJ/kg of biodiesel

Step 3: Divide value of a tonne of biofuel by total value of products per tonne of biofuel

Allocation factor = 37.2 / 38.9 = 95.7%

Step 4: Multiply upstream emissions and this module's emissions by the allocation factor

Upstream emissions (e.g. production of oilseed rape) = 1,272 kg CO_2e/t biodiesel

Conversion plant emissions = 455 kg CO_2e/t biodiesel

Carbon intensity of biodiesel = (1,272 + 455) x 0.957 = 1,652 kg CO_2e/t biodiesel

3.3 Make adjustments to the structure of existing fuel chains

This section describes how the structure of the default fuel chains can be changed. The RTFO Administrator allows for the structure to be changed in two ways: by removing a module (Section 3.3.1) or by adding a module (Section 3.3.2).

3.3.1 Removing a module

Examples of situations in which companies may wish to remove modules include:

- If a certain transport step does not occur because, for example the oilseed crushing plant and the biodiesel conversion plant are co-located.
- If feedstock drying occurs within the biofuel plant – removing the drying and storage module would mean that energy consumption for drying and storage could be reported within the biofuel conversion module.
- If oilseed crushing and biodiesel conversion take place within the same plant – using one conversion module means energy consumption could be reported for the plant as a whole and would not have to be allocated between crushing and conversion operations.

Companies will be required to maintain evidence that the biofuel was produced in the way represented by the revised fuel chain, for example, that a certain transport step does not occur or that crushing and transesterification take place on the same site. If modules are removed from the default fuel chain, companies will be required to use actual data for data points downstream of this module which may have been affected by the changes made – verifiers will review the entire fuel chain and the data used to ensure there are no inconsistencies. For example, within a biodiesel chain, it would not be possible to claim that oilseed crushing and biodiesel conversion take place within one plant, remove the oilseed crushing conversion module and then rely on default values for the biodiesel conversion module. The conversion module would have to include data specific to the conversion process covered by that module, i.e. include the combined inputs and efficiencies for both the crushing and conversion stages. Any changes to a default fuel chain must be recorded transparently – ideally in a format as close as possible to the existing default fuel chains (either

electronic or paper-based). Verifiers may request access to this information.

Table 7 Procedure for removing a module

Step 1:	Select the appropriate default fuel chain to be edited based on the biofuel feedstock type and other characteristics if relevant (e.g. type of fuel used in conversion process). If the Carbon Calculator is used, upload the default fuel chain as explained in the Carbon Calculator User Manual. If the calculations are performed using an Excel workbook, refer to the Excel carbon intensity templates spreadsheet.
Step 2:	Remove the module(s) that is not required.
Step 3:	Adjust the structure of the remaining modules to ensure that the new fuel chain is accurate and complete. Changes may need to be made to e.g.: Inputs and related units (e.g. for yields and emission totals) The co-products being exported.
Step 4:	Use actual data in place of single default values for any inputs which might have changed as a result of removing a module.
Step 5:	If an Excel workbook is used, complete all necessary calculations in modules which have been changed – and record changes in the 'Fuel Chain Summary' table. If using the Carbon Calculator, calculations will be performed automatically, provided that the user has correctly reconstructed the chain after deleting the module (as explained in the Carbon Calculator User Manual).
Step 6:	If any 'yields' have been changed, then the 'contribution to overall fuel chain' of all upstream modules will need to be recalculated and recorded in the 'Fuel Chain Summary' table.
Step 7:	If any allocation factors have been changed, then the 'contribution to overall fuel chain' of all upstream modules will need to be recalculated and recorded in the 'Fuel Chain Summary' table.

Step 8:	The new fuel chain carbon intensity can be calculated by summing all the rows given in the 'Fuel Chain Summary' table (excluding the module which has been removed). In the Carbon Calculator, the new fuel chain carbon intensity appears by clicking on the Fuel Chain module (see the Carbon Calculator User Manual for more information).
Step 9:	For reporting to the RTFO Administrator, this value must be converted to carbon intensity per MJ – using the standard energy content values (lower heating values specified in the Excel detailed carbon intensity data spreadsheet). In the Carbon Calculator, the fuel chain carbon intensity is automatically converted to carbon intensity per MJ – this value can also be read from the Fuel Chain module (see the Carbon Calculator User Manual for more information).

3.3.2 Adding a module

With the exception of crop production, the modules listed in Figure 1 can be added to an existing default fuel chain. Table 8 provides a list of the most important sources of GHG emissions which need to be considered within each module. This list is not exhaustive and it is the reporting company's responsibility to ensure that all sources of GHG emissions which will influence the final carbon intensity of the biofuel by one percent or more are taken into account.

Table 8 Most important sources of GHG emissions for all modules that can be added to an existing default fuel chain (excludes the cultivation module)

Module	Major influences of GHG emissions
Drying & storage	Fuel (e.g. diesel, fuel oil, natural gas, coal) Electricity

Conversion	Yields[11] Fuel (e.g. natural gas, fuel oil, coal) Electricity Chemicals Co-products
Transport	Diesel or other fuel for transport

Every module must include two 'totals': the module total (kg CO_2e/t product[12]) and the fuel chain contribution total (kg CO_2e/t biofuel). The Carbon Calculator also shows in each module, a running total of emissions up to the end of that module. For example the esterification step in the biodiesel chain will show the running total emissions from the beginning cultivation step up to the end of the esterification step.

Table 9 Procedure for adding a module

Step 1:	Select the appropriate default fuel chain to be edited based on the biofuel feedstock type and other characteristics if relevant (e.g. type of fuel used in conversion process). If the Carbon Calculator is used, upload the default fuel chain as explained in the Carbon Calculator User Manual. If the calculations are performed using an Excel workbook, refer to the Excel carbon intensity templates spreadsheet.
Step 2:	Add the new module(s) which is (are) required.
Step 3:	Adjust the structure of the remaining modules to ensure that the new fuel chain is accurate and complete. Changes may need to be made to e.g.: • Inputs and related units (e.g. for yields and emission totals) • The co-product being exported.

[11] Whilst yields (i.e. tonne output / tonne input) are not a 'source' of GHG emissions, they are required to enable the fuel chain contribution total to be calculated within existing modules that are upstream of the added module.

[12] Product at this point in the chain.

Step 4:	Actual data will need to be used for all inputs required within the new module – emission factors may be taken from the Excel detailed carbon intensity data spreadsheet. In addition, actual data will be required in place of single default values for any inputs which might have changed as a result of adding the new module.
Step 5:	If an Excel workbook is used, complete all necessary calculations in the modules which have been changed – and record changes in the 'Fuel Chain Summary' table (remembering to add the new module as a new row in the table). If using the Carbon Calculator, calculations will be performed automatically, provided that the user has correctly reconstructed the chain after adding the module (as explained in the Carbon Calculator User Manual).
Step 6:	If the new module has a 'yield' associated with it and/or if other modules have had their 'yields' altered then the 'contribution to overall fuel chain' of all upstream modules will need to be recalculated and recorded in the 'Fuel Chain Summary' table.
Step 7:	If the new module has an 'allocation factor' associated with it and/or if other modules have had their 'allocation factors' altered then the 'contribution to overall fuel chain' of all upstream modules will need to be recalculated and recorded in the 'Fuel Chain Summary' table.
Step 8:	The new fuel chain carbon intensity can be calculated by summing all the rows given in the 'Fuel Chain Summary' table for the specified feedstock – including the value for the new module which has been added. In the Carbon Calculator, the new fuel chain carbon intensity appears by clicking on the Fuel Chain module (see the Carbon Calculator User Manual for more information).

Step 9:	For reporting to the RTFO Administrator, this value must be converted to carbon intensity per MJ – using the standard energy content values (lower heating values specified in the Excel detailed carbon intensity data spreadsheet). In the Carbon Calculator, the fuel chain carbon intensity is automatically converted to carbon intensity per MJ – this value can also be read from the Fuel Chain module (see the Carbon Calculator User Manual for more information).

4 Building a new fuel chain

An entirely new fuel chain can be constructed; however, it will almost always be easier (and it is recommended) to edit an existing default fuel chain where one is available for the biofuel feedstock. Note that, if a new fuel or feedstock is being introduced to the UK market and none of the existing default fuel chains represent the production processes, it will be necessary to use actual data to calculate a default value. See also Section G.5 Technical Guidance Part One regarding this issue.

Table 10 Procedure for building a new fuel chain

Step 1:	Define the steps which occur during the production of a biofuel using the modules shown in Figure 1. If the Carbon Calculator is used, upload the appropriate modules and create the link between them as explained in the User Manual.
Step 2:	Identify the main product produced in each module (e.g. wheat, ethanol, etc.). All emissions within a module must be calculated per tonne of this product.
Step 3:	Within each module, identify all sources of GHG emissions which will influence the final carbon intensity of the biofuel by one percent or more.
Step 4:	Within each conversion module, identify the co-products produced and decide on the most appropriate treatment based on the rules outlined in Section 3.2.3.
Step 5:	Ensure that each conversion module contains yield data (this is needed to establish the contribution that upstream emissions make to the final carbon intensity of a biofuel i.e. for deriving the 'Fuel Chain Summary' table).
Step 6:	Complete a fuel chain structure in the same format which has been used for the default fuel chains as shown in the Excel detailed carbon intensity data spreadsheet and carbon intensity templates spreadsheet – verifiers may review this structure.
Step 7:	Complete the fuel chain structure using actual data and emission factors from the detailed carbon intensity data Excel spreadsheet.

Step 8:	The new fuel chain carbon intensity can be calculated by adding up the contribution of all the different modules. In the Carbon Calculator, the new fuel chain carbon intensity appears by clicking on the Fuel Chain module (see the Carbon Calculator User Manual for more information).
Step 9:	For reporting to the RTFO Administrator, this value must be converted to carbon intensity per MJ – using the standard energy content values (lower heating values specified in the detailed carbon intensity data spreadsheet). In the Carbon Calculator, the fuel chain carbon intensity is automatically converted to carbon intensity per MJ – this value can also be read from the Fuel Chain module (see the Carbon Calculator User Manual for more information).

Note on emission factors

Where no standard emission factor is available from BioGrace by the time of RED implementation suppliers should make a request for a value to be published by the Commission[13]. In the absence of the Commission publishing a value, suppliers will have to find these in published literature such as peer reviewed scientific articles. They will also need to be able to prove that the value they use for their calculations is in line with the following requirements as set out in the RED[14]:

1) The standard emission factor should be obtained from independent, scientifically expert sources;
2) The standard emission factor should be updated as those sources progress their work.

[13] As for default carbon intensities, the supplier may make a request to the RTFO Administrator for an emission factor for a particular substance. If the Administrator receives several requests for the same substance, it will request that the European Commission and/or the JRC publish a new standard emission factor. However, the Commission is also likely to have its own thresholds for deciding that a substance is sufficiently commonly used in a biofuel production process, before publishing an emission factors for it. Therefore, the RTFO Administrator cannot guarantee the timeline in which the European Commission or the JRC will produce a new standard emission factor, if at all.

[14] These criteria are set out in paragraph 83 of the introduction to the RED.

Annex A Soil N_2O emissions methodology

Table 11 shows how N_2O emissions are calculated. This approach is expected to continue for RED implementation, unless the RTFO Administrator is otherwise advised by the European Commission. Table 2**Table 11 is included for information purposes only.**

Table 11 Overview of the N_2O emission calculation methodologies in different parts of the RED-related carbon intensity calculations

Soil N_2O emission assessment needed for:	**Methodology used:**
RED published default values	Version 2c of JEC report says that the JEC uses a model built on a version 82N of the DNDC model and using the database-calculation-model of the soils-and-waste unit of the Institute for Environment and Sustainability at JRC-Ispra.
RED-ready default values (calculated by E4tech)	For fuel chains existing in RED: JRC published values For fuel chains not-existing in RED: IPCC Tier 1 methodology
Calculation using actual data in Carbon Calculator	IPCC Tier 1 methodology
NUTS 2 reports	Depends on the countries (DNDC, Stehfest and Bouwman, IPCC Tier 1). The UK methodology uses IPCC Tier 1 methodology (including N_2O emissions from organic soils cultivation and crop residues left on field).