KZR INiG System /7

Guidance for proper functioning of mass balance system

by The Oil and Gas Institute

The KZR INiG System/7

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1. Introduction.

Compliance with the sustainability criteria shall be demonstrated by economic operators participating in the KZR INiG System through assurances of traceability of a given quantity of biomass with the assigned proper certificate of compliance with the sustainability criteria in the whole supply chain.

Mass balance system is a set of statements and data ensuring supervision over quantities of biomass flowing through the supply chain and production, from an agricultural producer or first waste collection point to the final biofuels or bioliquids producer. The mass balance always has to start from the origin of the feedstock.(e.g. for Used Cooking Oil the first collector must be included in the scheme and must be able to provide evidence of the restaurants they collected from).

This document applies to all economic operators participating (*i.e. system participants*) in the *KZR INiG System* and at any sites where biomass, biofuel and bioliquids products are legally and physically controlled by system participants. The compliance with all requirements of this mass balance system is demonstrated by system participants during audit carried out by independent certification bodies. The system participants in the mass balance system are the;

- agricultural producers
- first gathering points, middlemen, traders, brokers,
- intermediate producers (biomass processors)
- biofuel, bioliquid manufacturers
- fuel producers, final suppliers, others that are :

  any other economic operators involved in the processing, conversion, transformation, manufacturing, trading, storage, first waste collection points, distribution of waste, residues and biomass, biofuel and bioliquid products and/or otherwise the way of handling.

In order to ensure proper supervision over these streams, Directive 2009/28/EC **(RED)** introduces the obligation of development and application of the mass balance system in the enterprise. It results directly from article 18 of the RED. According to directive, Member States require that system participants apply the mass balance system which will be a basis for a demonstration of compliance with the sustainability criteria. Mass balance system:

a) allows consignments of raw material or biofuel with differing sustainability characteristics to be mixed;

b) requires information about the sustainability characteristics and sizes of the consignments referred to in point (a) to remain assigned to the mixture; and

c) provides for the sum of all consignments withdrawn from the mixture to be described as having the same sustainability characteristics, in the same quantities, as the sum of all consignments added to the mixture.

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 /3/ Reference with national legislation*
- *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 /8/ Guidelines for the determination of the lifecycle per unit values of GHG emissions for biofuels and bioliquids*

The reference normative documents are:

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

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.

3. Definitions

KZR INiG System/2/ Definitions

4. Guidelines for the construction of a mass balance system

According to the rules of the KZR INiG System, economic operators must enforce a mass balance system, complying with the requirements of KZR INiG System. Each system participant is obliged to introduce a mass balance system, which is the subject of assessment during an audit. The mass balance system shall operate at least at the level of a site. Site is defined as a geographical location with precise boundaries within which products can be mixed. The mass balance system shall operate at a level where consignments could normally be in contact, such as in a container, processing or logistical facility or site.

The mass balance system is to ensure traceability, supervision, management of the biomass streams (processed biomass) meeting the sustainability criteria.

In order to minimize the administrative burden for the economic operator (system participant), it is suggested to expand the operational system already existing in the company, e.g. a financial-bookkeeping system, storage system, etc., supplementing it with elements revolving around sustainability.

It must be emphasized that the introduction of the mass balance system, and similarly - the whole system of sustainability criteria, should not disturb significantly the existing organization of document flow within the company.

The first step is to define the system's boundaries and to designate points of raw material/feedstock, (biomass, waste or residue) entry and final product exit.

According to *KZR INiG System* the moment of receipt of biomass (processed biomass) is the entry point (exit point) of a stream to the mass balance system of a given economic operator.

Mass balance system means record keeping where "sustainability characteristics" remain ascribed to a given batch, lot or consignment of the raw material. It means that each economic operator**,** which processes, converts, transforms, manufactures, trades, stores, distributes and/or otherwise handles the biomass (processed biomass), ensures traceability of every batch, lot or consignment of product that goes through the processing unit.

Sustainability characteristic of given batch is describe by input/output data (see point 5).

Traceability shall be ensured at every stage of the chain of custody.

The mass balance system shall give consideration to data on GHG of all compliant batches, lots or consignments in a given accounting period, excluding GHG emissions that are ascribed to parts that do not comply with the sustainability requirements. Only compliant batches, lots or consignment shall be accounted for in the GHG balance. According to the KZR INiG system it is not permitted for GHG emissions to be averaged across different batches.

In the case of blending of batches, lots or consignments with identical sustainability characteristics, its total mass is taken into consideration in the calculations of GHG emission. This means that in the purpose of GHG emission calculation, batches from different supply but with the same sustainability characteristic can be summed. Note that it is permitted if **all sustainability characteristics** are identical. According to KZR INiG scheme, it is also permitted to allocate the worst GHG value to all batches that have otherwise the same sustainability characteristics.

When input batches, lots or consignments with various sustainability characteristics are blended together (processed together), the separate sizes and sustainability characteristics of each batch remain assigned to the mixture. This data shall be documented in the mass balance system records.

If the mixture is split up, the quantity of the compliant batch taken out of this mixture shall not be greater than the quantity of the input compliant batch introduced into the mixture (taking into account an efficiency coefficient or a conversion coefficient).

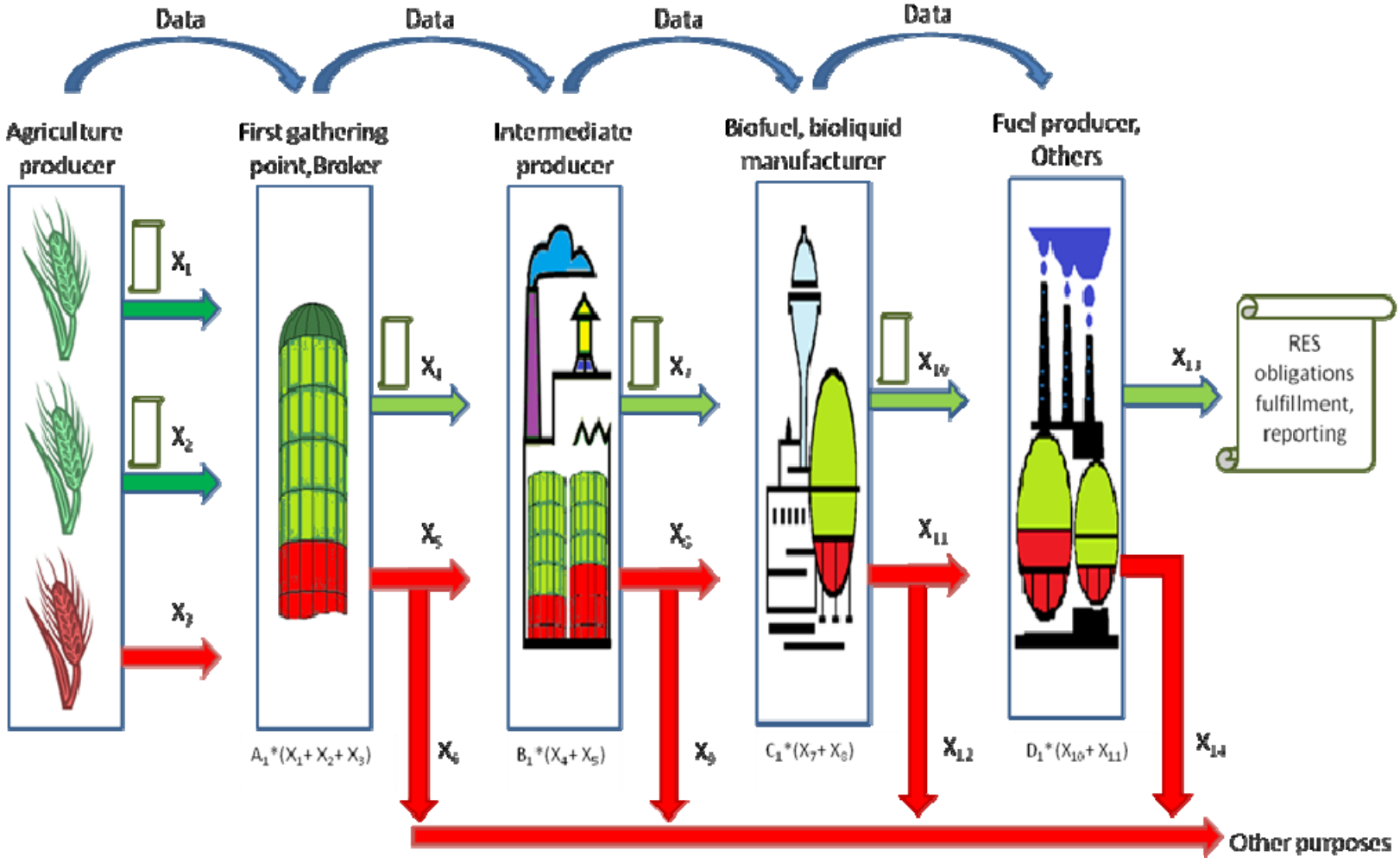
The mass balance may be calculated in a defined time period and verified regularly. A 3 months period is the maximum allowed time in the KZR INiG System. In individual cases, each producer shall plan mass balance methods and adjust to his operation profile, in a way ensuring its observation and an easy method of verification.

For correct implementation and usage of the mass balance, it is necessary to identify all processes occurring at the production plant, from the entry of the commodity to the moment of shipment to the customer. Development of a **process map** showing biomass path and connections between the individual processes will be helpful. It will allow ensuring traceability of biomass stream complying with the sustainability criteria, and it will also be a basis for carrying out calculations of GHG emissions connected with this stage of biofuel or bioliquids life cycle.

Ensuring traceability of the individual biomass batches, lots or consignments does not need to consist in physical supervision over the individual shipments, but it must take place at the stage of purchase and sale of batches meeting sustainability criteria (defined entry and exit points of streams from the system), and entries and exits to/from the individual processes, particularly the ones in which a change in mass or conversion to another product occurs. So each system's participant (economic operator) carries out a mass balance based on invoices (reception documents), records of quantity of the product complying with the sustainability criteria, bought and sold by this economic operator.

For production processes and processing, and for other processes where a change in mass of the biomass may occur, **everyone defines an efficiency coefficient, a conversion coefficient**. An example of mass balance diagram in the whole lifecycle of a biofuel is shown in the Figure below.

Fig. 1 Diagram of a mass balance of the INiG System



The above diagram presents a mass balance system in the whole production chain of biofuel and bioliquids in an illustrative and very simplified way.

The orange rectangles define the boundaries of a mass balance system at each production site.

Agriculture producer

The agriculture producer is the first link in the chain of custody obliged to introduce a mass balance system. He shall define the quantity of produced biomass and its sustainability characteristic (X_{1-3}), information concerning land-use change and all data required to verify GHG emission calculations (if applicable). In order to confirm the data, the agriculture producer shall deliver the yield per hectare and the size of his field.

First gathering point/ broker

The raw material batches purchased from the agricultural producer together with their characteristics are the input data. The first gathering point may accept biomass also from agricultural producers that do not declare meeting the sustainability criteria. In the above diagram, "X_3" is the raw material quantity from an agricultural producer that does not declare meeting the sustainability criteria, while X_1 and X_2 quantities come from an agricultural producer declaring meeting the sustainability criteria. Supply size shall be adjusted to storage parameters. It is proposed that the following should be assumed as storage parameters of grain in the KZR INiG System:

- impurities contents not more than 3% of impurities;
- moisture content, for oily seeds 7%, for grains 14%, for maize 15%.

To these quantities emission values gCO_{2eq}/MJ (gCO_{2eq}/mass or volume unit) are ascribed, determined according to the methodology of a given system. The first gathering point identifies processes that the biomass is undergoing within its boundaries. Energy demand necessary for the calculation of GHG emissions for the identified processes is determined, and also in the case when during the processes a change in biomass quantity occurs (coefficient marked as A_1 is presented in the diagram).

It is left to the discretion of the first gathering point to plan the document flow in a way ensuring that information on quantities of the raw material meeting and not meeting sustainability criteria currently stored is available at every moment.

The simplest way to meet this requirement is a proper differentiation in the financial-bookkeeping system of the economic operator subject to audit. In the case when an invoice correction has taken place by a corrective quantity of biomass sold, proper changes in the mass balance shall be introduced.

Intermediate producer

The next system participant, similarly as the first gathering point, shall identify pathways and processes, which the biomass is undergoing and define the performance coefficient, conversion coefficient („B_1" is a coefficient in the above diagram) for these processes. Given the fact that raw materials for biofuels and bioliquids production may be characterized by various indices of greenhouse gas emissions, calculations of GHG emissions must be carried out based on the intermediate producer's mass balance with regard to emissivity and energy consumption of the particular individual processes, and also after allocation of emissions to the individual products. $X_4 – X_5$ represent the quantity of compliant biomass and X_5 is non compliant biomass entering into the producer's mass balance system. The output streams are X_7-X_8. To these quantities emission values gCO_{2eq}/MJ (gCO_{2eq}/mass or volume unit) are ascribed, determined according to the methodology of the KZR INiG System or another recognized EU system.

Biofuel/bioliquid manufacturer

An analogous procedure takes place at the subsequent stages, where „X_7","X_8" are biomass quantity defined based on purchase – sale documents and an input data in the mass balance system at the system participant, and an input data in the mass balance system at the manufacturer of the biofuel/bioliquids. To these quantities emission values gCO_{2eq}/MJ (gCO_{2eq}/mass or volume unit) are ascribed, determined according to the methodology of the KZR INiG System or another recognized EU system. Identical procedures shall be enforced at the manufacturer of the biofuel/bioliquids, i.e.

- identification of the biomass pathway in the production plant,
- development of a process map with indication of the efficiency coefficient or a conversion coefficient (C_1), ensuring of traceability of the product meeting the sustainability criteria,
- allocation of emissions to the individual products.

In the above diagram, the efficiency coefficient or conversion coefficient is marked in a general way as "C_1", while depending on the type of biofuel/bioliquids manufactured and technology used, $C_1*(X_7 + X_8)$ equation will take a more complex, extended form.

Fuel producer, final supplier, others

In order to ensure traceability of meeting the sustainability criteria of biofuel, each economic operator shall introduce a mass balance system. A fuel producer, final supplier or other economic operators handling biomass (processed biomass, biofuel, bioliquids) is obliged to define input (X_{10}, X_{11}) and output (X_{13}, X_{14}) streams. To these quantities emission values gCO_{2eq}/MJ (gCO_{2eq}/mass or volume unit) are ascribed, determined according to the methodology of the KZR INiG System or another recognized EU system. In the above diagram, the efficiency coefficient or conversion coefficient is marked in a general way as "D_1", while depending on the type of fuel production and other economic operators activity, $D_1*(X_{10} + X_{11})$ equation will take a more complex, extended form.

5. Documenting the verified data

FprEN 16214-2 standard *Sustainably produced biomass for energy applications – Principles, criteria, indicators and verifies for biofuels and bioliquids – Part 2: Conformity assessment including chain of custody and mass balance* does not provide a scheme for single procedure and guidelines for building a mass balance system. The system may be based on another system, already in place in a processing unit. It is important that the introduction of an evaluation system of the sustainability criteria does not cause excessive administrative difficulties at the system participant. That is why one simple evaluation algorithm of the introduced mass balance system cannot be built. However, immediate identification of the data that shall be collected by the system participant is critical.
A map of processes performed in the production unit together with definition of input and output data for each process is a starting point for the development of inventory tables. If during the process, a change in mass or conversion to another product occurs, it is necessary to provide corresponding coefficients in the mass balance calculation. In a defined process, by-products and waste shall be counted.

In order to ensure traceability of the product batches meeting the sustainability criteria, the economic operator shall provide to the next operating operator information about input and output data that he is obliged to report, demonstrate during audit, exchange and collect within mass balance system, as follows:

Input minimum data

- data identifying the economic operator (supplier of the raw material)
- did "a recognised voluntary scheme" certify the supplier (Yes/No) and in case 'yes', the name of this voluntary scheme
- the name of the purchased product
- data confirming sustainability of the biomass/processed biomass (include number and date of the certificate and name of recognized certification scheme, related contract number),
- type of raw material/feedstock (The name of raw material of the purchased product e.g. rapeseed oil, sunflower oil, rapeseed methyl ester, corn etc.)
- shipment destination, date and supply size,
- country of origin of the biomass and the NUTS2 region, if ~~applicable~~, available
- originating from waste and residue, the name of waste feedstock e.g. UCO, bakery waste etc.), if applicable

- has the bonus for degraded land be applied? (Yes/NO/No data)
- cumulative greenhouse gas emission (saving) data characterizing the batch (actual or disaggregated default value or regional default value), expressed in gCO_{2eq}/MJ or gCO_{2eq}/t, calculated according to the RED methodology (implemented in *KZR INiG System/8/ Guidelines for determination of lifecycle per unit values of GHG emissions for biofuels and bioliquids,* including emission received from the previous economic operators.,
- annualised emission from carbon stock changes caused by land-use change,
- delivery date and unique identification number, transport distances,
- statement by the economic operator that delivered raw material/feedstock (other than waste and processing residue, but including agricultural, aquaculture, fisheries and forestry residues) is compliant with the land-use requirements described in RED and in the KZR INiG System documents ~~or in case of the KZR INiG system participant in documents:~~
  - ~~*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 /6/ Land use for biomass production – agricultural and environmental requirements and standards*~~
- name, function and signature of authorized person confirming data

Output, minimum data:

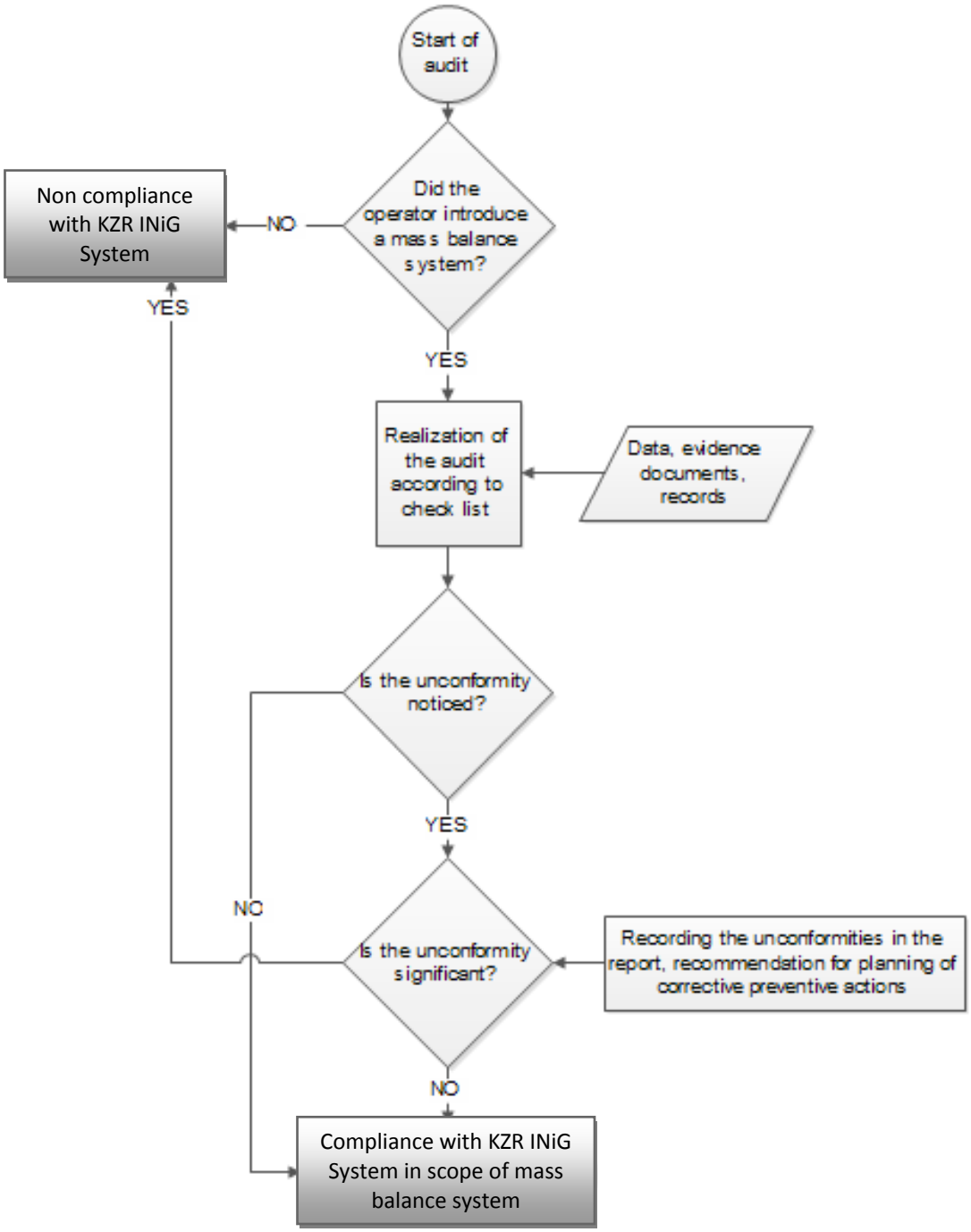
- data identifying the seller,
- information that the KZR INiG Scheme certified the operator, certificate number and the name of certification body),
- The name of the sold product
- confirmation that the batch meets the sustainability criteria according to the RED,
- type of raw material/feedstock (~~if applicable~~), The name of raw material of the sold product e.g. rapeseed oil, sunflower oil, rapeseed methyl ester, corn etc.)
- ~~type of delivered biomass (processed biomass, if applicable type of wastes and residues)~~
- originating from waste and residue, the name of waste feedstock e.g. UCO, bakery waste etc.), if applicable
- ~~—~~
- shipment destination, date and supply size,

- country of origin of the biomass and the NUTS2 region, if available
- ~~if applicable, origin from waste and residue~~,
- has the bonus for degraded land be applied? (Yes/NO/ No data),
- GHG emission coefficient characterizing the batch (actual or disaggregated default value or regional default value), expressed in gCO_{2eq}/MJ or gCO_{2eq}/t, calculated according to the RED methodology (implemented in *KZR INiG System/8/ Guidelines for determination of lifecycle per unit values of GHG emissions for biofuels and bioliquids*. It shall include emission received from the previous economic operators),
- annualised emission from carbon stock changes caused by land-use change,
- delivery date and unique identification number, transport distances,
- statement by the economic operator that delivered raw material/feedstock (other than waste processing residue, but including agricultural, aquaculture, fisheries and forestry residues) is compliant with the land-use requirements described in the RED and in the KZR INiG documents~~:~~
  - ~~*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 /6/ Land use for biomass production – agricultural and environmental requirements and standards*~~
- name, function and signature of authorized person confirming data

6. Decision tree

The diagram below shows a decision tree – a procedure valid during the verification of correctness of a mass balance system.

Figure 2. The procedure valid during the verification process of a mass balance system introduction into the processing unit



7. Checklist

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