

## TOOL25

### Methodological tool

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

Version 03.0



**United Nations**  
Framework Convention on  
Climate Change

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## **1. Introduction**

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

## **2. Scope, applicability, and entry into force**

### **2.1. Scope**

2. 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 a CDM project activity.
3. 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.

### **2.2. Applicability**

4. The Executive Board has restricted the applicability of this document to the approved methodologies ACM0017 and AM0089 until further revisions are done by the Methodologies Panel.
5. This methodological tool is applicable to project activities that apply any version of the approved methodologies AM0089 and ACM0017. Reference to the “Guidelines on apportioning emissions from production processes between main product and co- and by-products” (if any) in the project design document of registered project activities shall be read as “Methodological tool: Apportioning emissions from production processes between main product and co- and by-products”.

### **2.3. Entry into force**

6. Immediately upon adoption of the methodological tool at the eighty-fourth meeting of the Board (28 May 2015).

## **3. Normative references**

7. This methodological tool refers to the following approved methodologies:
  - (a) AM0089 “Production of diesel using a mixed feedstock of gasoil and vegetable oil”; and
  - (b) ACM0017 “Production of biodiesel for use as fuel”.

## **4. Definitions**

8. The definitions contained in the Glossary of CDM terms shall apply.

9. 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.

## 5. Methodology procedure

### 5.1. Approaches for apportioning emissions from production process

10. 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 by-products 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.
11. Furthermore, the following criteria apply:
- (a) Emissions from the production process shall not be allocated to residues/wastes, which are used/consumed in a CDM 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 project participants plan to use it under the CDM project activity, no emissions should be apportioned to it.
12. In exceptional cases, project participants 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.

## 5.2. Examples of the application of the methodological tool

### (a) Apportioning by market prices

13. The CDM project is the production, sale and consumption of blends of petrodiesel with palm methyl ester to be used as fuel.
14. 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)

For calculations, the following values are applied:

Parameter	Value Applied	Source
$MP_{MP,y}$	586 €/tonne	Malaysian Palm Oil Board. July 2008. <a href="http://econ.mpob.gov.my/upk/daily/20080730latest.htm">http://econ.mpob.gov.my/upk/daily/20080730latest.htm</a>
$M_{MP}$	1.05 tonnes	Ecofys.(2007). Technical Specification: Greenhouse Gas Calculator for biofuels. p. 56
$MP_{BP,y}$	332 €/tonne	Malaysian Palm Oil Board. July 2008. <a href="http://econ.mpob.gov.my/upk/daily/20080730latest.htm">http://econ.mpob.gov.my/upk/daily/20080730latest.htm</a>
$M_{BP}$	0.25 tonnes	Ecofys.(2007). Technical Specification: Greenhouse Gas Calculator for biofuels. p. 56

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

15. 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.

(b) Substitution approach (or system expansion)

16. A CDM 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.
17. 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.
18. 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:

$$PE_y = FC_{PJ,NG,y} \times NCV_{NG,y} \times EF_{CO_2,NG,y} \quad \text{Equation (3)}$$

$$BE_y = EG_{PJ,y} \times EF_{grid,y} + HG_{PJ,y} \times EF_{BL,boiler} \text{ with } EF_{BL,boiler} = \frac{EF_{CO_2,NG,boiler}}{\eta_{boiler}} \quad \text{Equation (4)}$$

Where:

$PE_y$	=	Project emissions in year $y$ (t CO <sub>2</sub> /yr)
$FC_{PJ,NG,y}$	=	Quantity of natural gas combusted in the project plant in year $y$ (m <sup>3</sup> /yr)
$NCV_{NG,y}$	=	Net calorific value of natural gas in year $y$ (GJ/m <sup>3</sup> )
$EF_{CO_2,NG,y}$	=	CO <sub>2</sub> emission factor of natural gas in year $y$ (t CO <sub>2</sub> /GJ)
$BE_y$	=	Baseline emissions in year $y$ (t CO <sub>2</sub> /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 <sub>2</sub> /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 <sub>2</sub> /GJ)
$EF_{CO_2,NG,boiler}$	=	CO <sub>2</sub> emission factor of natural gas that would be used in the baseline scenario boiler (t CO <sub>2</sub> /GJ)
$\eta_{boiler}$	=	Energy efficiency of the boiler that would be used in the baseline

## scenario for heat generation

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

(c) Allocation by energy content

20. A CDM 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:

$$AF_1 = (NCV_{MP} \times M_{MP}) / (NCV_{MP} \times M_{MP} + NCV_{BP1} \times M_{BP1} + NCV_{BP2} \times M_{BP2}) \quad \text{Equation (5)}$$

Where:

$AF_1$	=	Allocation factor for treatment to the natural gas (fraction)
$NCV_{MP}$	=	Net calorific value of main product (natural gas) (GJ/m <sup>3</sup> )
$M_{MP}$	=	Mass of main product (natural gas) associated with the daily production of the treatment plant (m <sup>3</sup> )
$NCV_{BP1}$	=	Net calorific value of LPG (GJ/m <sup>3</sup> )
$M_{BP1}$	=	Mass of LPG by-product from the gas treatment plant associated with the daily production of the treatment plant (m <sup>3</sup> )
$NCV_{BP2}$	=	Net calorific value of gasoline (GJ/m <sup>3</sup> )
$M_{BP,2}$	=	Mass of gasoline by-product from the gas treatment plant associated with the daily production of the treatment plant (m <sup>3</sup> )

For calculations, the following values are applied:

Parameter	Value Applied	Source
$NCV_{MP}$	0.0336	IPCC 2006
$M_{MP}$	21,000,000	Hypothetical configuration of a gas treatment plant.
$NCV_{BP1}$	24.123	IPCC 2006
$M_{BP1}$	1,650	Hypothetical configuration of a gas treatment plant.
$NCV_{BP2}$	31.453	IPCC 2006
$M_{BP2}$	500	Hypothetical configuration of a gas treatment plant.

$$AF_1 = (0.0336 \times 21,000,000) / (0.0336 \times 21,000,000 + 24.123 \times 1,650 + 31.453 \times 500) = 0.93 \quad \text{Equation (6)}$$

21. 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.

*(d) Attributing all emissions to the main product*

22. The application of this option is illustrated for the same combined heat and power plant 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.
23. Hence, project emissions are the emissions from combustion of natural gas and baseline emissions are the emissions from electricity generation in the grid:

$$PE_y = FC_{PJ,NG,y} \times NCV_{NG,y} \times EF_{CO_2,NG,y} \quad \text{Equation (7)}$$

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

Where:

$PE_y$	=	Project emissions in year $y$ (t CO <sub>2</sub> /yr)
$FC_{PJ,NG,y}$	=	Quantity of natural gas combusted in the project plant in year $y$ (m <sup>3</sup> /yr)
$NCV_{NG,y}$	=	Net calorific value of natural gas in year $y$ (GJ/m <sup>3</sup> )
$EF_{CO_2,NG,y}$	=	CO <sub>2</sub> emission factor of natural gas in year $y$ (t CO <sub>2</sub> /GJ)
$BE_y$	=	Baseline emissions in year $y$ (t CO <sub>2</sub> /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 <sub>2</sub> /MWh)

24. 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 project participants 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).

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### Document information

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<i>Version</i>	<i>Date</i>	<i>Description</i>
03.0	28 May 2015	EB 84, Annex 8 Revision to reclassify this document from a Guideline to a Tool.
02.0	17 September 2010	EB 56, Annex 9 Revision to make the guidelines applicable to newly approved methodology AM0089.
01.0	16 October 2009	EB 50, Annex 12 Initial adoption.

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