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Circular Certification Product

ASSESSMENT METHODOLOGY AND TECHNICAL MANUAL

Circular Certification

Data di emissione	06/07/2023
Revisione	1.0

Data	Rev.	Stato	Data di pubblicazione	Note
16/01/2022	0.1	Draft	NA	Prima emissione
10/03/2022	0.2	Draft	NA	Revisione post conclusione dei piloti
22/06/2022	0.3	Draft	NA	Revisione post confronto con EcoPlatform
02/02/2023	0.4	Draft	NA	Eliminato capitolo “Assessment Score” in quanto relativo a considerazioni non pertinenti l’utilizzo del tool e dello Schema di Certificazione
07/03/2023	0.5	Draft	NA	Chiarito che i materiali di scarto recuperati all’interno dello stesso ciclo produttivo non possono essere conteggiati come “circular materials”.
21/06/2023	0.6	Draft	NA	Aggiornato il documento coerentemente alle richieste di modifica del Regolamento da parte di Accredia
06/07/2023	1.0	Stable	NA	Versione definitiva

Sommario

1 ASSESSMENT METHODOLOGY

1.1 Specific approach

The New Circularity Index developed by Enel X and ICMQ has the aim to measure the relevance of non-virgin materials and renewable energy consumed in a product life, calculated as a relative percentage of total material and energy flows. The NCI is applicable to products for which a function is identifiable on its whole life, according to a from cradle to grave scenario. The calculation model takes into account the amount of materials, water, energy and transports involved in the process and the produced waste; the outcomes highlight the circularity index of materials, energy, water and waste.

1.2 Input data

The input data required for the NCI calculation have to be specific for the product and calculated according to its functional unit, in a life-cycle approach.

The specific inputs are:

- functional unit according to the product category
- reference service life according to the product category and a specific RSL if the producer can justify a different scenario
- materials as raw materials and components, packaging materials, auxiliary materials for production, consumable materials in use stage, materials for maintenance and their packaging, materials for remanufacturing and their packaging
- energy as electrical energy and thermal energy consumed in production, installation, use, maintenance, decommissioning, remanufacturing and transport in all life stages
- water as water consumed in production and use
- waste as waste generated during production, maintenance, end of life and remanufacturing

1.3 Calculations

The NCI analyses the flows of material, energy, water and waste that are involved in all the stages of the product life. In each of the four categories, NCI is the relationship between the circular inputs and the total inputs involved in the product life, as described below.

Materials

$$NCI\ of\ materials = \frac{Circular\ materials}{Circular\ materials + Non - circular\ materials}$$

Where:

- Circular materials = Renewable virgin materials + Recycled materials + Reused materials
- Non-Circular materials = Non-renewable virgin materials

Waste materials recovered within the production process under assessment shall not be counted as "circular materials".

Energy

$$NCI\ of\ energy = \frac{Circular\ energy}{Circular\ energy + Non - circular\ energy}$$

Where:

- Circular energy = Renewable electrical energy + Renewable thermal energy + Transport by electrical vehicle + Transport by train
- Non-Circular energy = Non-renewable electrical energy + Non-renewable thermal energy + Diesel + Unleaded petrol + Transport by truck + Transport by ship + Transport by aircraft

The calculation formula for the electric transport (electrical vehicle and train) takes into account as circular flow only the average percentage of renewable energy contained in the European mix, that is equivalent to 4,44%; the main share is considered non-circular flow.

Water

$$\boldsymbol{NCI\ of\ water = \frac{Circular\ water}{Circular\ water + Non - circular\ water}}$$

Where:

- Circular water = Recycled water
- Non-Circular water = Well water + Tap water

Waste

$$NCI\ of\ waste = \frac{Circular\ waste}{Circular\ waste + Non - circular\ waste}$$

Where:

- Circular waste = Waste to energy recovery + Waste for recycling + Waste for reuse
- Non-Circular waste = Waste to disposal

It is also calculated a material share and an energy share, as the material and energy contents for each year of reference service life, according to the functional unit.

1.4 Presentation of results

The "PRODUCT NCI" is a set of four specific NCIs, which represent:

- NCI of materials
- NCI of energy
- NCI of water
- NCI of waste

For the materials category, the following four values are presented:

- Quantity of Non-Circular inputs as: Non-renewable virgin materials (kg)
- Percentage of Non-Circular inputs as: Non-renewable virgin materials (% on total materials)
- Quantity of Circular inputs as: Circular materials (kg)
- Percentage of Circular inputs as: NCI of materials

The other three categories of energy, water and waste follow the same structure in results presentation.

1.5 Identification of gaps related to circularity information in the EPD

Based on the assessment, the NCI has a strong coherence with the EPD because was developed with the aim to become an EPD indicator. Therefore, the LCA principles and the assessment of the life-cycle stages are integrated with reference to the product functional unit and with a fully quantitative data collection. For each element inserted in the analysis, the quantity of circular and non-circular inputs has to be traced and demonstrated with useful supporting documents, as for a LCA study in EPD development.

The “Quality of recycling” category is not addressed because the NCI is based on the quantities of material/energy/water/waste and their characteristics are considered with the aim to link them to the circular or non-circular category, without and judgment about the quality of the process.

The “Design for disassembly” in not direct considered, even though this category can be intended to influence the waste management in the end of life, when the quantity of waste to recycling is measured.

2 TECHNICAL MANUAL

This technical manual briefly describes the structure of the calculation model owned by ICMQ and Enel X, developed to evaluate the Circularity Index of products and called "NCI Tool". The spreadsheets that make up the calculation model are described, reporting the information and data that have to be entered to allow the calculation and reach the "PRODUCT NCI".

The calculation model has the purpose of calculating a circularity index of the analyzed products, taking into account the amount of materials, water and energy involved in the process and the produced waste; therefore, it is necessary to evaluate the quantity of consumed materials, water and energy in the life stages under assessment and their recycled, recovered and renewable percentages. With regard to the supply chain of raw materials and components, the Tool analyses the characteristics of what is included in the bill of materials but not the energy consumption necessary for the production of raw materials and components and it assumes that the share of renewable energy in the production processes of raw materials and components does not make a significant contribution to the circularity of the product under assessment.

This version of the Technical Manual is applicable to: NCI Tool, Version 1.1 – Stable Version, released on 2023-05-15.

2.1 Data quality and data entry

Since the result of the analysis depends on the quality and accuracy of the qualitative information entered in each spreadsheet of the Tool, it is necessary that the values entered are real, reliable and demonstrable during the verification process. Therefore, the data have to be taken from the documents hold by the Organization who adopt the Tool in order to obtain the assessment of the Circularity Index (NCI) of the product. Greater accuracy must be pursued in the collection and insertion of primary data describing the stages of the process under the direct control of the attestation Owner. The sentence "realistic scenario" identifies the description of a scenario for which appropriate company documentation or literature sources are available to support the declared information during the verification process.

In each sheet of the Tool, there are some white cells, locked and not modifiable, that show data and information automatically entered. On the contrary, the light green color identifies the cells that must be filled in by the Organization, inserting the appropriate information and values, as described in the following paragraphs.

2.2 Definitions

The following definitions are applied in all parts of the Tool.

- National Energy Mix: electrical energy taken from the national electrical grid.
- Recycled material: material that is manufactured from a recovered material and transformed in a final product or in a component to be incorporated into a product; the Secondary Raw Materials and the materials derived from the End of Waste process are recycled materials.
- Renewable virgin material: Raw material of vegetable or animal origin which can be regenerated at the end of each production/consumption cycle within certain exploitation rates and, by extension,

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whose use does not jeopardize natural resources for future generations (UNI/TS 11820) (for example wood and bamboo).

- Renewable with guarantee of origin: electrical energy purchased by the process owner that is certified as green energy, according to a guarantee of origin certificate.
- Reused material: material that is taken from a product at the end of its useful life and is reused in a new product or material that is collected and inserted in a recycling or production process, instead to be disposed. Waste materials recovered within the production process under assessment shall not be counted as "circular materials".
- Self-consumption from self-production: electrical energy that is produced by the process owner from renewable resources and, at the same time, is consumed to feed the production process owned by the organization which request the NCI.

2.3 General information

This sheet allows you to enter key information in Column "D", that regards:

- the Owner of the NCI attestation;
- the analysed product;
- the responsible for the NCI calculation.

It should be noted that the information entered on this page will be reported in the verification report and in the final NCI attestation.

Regarding the product, the necessary information is:

- the commercial name, production code and production site, so as to unambiguously identify the object under assessment;
- the CPC Code;
- the functional unit (FU) or declared unit (DU), as defined by ISO 14040-14044;
- the reference service life (RSL) of the product, according to a standard scenario for the product category or according to a specific value calculated by the Organization and to be proven during verification. Only numerical values have to be inserted.

It is necessary to keep in mind that the quantitative information to be included in the following sheets is specific to the product under assessment and according to the chosen FU/DU and RSL scenario.

2.4 Selection of the life cycle phases

The circularity analysis theoretically assumes an overall assessment of all phases of the product life cycle; however, some phases might not be directly under the control of the Organization requesting the verification. For this reason, the use of realistic scenarios and/or evidences is permitted.

2.5 NCI Tool Modules

A1 – Raw Materials

The “A1-Raw Materials” module concerns the analysis of raw materials and components necessary to produce the product under assessment, therefore, data have to be specific and collected from the bill of materials (BOM) of the producer and from supplier documents or certifications.

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The list of materials and components that can be find in the BOM has to be filled in column "C", with the possibility to associate the components that have the same characteristics in terms of content of virgin/recycled/reused material. The corresponding quantity (kg) for each material or component is entered in column "D" with reference to the chosen FU/DU. The characteristics of the materials that constitute each component are specified in the following columns, as a percentage value (%) of the total weight:

- content of virgin material from renewable sources, column "G";
- content of recycled material, column "I";
- content of reused material, column "K";
- the percentage of virgin material from non-renewable sources is automatically calculated in column "E".

A share of undeclared materials and components can be indicated in cell "D30" and its quantity cannot exceed 5% of the total weight of the product under assessment.

The total weight of the final product can be entered in cell "D37" if different from what is indicated in cell "D31", which results from the sum of the items reported in the previous rows on the basis of the bill of materials.

NOTE.

(1) In cell "D30" at least 95% of the raw materials and components have to be declared.

A1 – Materials Packaging

The "A1-Materials Packaging" module concerns the analysis of the packaging materials used to deliver the raw materials and components from the suppliers to the producer of the product under assessment. These data have to be linked to the BOM and collected from the suppliers.

The list of materials and components that can be find in the product BOM is automatically inserted in column "C", with reference to the information entered in the "A1-Raw Materials" sheet; the quantity of component carried by each standard packaging unit must be entered in column "D". The packaging materials have to be specified in the following columns, indicating the characteristics of the origin (virgin/recycled/reused) and the relative amount (kg). The material typologies are:

- cardboard, column "G", "H" and "I";
- paper, column "J", "K" and "L";
- plastic, column "M", "N" and "O";
- steel, column "P", "Q" and "R";
- aluminium, column "S", "T" and "U";
- wood, column "V", "W" and "X".

The total amount of packaging materials is automatically calculated, taking into account the specific characteristics of them. A share of undeclared packaging materials can be indicated in cell "D30" and its quantity cannot exceed 20% of the total weight of the packaging for raw materials.

NOTES.

(1) In cell "D30", at least 80% of the packaging materials have to be declared.

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(2) In column "D", the net weight of raw material content in one typical packaging received by suppliers is to be declared.
(3) In column "F", the cells are automatically filled with the sum of the quantities declared in the columns from "G" to "X".

A2 – Materials Transport

The "A2-Materials Transport" module concerns the analysis of the transports that take place during the production phase and concern:

- transport of the raw materials and components from the supplier to the production site, also including the weight of the packaging of the raw materials;
- transport of the auxiliary materials necessary for production, excluding their packaging as it is considered irrelevant;
- transport of the packaging materials of the product under assessment to the production site, excluding their packaging as it is considered irrelevant.

The list of raw materials and components that have to be transported according to the product BOM is automatically inserted into cells from "C5" to "C30", with reference to the information entered in the "A1-Raw Materials" sheet; the weight to be transported is automatically inserted into cells from "D5" to "D30". The travelled kilometers have to be entered in the following columns, separately reporting the type of used vehicle:

- diesel truck, column "F";
- electrical vehicle, column "H";
- train, column "J";
- ship, column "L";
- aircraft, column "N".

The information has to be entered taking into account the actual way of transport and plausible travelled distances. What described for the transport of the raw materials is replicated in the same way for the transport of the auxiliary materials necessary for production, in lines from "37" to "51" and with reference to the information included in the "A3-Aux+Pack Materials" sheet. The data on the transport of the packaging materials for the final product are to be reported in lines from "58" to "75", with reference to the information included in the "A3-Aux+Pack Materials" sheet. If the same material or component is procured by several suppliers, an average distance set according to the supply scenario must be declared.

A3 – Aux+Pack Materials

The "A3-Aux+Pack Materials" module concerns the analysis of the auxiliary materials necessary during the production or the assembly stage and the packaging materials of the product under assessment to deliver the final product to clients. Data have to be specific and collected from the production plant documents and from supplier documents or certifications, if the attestation Owner is the use manager, otherwise they must be collected according to a realistic scenario.

The analysis of the auxiliary materials is coherent with the structure of the "A1-Raw Materials" module, the list of them has to be filled in cells from "C5" to "C19" and the corresponding quantities (kg) are entered in column "D" with reference to the chosen FU/DU. The characteristics of the auxiliary materials that are used in production or assembly stage are specified in the following columns, as a percentage value (%) of the total weight:

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- content of virgin material from renewable sources, column “H”;
- content of recycled material, column “J”;
- content of reused material, column “L”;
- the percentage of virgin material from non-renewable sources is automatically calculated in column “F”.

The analysis of the packaging materials used to deliver the product under assessment from the producer to the clients is coherent with the structure of the “A1-Materials Packaging”, the list of them has to be filled in cells from “C26” to “C40” and the corresponding quantities (kg) are entered in column “D”. The packaging materials have to be specified in the following columns, indicating the characteristics of the origin (virgin/recycled/reused) and the relative amount (kg). The material typologies are:

- cardboard, column “H”, “J” and “L”;
- paper, column “N”, “O” and “P”;
- plastic, column “Q”, “R” and “S”;
- steel, column “T”, “U” and “V”;
- aluminium, column “W”, “X” and “Y”;
- wood, column “Z”, “AA” and “AB”.

The total amount of packaging materials is automatically calculated.

NOTES.

(1) In cells “D5-19”, the amount of the auxiliary materials shall be related to the FU or DU.

(2) In cells “C26-40”, if the final product is delivered in only one package, fill only one row; if the final product is delivered in multiple packages, fill one row for each component.

(3) In cells “D26-40”, the net weight of final product/components content in one typical packaging delivered to the clients has to be declared.

(4) The cells “F26-40” are automatically filled with the sum of the quantities declared in the columns from "H" to "AB".

A3 – Production

The “A3-Production” module concerns the analysis of the impacts due to the production process, carried on in the production site declared in the “General information” module. The considered contributions include:

- the consumptions of electrical energy;
- the consumption of thermal energy;
- the consumption of water;
- the waste management.

For each type of energy consumption, it is possible to indicate either an overall value of the entire production process or separate values for specific production phases or plants, in column “C”.

The electricity consumption is evaluated taking into account the country where the production is located, which must be selected from the drop-down menu in cells from “D5” to “D14”. In cells from “E5” to “E14” the

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total electricity consumption for the production of 1 unit of product has to be reported with reference to the FU/DU chosen in the "General information" sheet. The percentage of specific energy consumption has to be filled in the following columns, divided it into:

- renewable energy with guarantee of origin, column "I";
- on site self-produced and self-consumed electricity, column "K";
- energy taken from the national grid, automatically calculated in column "F".

The consumptions of thermal energy are evaluated on the basis of the fuel consumptions declared in lines from "22" to "31" and divided according to the following types:

- natural gas, column "F";
- oil, column "I";
- unleaded petrol, column "K";
- LPG, column "M";
- coke, column "O";
- virgin naphtha, column "P";
- butane, column "Q";
- anthracite, column "R";
- lignite, column "S";
- kerosene, column "T";
- wood, column "U";
- biodiesel, column "V".

The consumptions of water have to be declared in lines from "40" to "49" and divided according to origin, such as:

- tap water, automatically calculated in column "F";
- well water, column "I";
- recycled water, column "K".

The total amount of production waste has to be declared in cell "E56" and it is analysed on the basis of its final destiny, such as:

- disposal, automatically calculated in cell "F56";
- energy recovery, cell "I56";
- recycling, cell "K56";
- reuse, cell "M56".

All data and information regarding the energy consumptions and the destinations of the waste in the production phase are under the responsibility of the producer and this sheet of the Tool has to be filled with information taken from documents relating to the energy supplies at the production plant and the waste management. With regard to the evaluation of production waste, only the types and quantities due to the production of the finished product under evaluation (scraps, packaging of raw materials, production auxiliaries…) must be considered.

NOTE.
(1) In cells "D5-14", the country must be selected according to the production unit.

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A4 – Product Transport

The "A4-Product Transport" module concerns the analysis of the transports that take place after the production phase, to deliver the product under assessment to the customers. The structure of this sheet is coherent with the "A2-Materials Transport", the final destination has to be considered as regions or countries and inserted in column "C", with their percentage of relevance according the chosen FU/DU in column "D". The travelled kilometers have to be entered in the following columns, separately reporting the type of used vehicle:

- diesel truck, column "G";
- electrical vehicle, column "I";
- train, column "K";
- ship, column "M";
- aircraft, column "O".

The information has to be entered taking into account the actual way of transport and plausible travelled distances.

A5 – Installation

The "A5-Installation" module concerns the analysis of the impacts due to the energy consumption which occurs during the installation of the product under assessment and takes into account the following contributions:

- the consumptions of electrical energy;
- the consumption of fuels.

For each type of consumption, it is possible to indicate either an overall value of the entire installation process or separate values for specific installation phases or parts of the products, in column "C".

The electricity consumption is evaluated taking into account the country where the product is installed, which must be selected from the drop-down menu in cells from "D5" to "D14". In cells from "E5" to "E14" the total electricity consumption for the installation of 1 unit of product has to be reported with reference to the FU/DU chosen in the "General information" sheet. The percentage of specific energy consumption has to be filled in the following columns, divided it into:

- renewable energy with guarantee of origin, column "I";
- on site self-produced and self-consumed electricity, column "K";
- energy taken from the national grid, automatically calculated in column "F".

The consumptions of fuels are evaluated on the basis of the following types:

- diesel, column "N";
- unleaded petrol, column "O".

The installation activities can be carried out either by the manufacturer himself or by a different subject, consequently, the organization requesting the NCI attestation may be different from the one that conducts this specific activity. If the attestation Owner is the one who takes care of the installation, the data relating to energy and fuel consumptions must be primary and taken from internal documents; if the attestation Owner is a person other than the one who takes care of the installation, the data can be reasonably assumed.

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NOTE.

Module A5 concerns the analysis of electrical energy and fuels necessary to install the product under assessment. Materials for installation (such as silicon, glue, etc.) have not to be included.

B1 – Use Energy+Water

The "B1-Use Energy+Water" module concerns the analysis of the impacts due to the operational stage of the product, according to its function and taking into account the RSL declared in the "General information" module, both as standard RSL and as specific one. The considered contributions include:

- the consumptions of electrical energy;
- the consumption of thermal energy;
- the consumption of water;
- the waste management.

The electricity consumption is divided in operative energy and energy losses in use. The first one regards the proper energy consumption to carry on the function for which the product is sell on the market and, if the attestation Owner is the producer, the quantity has to be assumed according to a realistic scenario; if the attestation Owner is the use manager, the energy consumption has to be measured in operative conditions and supporting documents have to be provided during the verification process. The value to be inserted has to take into account the whole useful life, according to the standard RSL or the specific RSL declared in the "General information" module. The energy losses during the operational stage have to be added according to three approaches:

- assumption with PCR: the product is covered by an EPDItaly PCR, the energy losses have to be assumed according to the calculation formulas reported in the PCR and the table in lines from "38" to "69" has to be filled in. For wind turbines and photovoltaic panels, the energy consumptions due to the plant management have to be added and multiplied for the chosen RSL;
- assumption without PCR: if the product is not covered by an EPDItaly PCR, the energy losses have to be assumed according to a realistic scenario;
- measurement: if the attestation Owner is the use manager, the energy losses have to be measured in operative conditions.

The electricity consumption is evaluated taking into account the country where the production is located, which must be selected from the drop-down menu in cells from "D5" to "D8". In cells from "E5" to "E8" the total electricity consumption for the product use has to be reported according to the previous description and with reference to the FU/DU chosen in the "General information" sheet. The percentage of specific energy consumption has to be filled in the following columns, divided it into:

- renewable energy with guarantee of origin, column "I";
- on site self-produced and self-consumed electricity, column "K";
- energy taken from the national grid, automatically calculated in column "F".

The consumptions of thermal energy are evaluated on the basis of the fuel consumptions declared in line "16" for the whole useful life and divided according to the following types:

- natural gas, column "F";

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- oil, column “I”;
- unleaded petrol, column “K”;
- LPG, column “M”;
- coke, column “N”;
- virgin naphtha, column “O”;
- butane, column “P”;
- anthracite, column “Q”;
- lignite, column “R”;
- kerosene, column “S”;
- wood, column “T”;
- biodiesel, column “U”.

The consumptions of water have to be declared in line “24” for the whole useful life and divided according to origin, such as:

- tap water, automatically calculated in column “F”;
- well water, column “I”;
- recycled water, column “K”.

If the product under assessment is characterized by energy losses during use and is covered by an EPDItaly PCR, the table in lines from “38” to “69” provides supporting calculations. The RSL of the product has to be chosen in cell “C41” according to the value declared in the “General information” module. The product power in use has to be filled in column “I”.

NOTES.

(1) In cell “E5”, the energy consumption has to be assumed according to a realistic scenario; if the attestation owner is the use manager, the energy consumption has to be measured in operative conditions. Insert the total energy consumption for the whole useful life (Standard RSL or Specific RSL).

(2) In cell “E6”, if the product is covered by an EPDItaly PCR, the energy losses have to be assumed according to the calculation formulas reported in the PCR (Fill in the table below). For wind turbines and photovoltaic panels, the energy consumptions due to the plant management have to be added and multiplied for the RSL.

(3) In cell “E7”, if the product is not covered by an EPDItaly PCR, the energy losses have to be assumed according to a realistic scenario.

(4) In cell “E8”, if the attestation owner is the use manager, the energy losses have to be measured in operative conditions.

(5) In cell “D5-8”, the country must be selected according to the use site.

B1 – Use Consumables

The “B1-Use Consumables” module concerns the analysis of the consumables materials that are necessary for some types of products during the operational stage, such as lubricant oil or detergents. If the attestation Owner is the use manager, data have to be specific and collected from the operational management documents, otherwise, the quantities of consumables can be assumed according to a realistic scenario.

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The analysis of the consumable materials is coherent with the structure of the "A1-Raw Materials" module, the list of them has to be filled in cells from "C5" to "C19" and the corresponding quantities (kg) are entered in column "D" with reference to the chosen FU/DU and RSL. The characteristics of the consumable materials that are needed during the use stage are specified in the following columns, as a percentage value (%) of the total weight:

- content of virgin material from renewable sources, column "G";
- content of recycled material, column "I";
- content of reused material, column "K";
- the percentage of virgin material from non-renewable sources is automatically calculated in column "E".

The impacts deriving from the packaging materials and the transport of the consumables are considered not relevant, therefore they are excluded from the calculation.

B2 – Maintenance Materials

The "B2-Maintenance Materials" module concerns the analysis of the materials that are substituted during the maintenance activities to preserve the original characteristics and functionality of the product under assessment. If the attestation Owner is the use manager, data have to be specific and collected from the documents of the maintenance activities that are carried on during the useful life, otherwise, the quantities of maintenance materials can be assumed according to a realistic scenario, such as the content of the maintenance manual delivered to the user together with the new product.

The analysis of the maintenance materials is coherent with the structure of the "A1-Raw Materials" module and the list of materials and components to be replaced has to be inserted in column "C", with reference to the product BOM and to the information entered in the "A1-Raw Materials" sheet; the quantity of each component that have to be replaced must be entered in column "D", with reference to the chosen FU/DU and RSL. The characteristics of the replaced materials are specified in the following columns, with specific percentages, similar to what declared in the "A1-Raw Materials" module and divided into virgin material from non-renewable and renewable sources, recycled and reused content. The characteristics of the packaging materials for the replaced components are to be analysed in the same way of the "A1-Materials Packaging" module and inserted in the table in lines from "39" to "63".

The amount of waste generated by the maintenance activities is automatically calculated in cell "D80" and is analysed on the basis of its final destiny, such as:

- disposal, automatically calculated in cell "E107";
- energy recovery, cell "G107";
- recycling, cell "I107";
- reuse, cell "K107".

B2 – Maintenance Transport

The "B2-Maintenance Transport" module concerns the analysis of the transports that take place during the maintenance activities, to deliver the materials and components needed to replace the original ones that have reached the end of their useful life. This sheet has the same structure of the "A2-Materials Transport" module and all the input data are automatically filled in with reference to this sheet and to the replacement amount

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in “B2-Maintenace Materials” module, column “D”. The travelled kilometers have to be entered in the following columns, separately reporting the type of used vehicle:

- diesel truck, column “F”;
- electrical vehicle, column “H”;
- train, column “J”;
- ship, column “L”;
- aircraft, column “N”.

B2 – Maintenance Energy

The “B2-Maintenace Energy” module concerns the analysis of the impacts due to the energy consumption which occurs during the installation of the replaced components in the maintenance activities. The structure of this sheet is the same of the “A5-Installation” module and takes into account the following contributions:

- the consumptions of electrical energy;
- the consumption of fuels.

For each type of consumption, it is possible to indicate either an overall value of the entire maintenance activity or separate values for specific maintenance phases, in column “C”.

The electricity consumption is evaluated taking into account the country where the product is installed and the components are replaced, which must be selected from the drop-down menu in cells from “D5” to “D14”. In cells from “E5” to “E14” the total electricity consumption for the maintenance has to be reported with reference to the FU/DU and RSL chosen in the “General information” sheet. The percentage of specific energy consumption has to be filled in the following columns, divided it into:

- renewable energy with guarantee of origin, column “I”;
- on site self-produced and self-consumed electricity, column “K”;
- energy taken from the national grid, automatically calculated in column “F”.
- The consumptions of fuels are evaluated on the basis of the following types:
- diesel, column “N”;
- unleaded petrol, column “O”.

If the attestation Owner is the user, the data relating to energy and fuel consumptions must be primary and taken from internal documents; otherwise, the data can be reasonably assumed on the basis of the maintenance manual delivered to the user together with the new product.

C1 – Decommissioning

The “C1-Decommissioning” module concerns the analysis of the impacts due to the energy consumption which occurs during the decommissioning of the product at the end of its useful life. The structure of this sheet is the same of the “A5-Installation” module, because the same operations are carried out in reverse order, and takes into account the following contributions:

- the consumptions of electrical energy;
- the consumption of fuels.

For each type of consumption, it is possible to indicate either an overall value of the entire decommissioning activity or separate values for specific disassembly phases, in column “C”.

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The electricity consumption is evaluated taking into account the country where the product was installed and is now decommissioned, which must be selected from the drop-down menu in cells from "D5" to "D14". In cells from "E5" to "E14" the total electricity consumption for the decommissioning has to be reported with reference to the FU/DU chosen in the "General information" sheet. The percentage of specific energy consumption has to be filled in the following columns, divided it into:

- renewable energy with guarantee of origin, column "I";
- on site self-produced and self-consumed electricity, column "K";
- energy taken from the national grid, automatically calculated in column "F".

The consumptions of fuels are evaluated on the basis of the following types:

- diesel, column "N";
- unleaded petrol, column "O".

It is considered to be plausible that the energy consumption for the decommissioning activities is lower than or equal to the consumption recorded for the installation phase. If the attestation Owner is the user, the data relating to energy and fuel consumptions must be primary and taken from internal documents; otherwise, the data can be reasonably assumed on the basis of the installation manual.

C2 – EoL Transport

The "C2-EoL Transport" module concerns the analysis of the transports that take place in the End-of-Life stage, after the decommissioning of the product, to deliver the materials and components taken from the devices to the site where the waste is managed. The structure of this sheet is coherent with the "A2-Materials Transport" and the total weight of the product is automatically reported in cell "D5" with reference to the "A1-Raw Materials" module. The travelled kilometers have to be filled in the following columns and separated by vehicle type, such as diesel truck, electrical vehicle, train, ship and aircraft.

C3 – Waste (Producer)

The "C3-Waste (Producer)" module concerns the analysis of the waste characteristics in the End-of-Life stage of the product, if no remanufacturing activities are conducted or planned. The amount of waste generated at the end of the operative stage of the product is automatically calculated in cell "D5" with reference to the "A1-Raw Materials" module and is analysed on the basis of its final destiny, such as:

- disposal, automatically calculated in cell "E5";
- energy recovery, cell "G5";
- recycling, cell "I5";
- reuse, cell "K5".

NOTE.

(1) In cells "G5, I5, K5", the data have to be assumed according to a realistic scenario.

C3 – Remanufacturing Materials

The "C3-Remanufacturing Materials" module concerns the analysis of waste materials in the product End-of-Life stage. This sheet is addressed to the remanufacturing activities and takes into account the materials that are substituted during this process with the aim to restore the technical characteristics and functionality lost because the product reached the end of its useful life; the materials and components that have a residual

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useful life are maintained while those that are no longer functional are replaced or updated. This stage is under the responsibility of the End-of-Life manager (business model evaluation); therefore, at least 99% of the materials at the EoL of the product under assessment have to be declared, taking into account the remanufacturing activities. The data have to be specific and collected from the documents of the remanufacturing activities that are carried on by the Owner of the attestation, otherwise, the quantities of remanufacturing materials can be assumed according to a realistic scenario, such as the list of the original components and their life expectation.

The analysis of the remanufacturing materials is coherent with the structure of the "A1-Raw Materials" and "B2-Maintenance Materials" modules and the list of materials and components mast be inserted in column "C", similarly to the information entered in the "A1-Raw Materials" sheet; the amount of material that have to be replaced in the remanufacturing activities must be entered in column "D", as weight value and with reference to the chosen FU/DU. The characteristics of the replaced materials are specified in the following columns with specific percentages, similar to what was inserted in the "A1-Raw Materials" module and divided into virgin material from non-renewable and renewable sources, recycled and reused content. The characteristics of the packaging materials for the replaced components are to be considered with reference to the "A1-Materials Packaging" module and inserted in the table in lines from "36" to "66".

The amount of waste generated by the remanufacturing activities is automatically calculated in cell "D80" and is analysed on the basis of its final destiny, such as:

- disposal, automatically calculated in cell "E81";
- energy recovery, cell "G81";
- recycling, cell "I81";
- reuse, cell "K81".

C3 – Remanufacturing Transport

The "C3-Remanufacturing Transport" module concerns the analysis of the transports that take place during the remanufacturing activities, to deliver the materials and components needed to replace the original ones that have reached the end of their useful life. This sheet has the same structure of the "A2-Materials Transport" module; the materials input data are automatically filled in with reference to the "C3-Remanufacturing Materials" module, in columns "C" and "D". The travelled kilometers have to be entered in the following columns, separately reporting the type of used vehicle:

- diesel truck, column "F";
- electrical vehicle, column "H";
- train, column "J";
- ship, column "L";
- aircraft, column "N".

The information has to be entered taking into account the actual way of transport and plausible travelled distances from the suppliers' sites.

C3 – Remanufacturing Energy

The "C3-Remanufacturing Energy" module concerns the analysis of the impacts due to the energy consumption which occurs during the installation of the replaced components in the remanufacturing

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activities. The structure of this sheet is the same of the “A5-Installation” and “B2-Maintenance Energy” module and takes into account the following contributions:

- the consumptions of electrical energy;
- the consumption of fuels.

For each type of consumption, it is possible to indicate either an overall value of the entire remanufacturing activity or separate values for specific replacement components, in column “C”.

The electricity consumption is evaluated taking into account the country where the product is remanufactured and the components are replaced, which must be selected from the drop-down menu in cells from “D5” to “D14”. In cells from “E5” to “E14” the total electricity consumption for the remanufacturing has to be reported with reference to the FU/DU chosen in the “General information” sheet. The percentage of specific energy consumption has to be filled in the following columns, divided it into:

- renewable energy with guarantee of origin, column “I”;
- on site self-produced and self-consumed electricity, column “K”;
- energy taken from the national grid, automatically calculated in column “F”.
- The consumptions of fuels are evaluated on the basis of the following types:
- diesel, column “N”;
- unleaded petrol, column “O”.

The remanufacturing activities can be carried out either by the manufacturer himself or by the End-of-Life manager (business model evaluation). If the attestation Owner is the EoL manager, the data relating to energy and fuel consumptions must be primary and taken from internal documents; otherwise, the data can be assumed according to a realistic scenario, such as the list of the original components and the energy needed for their substitution.

2.6 NCI Results

The “NCI Results” module presents the results of the analysis of the circularity index of the product under assessment. The result is called "PRODUCT NCI" and is represented by the indication of two numerical values and two percentage values which represent:

- non-circular inputs;
- circular inputs.

The "PRODUCT NCI" is a set of four specific NCIs, which represent:

- NCI of materials;
- NCI of energy;
- NCI of water;
- NCI of waste.
- Therefore, the specific percentage values are presented as:
- non-renewable virgin materials;
- circular materials;
- non-renewable energy;
- renewable energy;
- virgin water;

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- recycled water;
- waste to disposal;
- waste to recycling.

For completeness purposes, each percentage value is accompanied by the corresponding natural numerical value, expressed in “kg” of materials or “MJ” of energy or “l” of water. Moreover, the quantities of used materials and consumed energy are also related to each year of the useful life of the product, under the name of:

- material share;
- energy share.

The Reference Service Life has to be chosen in cell “B12” according to the value declared in the “General information” module, both as standard RSL and as specific one.

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