विद्युत मंत्रालय
MINISTRY OF
POWER

सत्यमेव जयते

METHODOLOGICAL TOOL

BM-T-014

Apportioning emissions from production processes between main product and co- and by-product

---

INDIAN Carb•n MARKET

Publication Date: 27 March 2025

Version 1.0

Table of Contents

1. Introduction

1. This methodological tool is for situations where a product, which is a main product/coproduct/by-product/residue (waste), is produced and/or consumed/used under an ICM project activity.

2. Definitions

2. For the purpose of this methodological tool the following definitions apply:

   (a) **Co-products**: products produced along with the main product and having similar revenues as the main product;

   (b) **By-products**: products produced along with the main product and having smaller revenues than the main product; and

   (c) **Residues/wastes**: residues/wastes are generated along with the main product but have no or negligible revenues.

3. Scope

3.1. Scope

3. The purpose of this methodological tool is to provide criteria for apportioning emissions from a production process between the main product, the co-products, the by-products and the residues (waste) where the main product is produced and/or consumed/used in an ICM project activity.

4. For example, the production of renewable biomass/biofuels often involves generation of co-products, by-products or residues (waste). In such cases, a procedure to apportion emissions, associated with the production of renewable biomass/biofuels, between the renewable biomass/biofuels, the co-products, and the by-products needs to be provided.

4. Procedure

4.1. Approaches for apportioning emissions from production process

5. One of the following approaches to apportion emissions shall be used in the methodologies:

   (a) **Apportioning by market prices**, i.e. apportioning of the emissions proportional to the market prices of the main product and the by-products or co-products. The market prices may be either monitored ex post or be determined once for the crediting period. This rule can be applied only if transparent and reliable information on market prices is available;

   (b) **Substitution approach (or system expansion)**. The by-products and co-products are included in the project boundary. For each by-product or co-product, the alternative production process(es) is/are identified as part of the procedure to identify how the by-product or co-product would have been produced. Respectively, the emissions associated with the alternative production process of the co-products and by-products are allocated to the co-product or by-product;

(c) **Allocation by energy content**, i.e. apportioning of the emissions proportional to the enthalpy of the main product and the by-products or co-products. This rule can only be applied in cases where the main product and all co-products or byproducts are fuels (e.g. petroleum products produced by an oil refinery);

(d) **Attributing all emissions to the main product**. As a conservative approach, all emissions from production process are accounted as project emissions. This approach cannot be used for the calculation of baseline emissions.

6. Furthermore, the following criteria apply:

(a) Emissions from the production process shall not be allocated to residues/wastes, which are used/consumed in an ICM project activity, for example, if biomass residues from sugar cane production (i.e. bagasse) are used for the production of electricity;

(b) If a co-product or by-product produced in conjunction with the production of the main product is not sold on the market and is not used/consumed no production emissions shall be apportioned to the co-product(s)/by-product(s). This applies, for example, where the oilseed meal or glycerin produced along with biofuel in the project activity would be dumped or left to decay. In such situation no emissions are apportioned to oilseed meal or glycerin;

(c) If a co- or by-product is currently not used in the market or is available in excess and non-obligated entities plan to use it under the ICM project activity, no emissions should be apportioned to it.

7. In exceptional cases, non-obligated entities may propose, as revision of this methodological tool or as part of proposed new methodologies, different allocation rules if they can justify that they are better suited than the allocation approaches provided in this methodological tool or if the necessary data to apply the allocation approaches provided in this methodological tool are not available.

4.2. Examples of the application of the methodological tool

4.2.1. Apportioning by market prices

8. The ICM project is the production, sale and consumption of blends of petrodiesel with palm methyl ester to be used as fuel.

9. In the oil mill (process 1 for the production of biodiesel) the main product is the palm oil and the by-product is the palm kernel. For apportioning by market prices to the main product (palm oil) the following equation is used:

$$AF_{1,y} = (MP_{MP,y} \times M_{MP}) / (MP_{MP,y} \times M_{MP} + MP_{BP,y} \times M_{BP}) \quad \text{Equation (1)}$$

Where

$AF_{1,y}$ = Allocation factor for process 1 (oil mill) in year y (fraction)

$MP_{MP,y}$ = Market price per ton of main product (palm oil) in year y ($/tonne)

M_{MP} = Mass of main product (palm oil) associated with the production of 1 tonne of final biofuel (tonne)

$MP_{BP,y}$ = Market price per ton of dry co-product (palm kernels) in year y ($/tonne)

M_{BP} = Mass of co-product (palm kernels) associated with the production of 1 tonne of final biofuel (tonne)

Parameter	Value Applied
$MP_{MP,y}$	586 €/tonne
M_{MP}	1.05 tonnes
$MP_{BP,y}$	332 €/tonne
M_{BP}	0.25 tonnes

$$AF_{1,y} = (586 \times 1.05) / (586 \times 1.05 + 332 \times 0.25) = 0.88 \quad \text{Equation (2)}$$

10. The emissions associated with the cultivation of biomass will then be allocated to the palm oil using the allocation factor. In the example as the allocation factor is 88%, 88% of the emissions of producing the biomass will be taken into account as emissions for the palm oil.

4.2.2. Substitution approach (or system expansion)

11. An ICM project is a natural gas fired combined heat and power plant. Electricity and steam are co-products. The project emissions from combustion of natural gas have to be apportioned between electricity and steam.

12. The apportioning of project emissions is made by including the production of the steam in the baseline scenario. Hence, the baseline scenario is not only determined for the generation of electricity but also for the generation of steam (co-product). For this example, it is assumed that the procedure to identify the most plausible baseline scenario results in that the electricity would be generated in the grid and the steam would be generated in a natural gas fired heat-only boiler.

13. With the substitution approach, all emissions from combustion of natural gas are accounted as project emissions and the baseline emissions are determined for both electricity and steam generation:

$$PE_y = FC_{PJ,NG,y} \times NCV_{NG,y} \times EF_{CO2,\,NG,y} \quad \text{Equation (3)}$$

$$BE_{y\,=} EG_{PJ,y} \times EF_{grid,y} + HG_{PJ,y} \times EF_{BL,boiler} \text{ with } EF_{BL,boiler} = \frac{EF_{CO2,NG,boiler}}{\eta_{boiler}} \quad \text{Equation (4)}$$

Where:

PE_y = Project emissions in year *y* (t CO_2/yr)

$FC_{PJ,NG,y}$ = Quantity of natural gas combusted in the project plant in year *y*(m³/yr)

$NCV_{NG,y}$ = Net calorific value of natural gas in year *y* (GJ/m³)

$EF_{CO2,NG,y}$ = CO_2 emission factor of natural gas in year *y* (t CO_2/GJ)

BE_y = Baseline emissions in year *y* (t CO_2/yr)

$EG_{PJ,y}$ = Quantity of electricity produced in the project plant in year *y* (MWh/year)

$EF_{grid,y}$ = Grid emission factor for electricity in year *y* (t CO_2/MWh)

$HG_{PJ,y}$ = Quantity of heat generated in the project plant in year *y* (GJ/year)

$EF_{BL,boiler}$ = Emission factor for heat generation in the boiler in the baseline scenario (t CO_2/GJ)

$EF_{CO2,NG,boiler}$ = CO2 emission factor of natural gas that would be used in the baseline scenario boiler (t CO_2/GJ)

η_{boiler} = Energy efficiency of the boiler that would be used in the baseline scenario for heat generation

14. This approach avoids the determination of an allocation factor (AF) by including both coproducts in the boundary. This approach has been applied in several approved baseline and monitoring methodologies.

4.2.3. Allocation by energy content

15. An ICM project is gas treatment plant, where the input is wet gas, the main product is natural gas and the by-products are liquefied petroleum gas (LPG) and gasoline. For apportioning emissions of the treatment plant to the natural gas by energy content the following equation is used:

$$AF_1 = (NCV_{MP} \times M_{MP}) / (NCV_{MP} \times M_{MP} + NCV_{BP1} \times M_{BP1} + NCV_{BP2} \times M_{BP,2})$$ Equation (5)

Where:

AF_1 = Allocation factor for treatment to the natural gas (fraction)

NCV_{MP} = Net calorific value of main product (natural gas) (GJ/m^3)

M_{MP} = Mass of main product (natural gas) associated with the daily production of the treatment plant (m^3)

NCV_{BP1} = Net calorific value of LPG (GJ/m^3)

M_{BP1} = Mass of LPG by-product from the gas treatment plant associated with the daily production of the treatment plant (m^3)

NCV_{BP2} = Net calorific value of gasoline (GJ/m^3)

$M_{BP,2}$ = Mass of gasoline by-product from the gas treatment plant associated with the daily production of the treatment plant (m^3)

For calculations, the following values are applied:

Parameter	Value Applied
NCV_{MP}	0.0336
M_{MP}	21,000,000
NCV_{BP1}	24.123

M_{BP1}	1,650
NCV_{BP2}	31.453
M_{BP2}	500

AF_1 = (0.0336 × 21,000,000) / (0.0336 × 21,000,000 + 24.123 × 1,650 + 31.453 *500)= 0.93 Equation (6)

16. The emissions associated with the gas treatment process will then be allocated to the natural gas using the allocation factor. For example if the allocation factor is 93%, then 93% of the emissions from the gas treatment process will be taken into account for the natural gas.

4.2.4. Attributing all emissions to the main product

17. The application of this option is illustrated for the same combined heat and as for the substitution approach above. The emissions from combustion of natural gas in the project plant are fully allocated to the generation of electricity (main product). The steam generation (in this case a by-product) is not included in the boundary.

18. Hence, project emissions are the emissions from combustion of natural gas and baseline emissions are the emissions from electricity generation in the grid:

$PE_y = FC_{PJ,NG,y} \times NCV_{NG,y} \times EF_{CO2,NG,y}$ Equation (7)

$BE_y = EG_{PJ,y} \times EF_{grid,y}$ Equation (8)

Where:

PE_y = Project emissions in year *y* (t CO_2/yr)

$FC_{PJ,NG,y}$ = Quantity of natural gas combusted in the project plant in year *y* (m^3/yr)

$NCV_{NG,y}$ = Net calorific value of natural gas in year *y* (GJ/m^3)

$EF_{CO2,NG,y}$ = CO_2 emission factor of natural gas in year *y* (t CO_2/GJ)

BE_y = Baseline emissions in year *y* (t CO_2/yr)

$EG_{PJ,y}$ = Quantity of electricity produced in the project plant in year *y* (MWh/year)

$EF_{grid,y}$ = Grid emission factor for electricity in year *y* (t CO_2/MWh)

19. This option results in lower emission reductions than the substitution approach. However, it is simple and would not require determining the baseline scenario for the heat generation. This may be a simple option for non-obligated entities in situations where the quantity of the steam generation is very small or where the steam generation would in the baseline only cause very minor emissions (e.g. if generated with renewable sources).

Revision/Changes in the Document

Version	*Date*	*Description*
1.0	27 March 2025	Initial Adoption