System Certyfikacji

ZRÓWNOWAŻONY ROZWÓJ
W PRODUKCJI BIOPALIW I BIOPŁYNÓW

INSTYTUT NAFTY I GAZU
Państwowy Instytut Badawczy

Guidelines for the determination of the lifecycle per unit values of GHG emissions for biofuels, bioliquids

by The Oil and Gas Institute

The KZR INiG-PIB System/8

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1. Introduction

Article 17(2) of Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (Official Journal of the European Union No. L 140/16 of 9.06.2009), called RED [1], defines one of the sustainability criterion pertaining to the ability of biofuels/ bioliquids/ to limit greenhouse gases emission. According to this article, greenhouse gases emission savings achieved by the use of biofuels/bioliquids amounts to at least 35 % compared to their relevant fossil fuel comparator. Starting from 1.01.2017, this value will increase to 50%. In the case of biofuels and bioliquids produced by installations that were operating on 23.01.2008, the requirement of the greenhouse gases emission saving will be valid from 1.04.2013. After those dates in order to meet the sustainability criteria all biofuel and bioliqiud (regardless of the biofuel / feedstock production date) need to pass the mentioned GHG threshold, according to the KZR INiG system.
From 1.01.2018, greenhouse gas emissions savings will amount to at least 60 % for biofuels and bioliquids produced in installations in which production started on 1.01.2017 or later (regardless of the feedstock production date).
Annex V Part C of the RED provides the following equation [1] for the calculation of the saving mentioned above:

$$SAVING = (E_F - E_B)/E_F \qquad [1]$$

where:
E_B – total emission from the biofuel or bioliquid (including emissions from carbon stock change caused by land-use change that has occurred since 1 January 2008), and
E_F – total emissions from the fossil fuel comparator.

E_F is the newest available actual average GHG emission value of the fossil part of gasoline and diesel oil formulations for the area of the European Union, reported under Directive 98/70/EC (FQD). If the latest data is not available, value of **83,8 gCO_{2eq}/MJ** is used, and for bioliquids used for energy production, in calculations of emission savings, the value of fossil fuel comparator (E_F) amounts to **91 gCO_{2eq}/MJ**. For bioliquids used for heat generation, their emission savings level shall be compared with the fossil fuel comparator (E_F) equal to **77 gCO_{2eq}/MJ**. In the case of bioliquids used in cogeneration, their emission savings shall be compared with the fossil fuel comparator (E_F) of **85 gCO_{2eq}/MJ**.

Determination of E_B value is an important issue. RED[1] specifies the method of determination of this value, leaving the possibility of determination of actual emission values or use of default values listed in the RED for the manufacturer. However; the latter may be employed under certain conditions which will be discussed further in the text of this document. The methodology of the actual values determination is provided in Annex V to the RED[1]and in Communications 2010/C 160/01 and 160/02, and EC Decision 2010/335/EU. The KZR INiG methodology is convergent with the RED methodology. **All emissions, including land use change emissions (e_l) are taken into account.**

2. Normative references:

All relevant KZR INiG System documents are valid for the scope of application. The normative references display the documents which contents are linked and have to be considered as common points.

KZR INiG System /1/ Description of INiG System of Sustainability Criteria – general rules
KZR INiG System /2/Definitions
KZR INiG System /4/ Land use for raw materials production – lands with high carbon stock
KZR INiG System /5/ Land use for raw materials production – biodiversity
KZR INiG System /6/ Land use for raw materials production – agricultural and environmental requirements and standards
KZR INiG System /7/ Guidance for proper functioning of mass balance system
KZR INiG System /10/ Guidelines for auditor and conduct of audit

PrEN 16214-1 *Sustainably produced biomass for energy applications – Principles, criteria, indicators and verifies for biofuels and bioliquids – Part 1: Terminology*.

PrEN 16214-4 *Sustainably produced biomass for energy applications – Principles, criteria, indicators and verifies for biofuels and bioliquids – Part 4: Calculation methods of the greenhouse gas emission balance using a life cycle analysis.*

PrEN 16214-5 *Sustainably produced biomass for energy applications – Principles, criteria, indicators and verifies for biofuels and bioliquids – Part 5: Guidance towards definition of residue and waste via positive list.*

Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC

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. Definitions

KZR INiG System/2/Definitions

4. Guidelines for the determination of greenhouse gases emissions in the lifecycle of biofuels

4.1. Conditions for use of default, actual values, according to the RED

Given the requirements of the methodology and necessity of its implementation, the method of calculation of greenhouse gas emissions in the lifecycle of biofuels is described sufficiently in the RED and communications supplementing it[2,3,7]. This is why, it has become a starting point for dedicated system solutions. And detailed rules of the calculation of greenhouse gas emissions, applied in a particular certification system, must follow the RED methodology. Therefore, fragments of the RED concerning this issue, are cited below.

Article 19.1 of the RED "***Calculation of the greenhouse gas impact of biofuels and bioliquids***" provides the following methods of calculation of greenhouse gas emissions in the biofuel lifecycle:

a) where a default value for greenhouse gas emission saving for the production pathway is laid down in part A or B of Annex V and where the e_1 value for those biofuels or bioliquids calculated in accordance with point 7 of part C of Annex V is equal to or less than zero, by using that default value;
b) by using an actual value calculated in accordance with the methodology laid down in part C of Annex V; or
c) by using a value calculated as the sum of the factors of the equation referred to in point 1 of part C of Annex V, where disaggregated default values in part D or E of Annex V may be used for some factors, and actual values, calculated in accordance with the methodology laid down in part C of Annex V, for all other factors.

Re a)

The default values for biofuels and the disaggregated default values for cultivation may be used only when their raw materials were:

- cultivated outside the European Community;
- cultivated in the Community in areas included in the list of the areas classified as level 2 in the nomenclature of territorial units for statistics (NUTS) or as a more disaggregated NUTS level in accordance with Regulation (EC) No 1059/2003 of the European Parliament and of the Council of 26 May 2003 on the establishment of a common classification of territorial units for statistics (NUTS)[4], where the typical greenhouse gas emissions from the cultivation of agricultural raw materials is expected to be lower than or equal to the emissions reported under the heading "Disaggregated default values for cultivation" in part D of Annex V to the RED, accompanied by a description of the method and data used to establish that list. That method shall take into account soil characteristics, climate and expected raw material yields;
- waste or residues other than agricultural, aquaculture and fisheries residues.

For biofuel and bioliquid not falling under the points mentioned above, actual value for cultivation shall be used.

Re b)

Actual values of greenhouse gases emissions resulting from the production of biofuels, may be used in every case.

Re c)

The RED allows also to use the sum of disaggregated default values and calculated actual values. Given the complex character of the methodology, adopting this solution may be the most convenient in Polish conditions.

It is, that within the INiG System, for cultivation, storage, transport and distribution stages, it is recommended to use default values (if corresponding conditions are met), while for biomass processing and biofuel/bioliqiud manufacturing stages – actual values.

In any case, annualized emissions from carbon stock changes caused by land-use change that has occurred since 1 January 2008, are taken into account.

4.2. Calculation of actual values of greenhouse gas emissions in the lifecycle of biofuels and bioliquids

In the case when the above conditions for usage of default values are not met, or when actual emission generated during a given process is indeed lower than the one cited in the RED, the economic operator has the possibility of proving the actual value of emissions in reference to unit of mass or unit of energy of the fuel.

According to the KZR INIG System guidelines, determination of actual values shall be carried out based on credible data, in a clear and evident way, easy to verify.

4.2.1. Credibility of data sources

Numerical data constituting a base for determination of values of GHG emissions per unit of mass or energy, usually originate from many sources, for instance they are operator-generated (such as size of production or quantity of energy used for production) or gathered from external sources (such as emission indicators for raw materials or energy purchased from an external supplier). The data generated within the plant (basic data) shall be stored in properly organized datasets, enabling reviews and verification in a simple way.

In the case when data are gathered from external sources (secondary data), particular care shall be taken in order to maintain their transparency and proper documentation of their origin. Literature data, collected for particular needs, shall originate from commonly available sources, be well documented and transparent.

Below is a recommended list of literature data
- Ecoinvent : http://www.ecoinvent.org
- Biograce : http://www.biograce.net

- GEMIS: http://www.oeko.de

Data concerning land use:
- IPCC Good practice guidance: http://www.ipcc-nggip.iges.or.jp

Data concerning artificial fertilizers and chemicals used in agriculture:
- EFMA: http://www.efma.org.

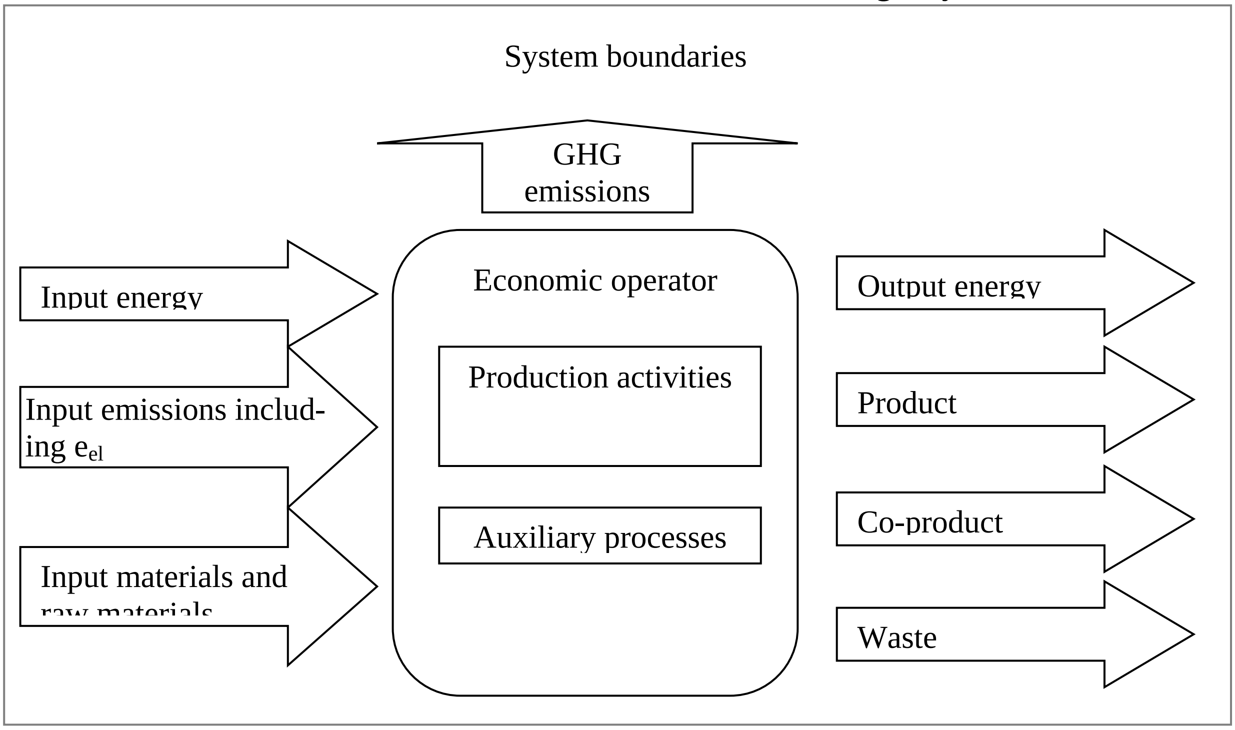
4.2.2 Applicable units

According to the requirements of the RED, the only unit approved for the determination of intensity of greenhouse gas emissions is gCO_{2eq}/MJ of energy contained in the biofuel. Given the diversification of links in the supply chain, usage of units proper for a given link is also allowable. In practice, it is hard to define the emissions generated at particular stages of biomass processing in relation to energy contained in the biofuel, if the final destination of the biomass is not known. In such cases, greenhouse gas emissions are expressed in a unit, in which the product is accounted for at the respective stage of production (it may be in mass or volume).

4.2.3. System boundaries, completeness of the data

The boundaries of the system of greenhouse gas emissions calculation in a given production plant (at a particular stage of biofuels lifecycle) shall converge with those determined for development of a mass balance system (according to the guidelines of the document entitled *System KZR INiG/7/ Guidance for proper functioning of mass balance system*). In the Figure below, the boundaries of the calculation system are shown schematically:

Fig.1 System boundaries



It is necessary to define all streams of raw materials, other materials and energies entering the system and exiting the system. Both minuteness of detail and scope of inclusion of the production activity within the system boundaries, are responsibilities of the economic operator (carrying out the calculations). The significance of the input data in the general GHG balance, and completeness and quality of the values collected from other sources, are the guidelines. **Any emissions from land use change (e_l) that has occurred since 1 January 2008 are taken into account.**

In the performance of some technological processes, small quantities of raw materials and reagents are utilized (e.g. antifoam agents, corrosion inhibitors, water treatment chemicals). Influence of these streams in GHG emission results is slight, and it may be omitted if adjusted with a verifier. In such cases, the rule recommended for the evaluation of the magnitude of influence of component data on the result, stipulates that if this value does not influence the value of the biofuel's ability to limit greenhouse gases emission saving rounded to one percentage point, the given factor may be disregarded.

4.2.4 Actual value calculation

Actual value of greenhouse gases emission in biofuels' lifecycle is calculated according to the following equation [2]:

$$E = e_{ec} + e_l + e_p + e_{td} + e_u - e_{sca} - e_{ccs} - e_{ccr} - e_{ee} \qquad \textbf{[2]}$$

where:

E - *total emissions from the use of the fuel;*

e_{ec} - *emissions from the extraction or cultivation of raw materials;*

e_l - *annualized emissions from carbon stock changes caused by land-use change;*

e_p - *emissions from processing;*

e_{td} - *emissions from transport and distribution;*

e_u - *emissions from the fuel in use;*

e_{sca} - *emission saving from soil carbon accumulation via improved agricultural management;*

e_{ccs} - *emission saving from carbon capture and geological storage;*

e_{ccr} - *emission saving from carbon capture and replacement; and*

e_{ee} - *emission saving from excess electricity from cogeneration.*

Emissions from the manufacture of machinery and equipment shall not be taken into account.
Greenhouse gas emissions from fuels, E, shall be expressed in terms of grams of CO_2 equivalent per MJ of fuel, gCO_2eq/MJ

GHG emission from energy consumption

At each of the biofuels, bioliquids production stages, GHG emission is generated in connection with the consumption of energy, both bought and generated by the plant. The energy externally supplied may be in the form of:

- fuel (coal, petroleum oil products, diesel oil, gasoline, natural gas, biomass (also biofuel feedstock, bioliquids);
- electricity from a local energy grid or another supplier;
- heat (commonly as steam) from the nearest available source.

In the case of the calculation of GHG emission generated in a set periodic inventory period (set by economic operator, maximum 3 months) in connection with using particular energy source, the following equation is used:

$$C_x = \epsilon_x * F_{ex} \qquad [3]$$

where:

C_x - *quantity of greenhouse gases (CO_{2eq}) expressed in mass units, resulting from energy consumption in a given period;*

ε_x - *quantity of energy used in a given period. If this value is not provided directly, and only the amount of fuel used is known, lower heating values shall be used for calculation of this value. Expressed in MJ*

F_{ex} - *GHG emission factor for fuel, taking into account its production and final consumption (expressed as CO_{2eq}/energy unit). For the calculations, it shall be assumed that complete combustion of the fuel occurred. In Poland, in the case of fossil fuels, indicators developed by National Center for Emission Balancing and Management (KOBiZE) may be used, applied for accounting in trading CO_2 emission quota[6]. In the case when biofuels/bioliquids are used as energy fuel, F_{ex} shall be defined according to the methodology provided in this document.*

Formula 3 must be used at each stage of biofuel/bioliqiud production.

GHG emission generated for heat production shall be calculated considering fuels and equipment used for the production; this value shall be provided by the supplier.

When calculating GHG emissions generated by the consumption of electricity not produced in the fuel production plant, the greenhouse gas emission intensity of the production and distribution of that electricity shall be assumed to be equal to the **average emission intensity of the production and distribution of electricity in a defined region**. In the case of the EU the most logical choice is the whole EU. In the case of third countries, where grids are often less linked-up across borders, the national average is the appropriate choice. By derogation from this rule, producers may use an average value for an individual electricity production plant for electricity produced by that plant, if that plant is not connected to the electricity grid.

4.2.4.1. Emissions from the extraction or cultivation of raw materials, e_{ec}, e_l

Economic operators shall make reference to the method and source used for determining actual values (e.g. average values based on representative yields, fertilizer input, N_2O emissions and changes in carbon stock).

For agricultural management (e_{ec} and e_l see formula No. 3) it is allowed to use either measured or aggregate values. When using aggregate values:

- The regional differences for these values should be taken into consideration when using this data. For the EU, a value relevant for the NUTS2 level or more fine-grained level shall be used. For other countries a similar level would be applicable.
- Such numbers should primarily be based on official statistical data from government bodies when available and of good quality. If not available, statistical data published by independent bodies may be used. As a third option, the numbers may be based on scientifically peer-reviewed work, with the precondition that data used lies within the commonly accepted data range when available.
- The data used shall be based on the most recent available data from the above-mentioned sources. Typically, the data should be updated over time, unless there is no significant variability of the data over time.
- For fertilizer use, the typical type and quantity of fertilizer used for the crop in the region concerned may be used. Emissions from the production of fertilizer should either be based on measured values or on technical specifications of the production facility. When the range of emissions values for a group[i] of fertilizer production facilities to which the facility concerned belongs is available, the most conservative emission number (highest) of that group shall be used.

[i] It refers to for example a situation where an economic operator knows that the fertilizer was produced by a certain company in a certain country. That company has a number of fertilizer production facilities in that country for which the range of processing emissions are known; an economic operator can claim the most conservative number of emissions from those group of fertilizer production facilities.

– When a measured value for yields is used (as supposed to an aggregated value) for the calculations, it is required to also use a measured value for fertilizer input and vice versa.

Emissions from the extraction or cultivation of raw materials, e_{ec}, shall include emissions from the extraction or cultivation process itself, from using engine fuels for agricultural machinery and other vehicles, from the collection of raw materials, from waste and leakages, and from the production of chemicals or products used in extraction or cultivation. Sequestration of CO_2 in the cultivation of raw materials shall be excluded. Estimates of emissions from cultivation may be derived from the use of averages calculated for smaller geographical areas than those used in the calculation of the default values, as an alternative to using actual values[1]. In the case of lack of default values, actual values shall be used. Calculation of actual values shall be carried out based on credible and documented data. Also, the calculation method shall be documented in a clear and evident way. Input data for the calculations shall include first of all: seeds, biomass yield per area unit, biomass parameters (e.g. moisture content), type of fuel and fuel consumption during cultivation and extraction, quantities and type of fertilizers, plant pesticides, herbicides or other chemicals used, quantities of co-products and other data, depending on specificity of a given production pathway.
The inputs/variables that affect emissions from cultivation will typically include seeds, fuel, fertiliser, pesticide, yield, and N_2O emissions from the field. The short carbon cycle uptake of carbon dioxide in the plants is not taken into account here [8].

GHG emissions from biomass production are calculated according to the following formula:

$$e_{ec} = e_{seed} + e_{chem} + e_{irr} + e_{field} + e_{burn} + e_{mm} \quad [4]$$

where:
e_{seed} GHG emissions from seeding material
e_{chem} GHG emissions from production and transport of fertilisers and agrochemicals
e_{irr} GHG emissions from crop irrigation.
e_{fuield} emissions (methane and mostly nitrous oxide) occurring during the cultivation cycle as a result of land management
e_{burn} GHG emission caused by pre and post-harvest burning
e_{mm} GHG emissions from agricultural, forestry machinery and other mobile or stationary machinery
e_{ec} value is expressed *as CO_{2eq} per mass or energy unit,*

GHG emissions from seeding material
include those incurred for production, storage and transport of seeds. Where seeding material is obtained from its own production, the amount of biomass retained as seeding material shall be subtracted from the total biomass production to calculate the net biomass production

GHG emissions from the production and transport of fertilisers and agrochemicals

GHG emissions from the production and transport of fertilisers and agrochemicals are calculated according to the following formula:

$$e_{chem} = Q_{chem} * F_{chem} \quad [5]$$

where

Q_{chem} is the quantity of fertiliser or agro-chemical applied per unit of land area, usually expressed in mass

F_{chem} is the GHG intensity (emission factor) of fertiliser or agro-chemical production and transport expressed in mass of CO_{2eq} per unit of fertiliser or agro-chemical (usually mass).

GHG emissions from crop irrigation

These are emissions caused by using machinery for pumping, storage and spreading of water. The related GHG emissions shall be calculated as e_{mm} emission

Greenhouse gases field emissions (*e_{fuield}*)

These are emissions (methane and mostly nitrous oxide) occurring during the cultivation cycle as a result of land management. These emissions consist of four different contributions:

$$e_{field} = e_{f-N2O\ direct} + e_{f-N20\ indirect} + e_{liming+ureain} + e_{CH4,flood} \quad [6]$$

where

$e_{f\text{-}N2O\ direct}$ is direct emissions expressed in mass of CO2eq per unit of land area;

$e_{f\text{-}N2O\ indirect}$ is indirect emissions expressed in mass of CO2eq per unit of land area;

$e_{liming+ureain}$ is the emission of CO2 from urea and lime application expressed in mass of CO_2eq per unit of land area

$e_{CH4flood}$ is the emission of CH4 from flooded cultures expressed in mass of CO2eq per unit of land area

An appropriate way to take into account N_2O emissions from soils is the IPCC methodology, including what are described there as both 'direct' and 'indirect' N_2O emissions[ii]. All three IPCC tiers could be used by economic operators. Tier 3, which relies on detailed measurement and/or modelling, seems more relevant for the calculation of 'regional' cultivation values than for the calculation of actual values.

Pre and post-harvest burning

These are emissions caused by burning of vegetation, dead organic matter or crop residues and may result in emissions of CH_4 and N_2O from incomplete combustion. CO_2 emissions from burning biomass material are considered to be zero.

Emission from fuel use in agricultural and forest machinery is calculated according to the equation [7]:

$$Fl_{mm} = Q_{mmf} * F_f \quad [7]$$

[ii] Cf. 2006 IPCC guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 11 (http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_11_Ch11_N2O&CO2.pdf).

where:

Fl_{mm} - *emission from use of agricultural and forest vehicles, expressed as* CO_{2eq} *per unit area, per year;*

Q_{mmf} - *fuel consumption of agricultural and forest machinery, expressed in units of mass, volume or energy per unit area, per year;*

F_t - *GHG emission factor from fuel production and consumption, expressed as* CO_{2eq} *per fuel unit (mass, volume, energy).*

For the purposes of reporting, these values may be also expressed in relation to the net amount of biomass produced, using the following equation [8]:

$$F_{mm} = \frac{Fl_{mm}}{Y_{bp}} \qquad [8]$$

where:

F_{mm} - *emission from use of agricultural machinery for biomass production, expressed as* CO_{2eq} *per unit of net biomass produced;*

Y_{bp} - *net biomass yield, expressed as net quantity biomass (in units of mass or volume), net of any losses or retained seeding material, per unit of land area, per year.*

In order to determine GHG emission from the use of chemicals utilized in agriculture, it is necessary to know their GHG emission factors, and quantity used in relation to their net biomass yield.

Annual emissions from carbon stock changes caused by land-use change, e_l,

Annual emissions from carbon stock changes caused by land-use change, e_l shall be calculated by dividing total emissions equally over 20 years.

For the calculation of those emissions the following rule shall be applied [9]:

$$e_l = (CS_R – CS_A) \times 3,664 \times 1/20 \times 1/P – e_B \qquad [9]$$

[iii]

where:

e_l - *annualized greenhouse gas emissions from carbon stock change due to land-use change (measured as mass of* CO_2*-equivalent per unit biofuel or bioliquid energy);*

CS_R - *the carbon stock per unit area associated with the reference land use (measured as mass of carbon per unit area, including both soil and vegetation). The reference land use shall be the land use in January 2008 or 20 years before the raw material was obtained, whichever was the later;*

CS_A - *the carbon stock per unit area associated with the actual land use (measured as mass of carbon per unit area, including both soil and vegetation). In cases where*

[iii] Coefficient obtained by dividing molar mass of CO_2 (44.010 g/mol) by molar mass of carbon (12.011 g/mol) amounts to 3.664

the carbon stock accumulates over more than one year, the value attributed to CS_A shall be the estimated stock per unit area after 20 years or when the crop reaches maturity, whichever the earlier;

P - *the productivity of the crop (measured as biofuel or bioliquid energy per unit area per year); and*

e_B - *bonus of 29 gCO_{2eq}/MJ biofuel or bioliquid if biomass is obtained from restored degraded land under the conditions provided below.*

The bonus of 29 gCO_{2eq}/MJ shall be attributed if evidence is provided that the land:

a) was not in use for agriculture or any other activity in January 2008; and
b) falls into one of the following categories:
   (i) severely degraded land, including such land that was formerly in agricultural use;
   (ii) heavily contaminated land.

The bonus of 29 gCO_{2eq}/MJ shall apply for a period of up to 10 years from the date of conversion of the land to agricultural use, provided that a steady increase in carbon stocks as well as a sizable reduction in the erosion phenomena for land falling under (i) are ensured and that soil contamination for land falling under (ii) is reduced.

The definition for "degraded land" is not yet available from the EC. Until such time that the definition of degraded land is finalized, there is no possibility to recognize the allocation of the 29gCO2/MJ biofuel bonus for degraded land (e_B).

The categories referred to in point (b) are defined as follows:

a) 'severely degraded land' means land that, for a significant period of time, has either been significantly salinated or has presented significantly low organic matter content and has been severely eroded;
b) 'heavily contaminated land' means land that is unfit for the cultivation of food and feed due to soil contamination.

Such land shall include land that is subject to Commission decision in accordance with the fourth subparagraph of Article 18(4) of the RED. The European Commission developed guidelines for calculations of land carbon stock for purposes of Annex V of the RED, published in the Commission Decision of 10 June 2010[7].

Methodology of calculation of land carbon stock is discussed in document entitled *System INiG/KZR/4/ Land use for biomass production – lands with high carbon stock.*

4.2.4.2 Emissions from processing, e_p

Emissions from processing shall include emissions from the processing itself; from waste and leakages; and from the production of chemicals or products used in processing.

Actual values for emissions from processing steps (e_p in the methodology) in the production chain must be measured or based on technical specifications of the processing facility. When the range of emissions values for a group of processing facilities to which the facility concerned belongs is available, the most conservative number of that group shall be used.

In the case of the **production stage**, given possible savings of greenhouse gases emissions and high traceability of production processes, exact measurements of GHG intensity of both equipment and raw material, it is ultimately recommended to use actual values.
In order to standardize the applicable methodology, some common assumptions shall be taken, intended for general use by all economic operators involved in biofuel and bioliquid generation and distribution. According to Communication[8] (see section 3.3.) it would not seem necessary to include in the calculation inputs which will have little or no effect on the result, such as chemicals used in low amounts in processing. Values of greenhouse gases emission savings are rounded to the nearest percentage point.

Emission from fuel use (heating fuels) at the processing stage is calculated according to the equation [3]

Co-processing of biomass with fossil raw material
Some processes of biomass conversion may be carried out simultaneously with the processing of fossil raw material. In such cases, it is necessary to define the share of the product of biological origin in the total amount of co-product at a given stage of processing. Greenhouse gases emissions generated at this and the following stages of processing shall be allocated to both the product of biological origin, and fractions from fossil parts.
In order to determine the share of the fraction of biological origin (β) in the product obtained in co-processing, the following equation shall be used [10]:

$$\beta = \frac{\Sigma(Q_{b,in}i * LHV_{b,in}i)}{\Sigma(Q_{in}j * LHV_{in}j)} \qquad \textbf{[10]}$$

where:

$Q_{b,in}i$	*- mass of i^{th} biomass directed to conversion process;expressed in mass unit*
$LHV_{b,in}i$	*- lower heating value of i^{th} biomass directed to conversion process, expressed as energy unit per mass unit;*
$Q_{in}j$	*- quantity of j^{th} stream (of both biological and fossil origins) introduced into the process, expressed in mass units;*
$LHV_{in}j$	*- lower heating value of j^{th} stream (of both biological and fossil origins) expressed as energy unit per mass unit.*

Emission allocation procedure, shall correspond with the character of the raw material. Some of GHG emission components (e.g. the ones introduced with reagents, chemicals, production, delivery and combustion of process fuel) are not directly connected with a given raw material, while the component generated by fuels produced within the plant or asso-

ciated with chemical reactions occurring in the biomass, may be allocated to the individual raw material streams.
GHG emission allocated to biomass stream is calculated according to the following equation [11]:

$$C_{c,bio} = \beta * (C_{rea} + C_{chem} + C_{fue} + C_{en} - C_{ex}) + C_{fui,bio} + C_{rebio} \quad [11]$$

where:

$C_{c,bio}$	*- GHG emission associated with biomass being a part of biofuel, bioliquid, or intermediate product, generated in the process of biomass and fossil raw material conversion, expressed in mass units CO_{2eq}, after allocation to co products;*
C_{rea}	*- GHG emission from production, delivery of reagents necessary for conversion process; expressed in mass units CO_{2eq}*
C_{chem}	*- GHG emission from production, delivery of chemicals necessary for conversion process; expressed in mass units CO_{2eq}*
C_{fue}	*- GHG emission from production, delivery and combustion of fuels bought externally; expressed in mass units CO_{2eq}*
C_{en}	*- emission from production, delivery of heat and electricity bought externally; expressed in mass units CO_{2eq}*
C_{ex}	*- emission from exported electricity produced in CHP system; expressed in mass units CO_{2eq}*
$C_{fui,bio}$	*- GHG emission from combustion of biomass produced/processed in the plant; expressed in mass units CO_{2eq}*
$C_{re,bio}$	*- GHG emission from chemical/biological reactions occurring in the biomass; expressed in mass units CO_{2eq}.*

Given that in the case of biological origin of the fuel, CO_2 emission generated from combustion of the fuel is not taken into account, it shall be assumed that this emission amounts to zero. However, it is necessary to take into account emitted nitrogen oxides and methane converted to CO_2 equivalent.

4.2.4.3 Emissions from transport and distribution, e_{td},

Emissions from transport and distribution shall include emissions from transport and storage of raw and semi-finished materials and from the storage and distribution of finished materials. This value contains also emission from depots and filling stations. Emissions from on-farm transport and distribution allocated to crops cultivation or raw material extraction shall not be covered by this point. They shall instead be covered by 4.2.4.1. Emission generated at this stage shall be calculated according to equation [12]:

$$F_t = \sum (F_f i * Qs_t i) * D_t \quad [12]$$

where:

$F_f i$ - *emission factor for production and use of* i^{th} *fuel expressed as* CO_{2eq} *per fuel unit (mass, volume or energy);*

$Qs_t i$ - *consumption of* i^{th} *fuel per unit travelled and per unit of product transported (mass, volume, energy content). In the case when it is used, the value takes into account the fuel used for empty back-haul, excluding situations when given means of transport have been used for other purposes;*

D_t - *distance covered by given means of transport, expressed in unit travel.*

Note on emissions from filling stations and depots

Source: Additional background information on depot and filling station emission provided from the European Commission to the EU voluntary schemes

The Communication 160/02 stated that (see section 2.1):

"Member States need to define which economic operators need to submit the information concerned. Most transport fuels are subject to excise duty, which is payable on release for consumption (9). The obvious choice is to place the responsibility for submitting information on biofuels on the economic operator who pays the duty. At this point information with regard to the sustainability criteria along the entire fuel chain shall be available (10)."

With footnote (10): *The one exception is the greenhouse gas emissions from distribution of the fuel (if needed for the calculation of an actual value). It would be appropriate to use a standard coefficient for this.*

Therefore it would make sense to use a standard coefficient for this (the BioGrace excel sheets show what numbers are used for filling stations in the typical/default values; those numbers an economic operator could consider using).

In addition, the emissions at the fuel depot also need to be included. Emissions at the depot and filling station both relate to electricity usage. One important point to note is that for imported biofuels there may be several depots that need to be included in the calculation (e.g. import and export terminals).

The BioGrace includes the following depot and filling station emissions (for all biofuels):

- Depot: 0.11 gCO2/MJ fuel (based on electricity usage of 0.00084 MJ/MJ fuel and the standard values for Electricity NG CCGT and Electricity EU mix LV)
- Filling station: 0.44 gCO2/MJ fuel (based on electricity usage of 0.0034 MJ/MJ fuel and the standard value for Electricity EU mix LV)

Relevant data are available on the Joint Research Center website:
http://re.jrc.ec.europa.eu/biof/html/input_data_ghg.htm

It is, that in the INiG certification system, **disaggregated default values for the transport stage** are ultimately used for the calculation of greenhouse gas emissions.

4.2.4.4. Emissions from the fuel in use, e_u,

Emissions from the fuel in use shall be taken to be zero for biofuels and bioliquids.

4.2.4.5.Emission saving from carbon capture and geological storage e_{ccs},

Emission saving from carbon capture and geological storage that have not already been accounted for in e_p, shall be limited to emissions avoided through the capture and sequestration of emitted CO_2 directly related to the extraction, transport, processing and distribution of fuel. The emission saving is expressed in gCO_2eq/MJ

4.2.4.6.Emission saving from carbon capture and replacement, e_{ccr},

Emission saving from carbon capture and replacement shall be limited to emissions avoided through the capture of CO_2 of which the carbon originates from biomass and which is used to replace fossil-derived CO_2 used in commercial products and services. The emission saving is expressed in gCO_2eq/MJ.
Both CCR and CCS processes require energy for capture, transport, and in the case of CCS also compression of CO_2, causing additional GHG emissions to the atmosphere (unless the energy used comes from renewable sources or from fuels not containing carbon). So the capture of CO_2 originating from biomass processing does not reduce the total GHG emission. In order to reduce CO_2 emission effectively, emissions generated during the capture and storage (replacement) processes shall also be (if possible) stored. If such process occurs, the avoided CO_2 emission is considered and not the amounts actually stored in deep geological structures.

4.2.4.7. Emission saving from excess electricity from cogeneration, e_{ee},

Emission saving from excess electricity from cogeneration shall be taken into account with reference to the excess electricity produced by fuel production systems that use cogeneration, except where the fuel used for the cogeneration is a co-product other than an agricultural crop residue. The emission saving is expressed in gCO_2eq/MJ.

The general allocation rule in point 17 of Annex V of the RED does not apply for electricity from CHP when the CHP runs on:
(i) fossil fuels;
(ii) bioenergy,
where this is not a coproduct from the same process; or
(iii) agricultural crop residues, even if they are a co-product from the same process
Instead, the rule of calculation of emission saving from excess electricity applies as follows[8]:

- Where the CHP supplies heat not only to the biofuel/bioliquid process but also for other purposes, the size of the CHP should be notionally reduced — for the calculation — to the size that is necessary to supply only the heat necessary for the biofuel/bioliquid process. The primary electricity output of the CHP should be notionally reduced in proportion.

- To the amount of electricity that remains — after this notional adjustment and after covering any actual internal electricity needs — a greenhouse gas credit should be assigned that should be subtracted from the processing emissions.
- The amount of this benefit is equal to the life cycle emissions attributable to the production of an equal amount of electricity from the same type of fuel in a power plant.

If the whole amount of heat produced by a CHP unit is consumed for biofuels production, GHG emission calculations shall be based on the total fuel consumption of the CHP plant. In the case when CHP works also for other external consumers, fuel consumption shall be distributed proportionally according to the heat consumption of the individual consumers.
If the ratio of electricity to heat consumed by the biofuels production plant is higher than that for electricity produced by CHP, it is assumed that the additional amount of electricity required comes from the local grid.
If the aforementioned ratio is lower, it may be assumed that the volume of energy production by CHP is of such as that required for biofuel production. Electricity surplus is allocated to biofuels according to the following equation [13]:

$$P_s = P_{CHP} * \frac{H_b}{H_{CHP}} - P_b \quad [13]$$

where:
P_s - *electricity surplus allocated to biofuel facility;expressed in energy unit*
P_{CHP} - *total electricity production in CHP plant; expressed in energy unit*
P_b - *amount of electricity consumed by biofuel production facility; expressed in energy unit*
H_b - *amount of heat consumed by biofuel production facility; expressed in energy unit*
H_{CHP} - *total amount of heat generated by the CHP, expressed in energy unit.*

The greenhouse gas emission saving associated with that excess electricity shall be taken to be equal to the amount of greenhouse gas that would be emitted when an equal amount of electricity was generated in a power plant using the same fuel as the cogeneration unit.
For the calculations, harmonized reference values of efficiency for distributed electricity production shall be used, as provided in Annex I to Decision of European Commission of 21 December 2006 setting harmonized reference values of efficiency for separated electricity production and heat according to Directive 2004/8/EC of European Parliament and of the Council (200/74/EC)[9]. Coefficients of GHG emission characterizing fuel used in a CHP plant, shall be based on a credible external source (e.g. national statistical data, BioGrace, GEMIS etc).

Energy needed for a given process may be generated by using part of the raw material or by streams obtained during raw material processing (e.g. residues). As these streams are of biological origin, CO_2 emission generated during their combustion shall be taken to be zero. In spite of this, GHG emission in the form of methane or N_2O shall be taken into account in the calculations.

When a part of the raw material is used as an energy fuel, GHG emission from the production and transport of the total amount of the raw material shall be taken into account in the calculations.
In the case of excess heat production (without cogeneration) and export of this heat to an external consumer (beyond the boundaries of the calculation system), part of the fuel used for production of this heat is not considered an input stream for the calculation system.
The net value of GHG emission accompanying the consumption and sale of energy is calculated according to the following equation [14]:

$$C_n = C_{if} + C_{ih} + C_{ieg} + C_{int} - C_{ex} \qquad [14]$$

where:

C_{if} - *emission from externally supplied fuel; expressed in mass units* CO_{2eq}

C_{ih} - *emission from externally supplied heat; expressed in mass units* CO_{2eq}

C_{ieg} - *emission from electricity supplied from the grid; expressed in mass units* CO_{2eq}

C_{int} - *emission from combustion of own raw material or internal streams; expressed in mass units* CO_{2eq}

C_{ex} - *emission connected with exported electricity produced in the CHP unit. expressed in mass units* CO_{2eq}

Savings of greenhouse gas emissions connected with electricity surplus, are considered equal to the amount of greenhouse gases that would be emitted, if the same amount of electricity as in a co-generation unit had been produced, in a power plant using the same fuel.

4.3. Biofuels/bioliquids partially originating from renewable sources

Biofuels, bioliquids, include also the ones which only in part consisted of substances originating from renewable sources. One example may be ethyl-tert-butyl ether (ETBE). For some of them, Annex III to the RED defines the proportions in which the fuel may be considered a fuel originating from renewable sources, for the purposes stated in this Directive. In the case when a given type of fuel is not listed in Annex III, particularly if the biofuel is produced in a flexible production process, not always ensuring control over constant proportion of components from various sources in the individual supplies, a method analogical to the method utilized in calculations concerning electricity produced in plant powered with mixed fuel, may be used successfully. The method consists in the following: „share of each energy source is calculated based on its energy contents”. For the purposes of meeting the sustainability criteria in reference to greenhouse gases emission savings, **part of the fuels originating from renewable sources has to meet an appropriate threshold of GHG emission saving . For some, such as ETBE, table 3-7 give default values (disaggregated default value)**

4.4 Allocation of GHG emissions to co-products and waste

In the production process, co-products, waste and residues form apart of the main product. Considering this, there is a need of defining allocation rules, or allocation of GHG emission intensities to the product groups mentioned above. Emission inventory for allocation shall also take into account all operation necessary for discard or utilization, so they leave the system without burdening with GHG emission (that is why emission value for the stage of collection of raw material-waste is considered zero).

Greenhouse gas emission is allocated between the main product (biofuel, processed biomass, processed biomass for biofuels production) and co-products, based on the energy content of the individual streams, according to the equation:

$$C_i = C_t * Q_i * \frac{LHV_i}{\Sigma(Q_i * LHV_i)} \qquad [15]$$

where:

C_t - total GHG emission incurred in production process, up to separation of products; *expressed in mass units* CO_{2eq}

C_i - amount of C_t allocated to stream *i*; *expressed in mass units* CO_{2eq}

Q_i - amount of stream *i* produced; expressed in energy unit

LHV_i - lower heating value of stream *I; expressed in energy unit per mass unit*.

The lower heating value used in applying this rule shall be that of the entire (co-)product, not only of the dry fraction of it. In many cases, however, notably in relation to nearly-dry products, the latter could give a result that is an adequate approximation

Co-products

If in the process of biofuel production simultaneously are generated: biofuel/bioliquid, for which emission is calculated, one or more products („co-products”), greenhouse gases emission is distributed between the biofuel or its intermediate product, and co-products, proportionally to their energy contents (defined according to the lower heating value for co-products other than electricity). One example may be production of ethanol from corn, where through the use of wet grinding, such products as maize syrup, maize oil, maize gluten powder, maize gluten fodder are obtained, as well as other food products, such as: vitamins or aminoacids. These products may be used as feed for animals (e.g. DDGS – *Dried Distiller's Grains with Solubles*). Emission is allocated then also to these products. GHG is not allocated to waste produced in the process.

In the case when co-products are taken into account in calculations, emissions to be allocated are: e_{ec} + e_l + these parts of e_p, e_{td} and e_{ee}, which take place before the phase of production, in which co-product forms, and during this phase. If, in relation to these co-products, any emissions have been allocated to earlier production phases in the lifecycle, only the part of emissions allocated to intermediate fuel product in the last production phase is taken into account, not the whole emissions.

For biofuels and bioliquids, all co-products are taken into account in calculations, including electricity omitted in e_{ee} with exclusion of agriculture crop residue, including straw, bagasse, husk, cobs and nutshells). In the calculations, for co-products with negative energy value, it is assumed that they have zero energy value.

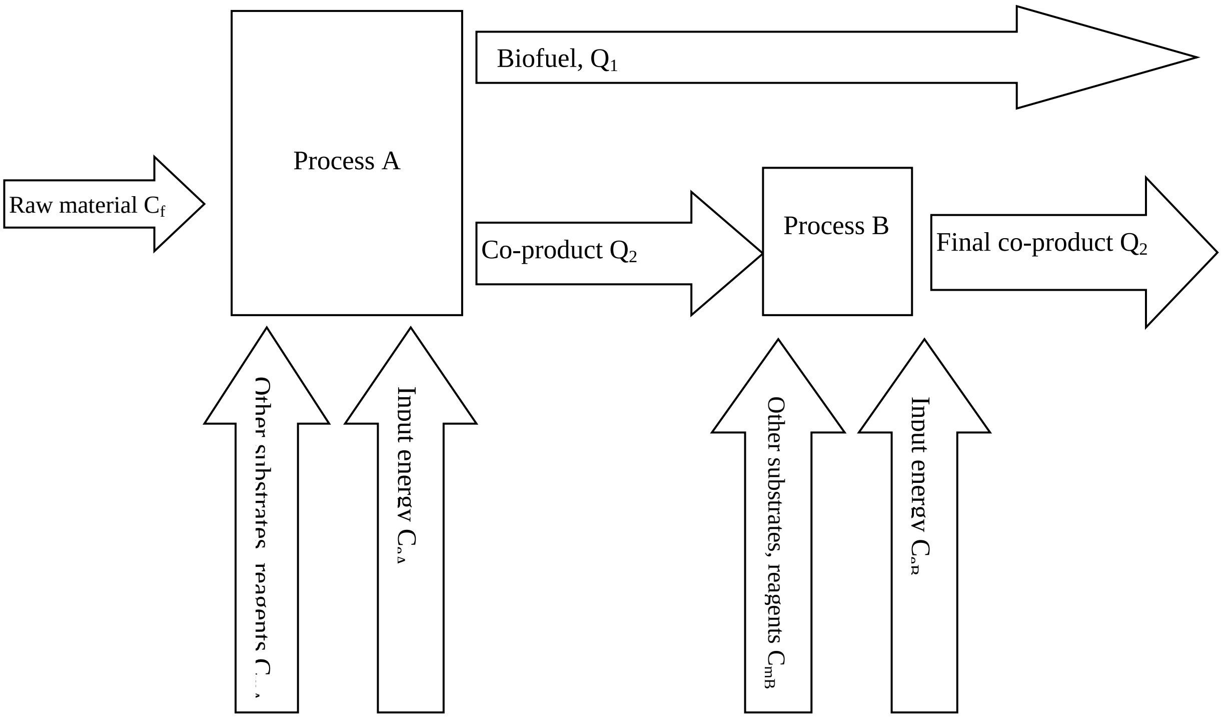
Wastes from processing, agricultural crop residues, including straw, bagasse, husks, cobs and nut shells, and residues from processing, including crude glycerine (glycerine that is not refined), shall be considered to have zero life-cycle greenhouse gas emissions up to the process of collection of those materials.

Allocation of emission to the individual products shall be applied directly at this stage of the productions process, during which biofuel, bioliquid or intermediate product, or co-product (substance that shall be suitable for storage or commerce) are produced.

Allocation of GHG emission to the individual products and co-products may be carried out at individual stages of the process in the plant, followed by further processing in the next stages of the production chain, for each of the products. However, if the product's or co-product's processing at further stages remains in direct relations (energy or material feedback loops) with any of the previous processing stages (e.g. turning back of the product stream in a given process), emission allocations shall be attributed in moments when each of the products reaches a point, in which, the next processing stages are no longer connected with material or energetic feedback loops from any earlier processing stages – (GHG emission is not allocated to the stream of product being turned back in the process).

Methodology of allocation of GHG emission to the product and co-product, in the case when the latter undergoes further processing, is shown schematically in the Figure below. Next Figure (No. 3) shows allocation between biofuel/bioliquid or intermediate and co-products with feedback loops.

Fig.2 Methodology of allocation of GHG emission



Total GHG emission from process A (including emission allocated to input energy), *expressed in mass units CO_{2eq}*:

$$C_{tA} = C_f + C_{mA} + C_{eA}$$

Total emission GHG from process B (including emission allocated to input energy), *expressed in mass units* CO_{2eq}:

$$C_{tB} = C_{mB}+C_{eB}$$

GHG emission allocated to stream 1 (biofuel/bioliquid), *expressed in mass units* CO_{2eq}:

$$C_1=C_{tA}*Q_1*LHV_1/(Q_1*LHV_1+Q_2*LHV_2)$$

GHG emission allocated to stream 2 (co-product), *expressed in mass units* CO_{2eq}:

$$C_2=C_{tA}*Q_2*LHV_2/(Q_1*LHV_1+Q_2*LHV_2)$$

Total emission allocated to the co-product stream: C_2+C_{tB}

Where

$C_{tA/B}$ *the* total GHG emission from process A/B (including emission allocated to input energy), *expressed in mass units* CO_{2eq}

C_f *the emission associated with feedstock, expressed in mass units* CO_{2eq}

$C_{mA/B}$ *the emission associated with other materials (A process or B), expressed in mass units* CO_{2eq}

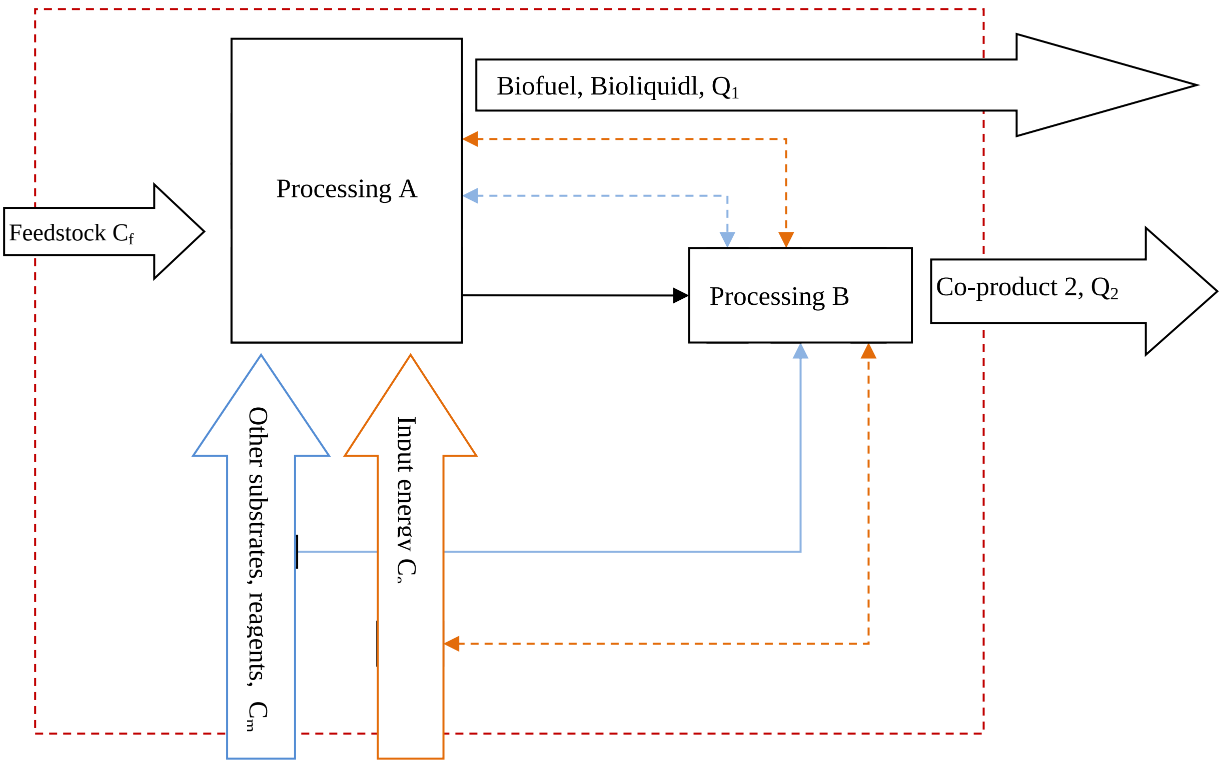
$C_{eA/B}$ *the emission associated with energy (A process or B), expressed in mass units* CO_{2eq}

$C_{1\ or 2}$ *the* GHG emission allocated to stream 1 or 2, *expressed in mass units* CO_{2eq}

$Q_{1/2}$ *the quantity of product 1/2, expressed in mass unit*

$LHV_{1/2}$ *the lower heating value of product 1/2, expressed as energy unit per mass unit*

Figure 3 Allocation between biofuel/bioliquid or intermediate and co-products with feedback loops



Total GHG emissions associated with all inputs: $C_t = C_f + C_m + C_e$

GHG emissions allocation to Biofuel/Bioliqiud: $C_1 = C_t *Q_1*LHV_1/(Q_1* LHV_1+Q_2* LHV_2)$

GHG emissions allocation to Co-product: $C_2 = C_t *Q_2*LHV_1/(Q_1* LHV_1+Q_2* LHV_2)$

Where

C_t: Total GHG emissions associated with all inputs, *expressed in mass units* CO_{2eq}

C_1: GHG emissions allocation to Biofuel/Bioliqiud, *expressed in mass units* CO_{2eq}

C_2: GHG emissions allocation to Co-product, *expressed in mass units* CO_{2eq}

C_f *the emission associated with feedstock, expressed in mass units* CO_{2eq}

C_m *the emission associated with other materials, expressed in mass units* CO_{2eq}

C_e *the emission associated with energy, expressed in mass units* CO_{2eq}

$Q_{1/2}$ *the quantity of product 1/2, expressed in mass unit*

$LHV_{1/2/}$ *the lower heating value of product 1/2, expressed as energy unit per mass unit*

Waste and residues

Waste from processing, an agriculture crop residue, including straw, cobs and nutshells, and residue formed in other processing operations, including raw (non-refined) glycerol, are considered materials not emitting any greenhouse gases in their whole lifecycle, up to the process of collection of those materials. Emissions are not allocated to crop residues or to waste from processing – they are considered non-emissive.

For the determination of the GHG emission savings value for a given biofuel, knowledge of the total GHG emissions generated in the lifecycle of this product is necessary. Therefore, the intensity level of greenhouse gas emissions shall be determined at every stage by every economic operator handling biomass/processed biomass for energy purposes. Given the large diversification in operational activities of individual economic operators, there will be differences in: the scope of data, operation taken into account, and units in which the calculations will be carried out. The Table 1 below gathers the most important elements pertaining to the calculations of GHG emissions at every stage.

Table 1 – Basic elements of GHG emission calculation at different stage

Production stage	**GHG emission**	**Reference to system document**	**Unit**	**Subject**
Land-use	Carbon stock change Soil degradation	*KZR INiG System /4/ Land-use for biomass production – lands with high carbon stock* *KZR INiG/ System 5/ Land-use for biomass production – biodiversity* *KZR INiG System /8/ Guidelines for determination of lifecycle per unit values of GHG emissions for biofuels, bioliquids*, p.4.2	kg CO_{2eq}/ha/year	Economic operator

Production stage	GHG emission	Reference to system document	Unit	Subject
Biomass production	Emission from usage of fertilizers and plant pesticides Emission from usage of agricultural machinery	*KZR INiG System /8/Guidelines for determination of lifecycle per unit values of GHG emissions for biofuels, bioliquids*, p.4.2, p.4.4	kg CO_{2eq}/t of biomass	
Biomass purchase, brokerage	Emission from biomass purification and storage processes	*System KZR INiG/8/ Guidelines for determination of lifecycle per unit values of GHG emissions for biofuels, bioliquids*, p.4.2, p.4.4	kg CO_2/t of biomass	First gathering point, Broker
	Emission from biomass transport	*System KZR INiG/8/ Guidelines for determination of lifecycle per unit values of GHG emissions for biofuels, bioliquids*, p.4.2	kg CO_2/t of biomass	Broker
Biomass processing	Emission introduced with reagents Emission from processes and operation	*System KZR INiG/8/ Guidelines for determination of lifecycle per unit values of GHG emissions for biofuels, bioliquids*, p.4.2, p.4.4	kg CO_{2eq}/t of biomass or g CO_{2eq}/MJ of energy contained in the biofuel	Intermediate producer
Biofuel/bioliquid manufacturing	Emission introduced with reagents Emission from processes and activities	*System KZR INiG/8/ Guidelines for determination of lifecycle per unit values of GHG emissions for biofuels, bioliquids*, p.4.2, p.4.3, p.4.4	g CO_{2eq}/MJ of energy contained in the biofuel	Biofuel/ bioliquid manufacturer

4.5. Usage of default values

If the conditions defining the usage of default values are met, biofuels, bioliquids, manufacturers may indicate the default greenhouse gas emission saving shown below for the indicated biofuels production pathways, presented in Table 2[1]. Default values are based on the RED which is in force since April 23, 2009

Table 2 - Default greenhouse gas emission saving for biofuels, bioliquids manufactured without net carbon dioxide emission from land-use change

Production pathway	Default greenhouse gases emission saving
Sugar beet ethanol	52 %
Wheat ethanol (process fuel undefined)	16 %
Wheat ethanol (lignite as process fuel in CHP plant)	16 %
Wheat ethanol (natural gas as process fuel in conventional boiler)	34 %

Production pathway	Default greenhouse gases emission saving
Wheat ethanol (natural gas as process fuel in CHP plant)	47 %
wheat ethanol (straw as process fuel in CHP plant)	69 %
Corn (maize) ethanol Community produced (natural gas as process fuel in CHP plant)	49 %
Sugar cane ethanol	71 %
The part from renewable sources of ethyl-tert-butyl-ether (ETBE)	Equal to that of the ethanol production pathway used
The part from renewable sources of tert-amyl-ethyl-ether (TAEE)	Equal to that of the ethanol production pathway used
Rape seed biodiesel	38 %
Sunflower biodiesel	51 %
Soybean biodiesel	31 %
Palm oil biodiesel (process not specified)	19 %
Palm oil biodiesel (process with methane capture at oil mill)	56 %
Waste vegetable or animal (*) oil biodiesel	83 %
Hydrotreated vegetable oil from rape seed	47 %
Hydrotreated vegetable oil from sunflower	62 %
Hydrotreated vegetable oil from palm oil (process not specified)	26 %
Hydrotreated vegetable oil from palm oil (process with methane capture at oil mill)	65 %
Pure vegetable oil from rape seed	57 %
Biogas from municipal organic waste as compressed natural gas	73 %
Biogas from wet manure as compressed natural gas	81 %
Biogas from dry manure as compressed natural gas	82 %
(*) Not including animal oil produced from animal by-products classified as category 3 material in accordance with Regulation (EC) No 1774/2002 of the European Parliament and of the Council of 3 October 2002 laying down health rules on animal by-products not intended for human consumption.	

If the conditions defining usage of default values are met, economic operators in the supply chain may indicate the default values, shown below (table 3-6). Table 7-10 contain estimate disaggregated default values for future biofuel and bioliquid[1].

Table 3. Disaggregated default values for cultivation: 'e_{ec}' as defined in formula 2 section 4.2.4

Biofuel and bioliquid production pathway	Typical greenhouse gas emissions (gCO2eq/MJ)	Default greenhouse gas emissions (gCO2eq/MJ)
sugar beet ethanol	12	12
wheat ethanol	23	23
corn (maize) ethanol, Community produced	20	20
sugar cane ethanol	14	14
the part from renewable sources of ETBE	Equal to that of the ethanol production pathway used	
the part from renewable sources of TAEE	Equal to that of the ethanol production pathway used	
rape seed biodiesel	29	29
sunflower biodiesel	18	18
soybean biodiesel	19	19
palm oil biodiesel	14	14
waste vegetable or animal (*) oil biodiesel	0	0
hydrotreated vegetable oil from rape seed	30	30
hydrotreated vegetable oil from sunflower	18	18
hydrotreated vegetable oil from palm oil	15	15
pure vegetable oil from rape seed	30	30
biogas from municipal organic waste as compressed natural gas	0	0
biogas from wet manure as compressed natural gas	0	0
biogas from dry manure as compressed natural gas	0	0
(*) Not including animal oil produced from animal by-products classified as category 3 material in accordance with Regulation (EC) No 1774/2002		

Table 4. Disaggregated default values for processing (including excess electricity): 'e_p – e_{ee}' as defined in formula 2 section 4.2.4

Biofuel and bioliquid production pathway	Typical greenhouse gas emissions (gCO2eq/MJ)	Default greenhouse gas emissions (gCO2eq/MJ)
sugar beet ethanol	19	26
wheat ethanol (process fuel not specified)	32	45
wheat ethanol (lignite as process fuel in CHP plant)	32	45
wheat ethanol (natural gas as process fuel in conventional boiler)	21	30
wheat ethanol (natural gas as process fuel in CHP plant)	14	19
wheat ethanol (straw as process fuel in CHP plant)	1	1
corn (maize) ethanol, Community produced (natural gas as process fuel in CHP plant)	15	21
sugar cane ethanol	1	1
the part from renewable sources of ETBE	Equal to that of the ethanol production pathway used	
the part from renewable sources of TAEE	Equal to that of the ethanol production pathway used	
rape seed biodiesel	16	22
sunflower biodiesel	16	22
soybean biodiesel	18	26
palm oil biodiesel (process not specified)	35	49
palm oil biodiesel (process with methane capture at oil mill)	13	18
waste vegetable or animal oil biodiesel	9	13
hydrotreated vegetable oil from rape seed	10	13
hydrotreated vegetable oil from sunflower	10	13
hydrotreated vegetable oil from palm oil (process not specified)	30	42
hydrotreated vegetable oil from palm oil (process with methane capture at oil mill)	7	9
pure vegetable oil from rape seed	4	5
biogas from municipal organic waste as compressed natural gas	14	20
biogas from wet manure as compressed natural gas	8	11
biogas from dry manure as compressed natural gas	8	11

Table 5. Disaggregated default values for the transport and distribution: 'e_{td}' as defined in formula 2 section 4.2.4

Biofuel and bioliquid production pathway	Typical greenhouse gas emissions	Default greenhouse gas emissions

	(gCO2eq/MJ)	(gCO2eq/MJ)
sugar beet ethanol	2	2
wheat ethanol	2	2
corn (maize) ethanol, Community produced	2	2
sugar cane ethanol	9	9
the part from renewable sources of ETBE	Equal to that of the ethanol production path-way used	
the part from renewable sources of TAEE	Equal to that of the ethanol production path-way used	
rape seed biodiesel	1	1
sunflower biodiesel	1	1
soybean biodiesel	13	13
palm oil biodiesel	5	5
waste vegetable or animal oil biodiesel	1	1
hydrotreated vegetable oil from rape seed	1	1
hydrotreated vegetable oil from sunflower	1	1
hydrotreated vegetable oil from palm oil	5	5
pure vegetable oil from rape seed	1	1
biogas from municipal organic waste as compressed natural gas	3	3
biogas from wet manure as compressed natural gas	5	5
biogas from dry manure as compressed natural gas	4	4

Table 6. Total for cultivation, processing, transport and distribution

Biofuel and bioliquid production pathway	Typical greenhouse gas emissions (gCO2eq/MJ)	Default greenhouse gas emissions (gCO2eq/MJ)
sugar beet ethanol	33	40
wheat ethanol (process fuel not specified)	57	70
wheat ethanol (lignite as process fuel in CHP plant)	57	70
wheat ethanol (natural gas as process fuel in conventional boiler)	46	55
wheat ethanol (natural gas as process fuel in CHP plant)	39	44
wheat ethanol (straw as process fuel in CHP plant)	26	26
corn (maize) ethanol, Community produced (natural gas as process fuel in CHP plant)	37	43
sugar cane ethanol	24	24
the part from renewable sources of ETBE	Equal to that of the ethanol production pathway used	
the part from renewable sources of TAEE	Equal to that of the ethanol production pathway used	
rape seed biodiesel	46	52
sunflower biodiesel	35	41
soybean biodiesel	50	58
palm oil biodiesel (process not specified)	54	68
palm oil biodiesel (process with methane capture at oil mill)	32	37
waste vegetable or animal oil biodiesel	10	14
hydrotreated vegetable oil from rape seed	41	44
hydrotreated vegetable oil from sunflower	29	32
hydrotreated vegetable oil from palm oil (process not specified)	50	62
hydrotreated vegetable oil from palm oil (process with methane capture at oil mill)	27	29
pure vegetable oil from rape seed	35	36
biogas from municipal organic waste as compressed natural gas	17	23
biogas from wet manure as compressed natural gas	13	16
biogas from dry manure as compressed natural gas	12	15

Estimated disaggregated default values for future biofuels and bioliquids that were not on the market or were only on the market in negligible quantities in January 2008

Table 7. Disaggregated default values for cultivation: 'e_{ec}' as defined in formula 2 section 4.2.4

Biofuel and bioliquid production pathway	Typical greenhouse gas emissions (gCO2eq/MJ)	Default greenhouse gas emissions (gCO2eq/MJ)
wheat straw ethanol	3	3
waste wood ethanol	1	1
farmed wood ethanol	6	6
waste wood Fischer-Tropsch diesel	1	1
farmed wood Fischer-Tropsch diesel	4	4
waste wood DME	1	1
farmed wood DME	5	5
waste wood methanol	1	1
farmed wood methanol	5	5
the part from renewable sources of MTBE	Equal to that of the methanol production pathway used	

Table 8. Disaggregated default values for processing (including excess electricity): '$e_p - e_{ee}$' as defined in formula 2 section 4.2.4

Biofuel and bioliquid production pathway	Typical greenhouse gas emissions (gCO2eq/MJ)	Default greenhouse gas emissions (gCO2eq/MJ)
wheat straw ethanol	5	7
wood ethanol	12	17
wood Fischer-Tropsch diesel	0	0
wood DME	0	0
wood methanol	0	0
the part from renewable sources of MTBE	Equal to that of the methanol production pathway used	

Table 9. Disaggregated default values for transport and distribution: '*etd*' as defined as defined in formula 2 section 4.2.4

Biofuel and bioliquid production pathway	Typical greenhouse gas emissions (gCO2eq/MJ)	Default greenhouse gas emissions (gCO2eq/MJ)
wheat straw ethanol	2	2
waste wood ethanol	4	4
farmed wood ethanol	2	2
waste wood Fischer-Tropsch diesel	3	3
farmed wood Fischer-Tropsch diesel	2	2
waste wood DME	4	4
farmed wood DME	2	2
waste wood methanol	4	4

Biofuel and bioliquid production pathway	Typical greenhouse gas emissions (gCO2eq/MJ)	Default greenhouse gas emissions (gCO2eq/MJ)
farmed wood methanol	2	2
the part from renewable sources of MTBE	Equal to that of the methanol production pathway used	

Table 10. Total for cultivation, processing, transport and distribution

Biofuel and bioliquid production pathway	Typical greenhouse gas emissions (gCO2eq/MJ)	Default greenhouse gas emissions (gCO2eq/MJ)
wheat straw ethanol	11	13
waste wood ethanol	17	22
farmed wood ethanol	20	25
waste wood Fischer-Tropsch diesel	4	4
farmed wood Fischer-Tropsch diesel	6	6
waste wood DME	5	5
farmed wood DME	7	7
waste wood methanol	5	5
farmed wood methanol	7	7
the part from renewable sources of MTBE	Equal to that of the methanol production pathway used	

It is important to note that there are no default emission values for the component 'land-use changes' (e_l formula 2 section 4.2.4). If disaggregated default values are used for the cultivation stage, GHG emissions from land-use changes always have to be added to them.

The disaggregated default values listed in the tables above are expressed in gCO_2eq/MJ. Economic operators, who need the values in GHG emissions per kg product (when the fate of product is unknown), shall take the value from an appropriate reference source (e.g. BioGrace[5]).

The values listed in table (3-11) based on the RED. In the case when EC makes any changes to the default values or the GHG methodology, then these changes will be reflected with immediate effect in the KZR INiG System. Any changes to the GHG methodology shall be notified to the Commission without delay

5. Verified data collecting

In internal procedures of an economic operator participating in the INiG Certification System, the method for the determination of greenhouse gas emission values for products shall be recorded. Particularly it shall be noted whether default or actual values are used (INiG system permits both these possibilities).

In the case when default values are used, it is necessary to provide objective proof confirming that the necessary conditions are met.

In the case when actual values are used, the economic operator is obliged to collect identifying information:
- boundaries of the calculation system;
- input data (raw materials, energy media);
- output data (products, energy media);
- internal processes together with their energy requirements;
- sources of primary data;
- sources of secondary data;
- method of calculations;
- waste, co-products.

All data shall be gathered in a clear, readable, transparent way easy to verify.

6. Decision tree

Every economic operator in the supply chain is obliged to provide intensities of greenhouse gas emissions for their product. The intensity may be expressed by using the calculated actual values or – if relevant conditions are met – using default values. Below, the procedure for the determination of GHG emission intensity is shown schematically. Considering large diversification in the character of operation at individual economic operators, three groups of economic operators are distinguished, for which the procedures are similar.

Fig.3 Agriculture producer decision tree

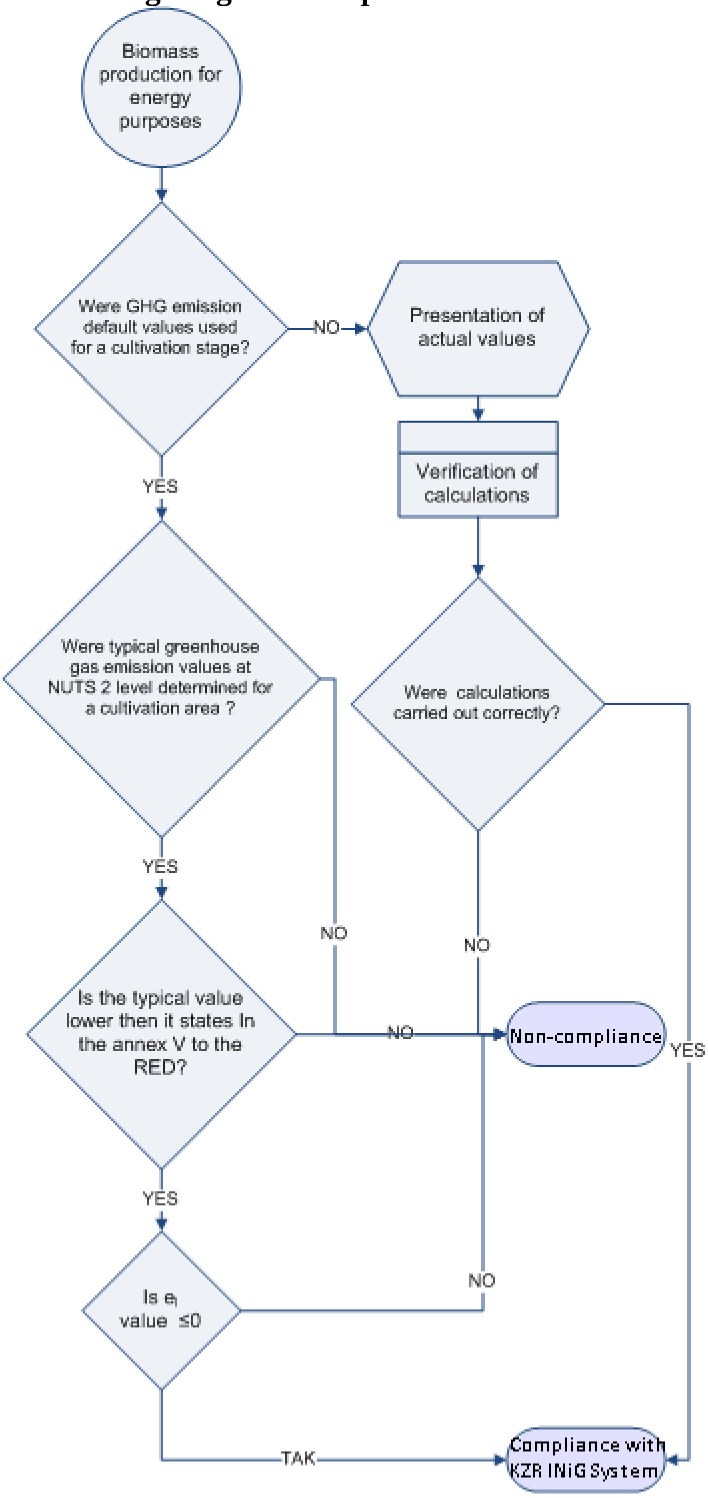


Fig. 4 Intermediate producer decision tree

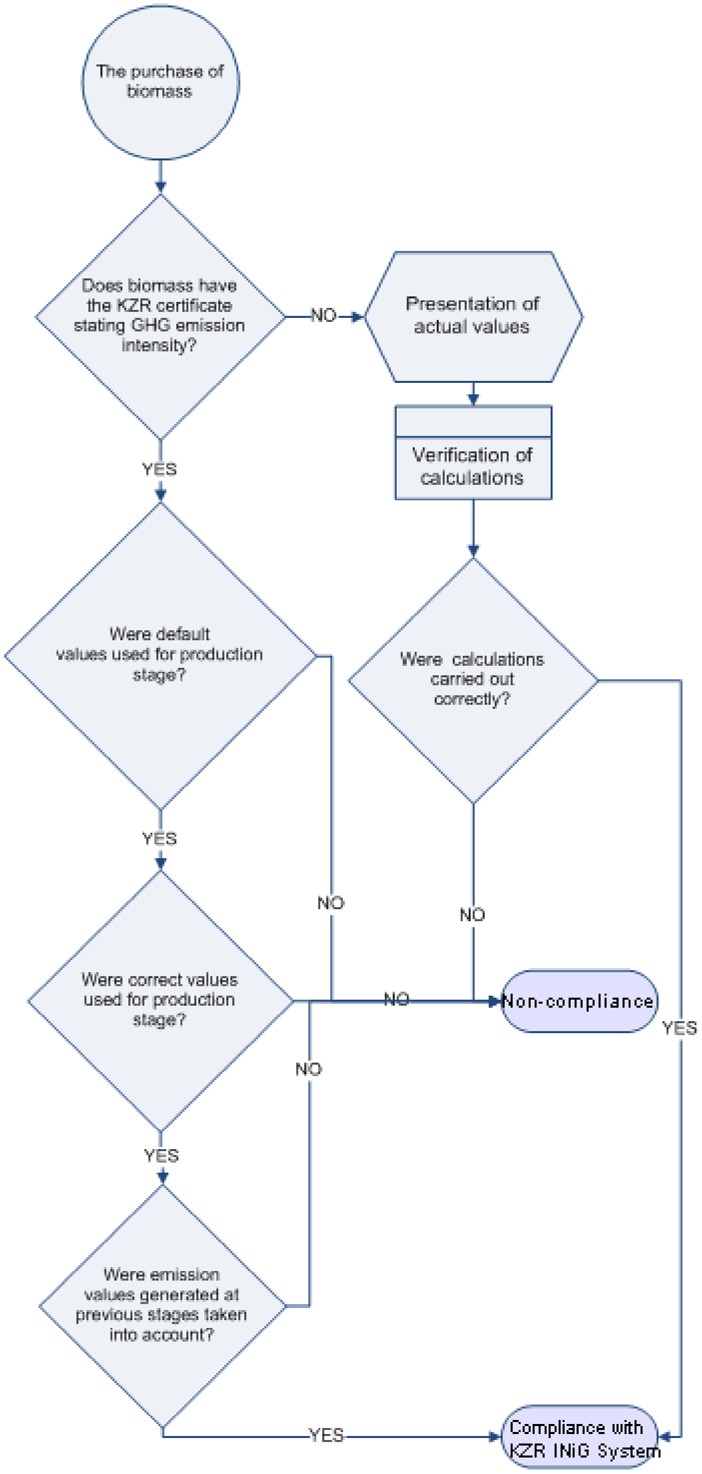
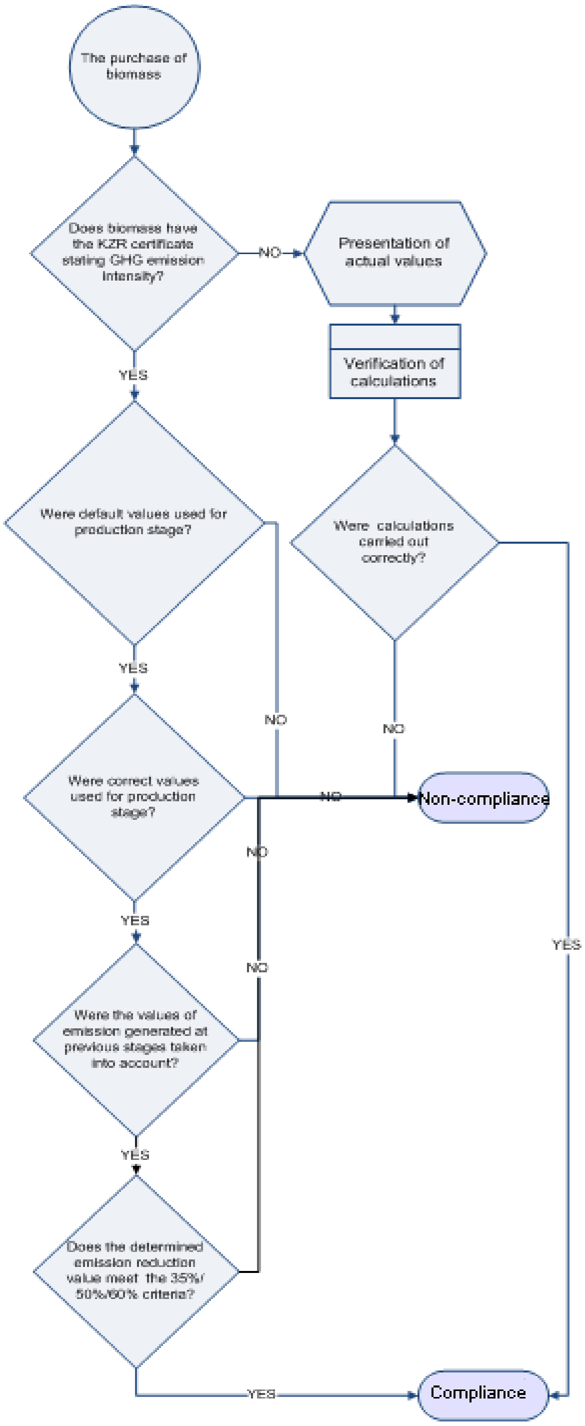


Fig. 5 Biofuel/bio-liquid/ bio-component producer decision tree



7. Checklist

The check list with guidelines for an auditor is published in document entitled *KZR INiG System/10/ Guidelines to auditor and conduct of audit*.

8. References

1. Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC (Official Journal of European Union No. L 140/16 of 9.06.2009).
2. Communication from the Commission on voluntary schemes and default values in the EU biofuels and bioliquids sustainability scheme (Official Journal of European Union C 160/01 of 19.06.2010).
3. Communication from the Commission on the practical implementation of the EU biofuels and bioliquids sustainability scheme and on counting rules for biofuels (Official Journal of European Union C 160/02 of 19.06.2010).
4. Regulation (EC) No. 1059/2003 of the European Parliament and of the Council of 26 May 2003 on the establishment of a common classification of territorial units for statistics (NUTS), O.J. L 154 of 21.6.2003, p. 1.
5. FPrEN 16214-4 Sustainably produced biomass for energy applications – Principles, criteria, indicators and verifies for biofuels and bioliquids – Part 4:Calculation methods of the greenhouse gas emission balance using a life cycle analysis.
6. http://www.kobize.pl/index.php?mact=News,cntnt01,detail,0&cntnt01articleid=147&cntnt01origid=51&cntnt01returnid=116
7. Commission Decision of 10 June 2010 on guidelines for the calculation of land carbon stocks for the purpose of Annex V to Directive 2009/28/EC (notified under document C(2010) 3751) O.J. L 151/19 of 17.06.2010.
8. Communication from the Commission on the practical implementation of the EU biofuels and bioliquids sustainability scheme and on counting rules for biofuels, Official Journal of European Union C160/08 of 19.06.2010.
9. Commission Decision of 21 December 2006 establishing harmonized efficiency reference values for separate production of electricity and heat in application of Directive 2004/8/EC of the European Parliament and of the Council
10. PrEN 16214-5Sustainably produced biomass for energy applications – Principles, criteria, indicators and verifies for biofuels and bioliquids – Part 5: Guidance towards definition of residue and waste via positive list.