Italian National Agency for New Technologies,
Energy and Sustainable Economic Development

GBEP Task Force on Sustainability

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Workshop on the Implementation Guide for the GBEP Sustainability Indicators for Bioenergy

Introduction to environmental impacts allocation

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Outline

- **Framework and principles from ISO 14040-14044**
- **Detailed guidance: the ILCD**
- **Allocation in legislation: the Renewble Energy Directive**
- **Case studies**
- **Conclusions, personal views, food for thought**

From ISO 14044:2006: Environmental management - Life cycle assessment - Requirements and guidelines

Framework and principles: from ISO 14040-14044

Definition:

Allocation: partitioning the input or output flows of a process or a product system between the product system under study and one or more other product systems

ISO recommends a **stepwise procedure:**

- **Step 1**: Wherever possible, allocation should be avoided by
  - 1) system **subdivision**
  - 2) system **expansion**
- **Step 2**: if allocation cannot be avoided: physical relationships
- **Step 3**: Where relevant physical relationship are not found, economic allocation

Other recommendations:

- Allocation to co-products only: no allocation to waste.
- No mixes of allocation procedures

From ISO 14044:2006: Environmental management - Life cycle assessment - Requirements and guidelines

Framework and principles: from ISO 14040-14044

Step 1:

Wherever possible, allocation should be avoided by

1. dividing the unit process to be allocated into two or more sub-processes and collecting the input and output data related to these sub-processes, or
2. expanding the product system to include the additional functions related to the co-products,

System sub-division: e.g. environmental impacts of forest logging in a Country shall be allocated to the bioenergy sector and wood products sector in accordance to their share (statistical attribution issue)

System expansion: based on the principle of equivalence of additive and subtractive systems: e.g. to the heat produced by a CHP credits are given for the electricity produced.

From ISO 14044:2006: Environmental management - Life cycle assessment - Requirements and guidelines

Framework and principles: from ISO 14040-14044

Step 2:

Where allocation cannot be avoided, the inputs and outputs of the system should be partitioned between its different products or functions in a way that reflects the underlying physical relationships between them; i.e. they should reflect the way in which the inputs and outputs are changed by quantitative changes in the products or functions delivered by the system. (i.e. Mass, Energy, Exergy, nutritional properties, etc..)

Step 3:

Where physical relationship alone cannot be established or used as the basis for allocation, the inputs should be allocated between the products and functions in a way that reflects other relationships between them. For example, input and output data might be allocated between co-products in proportion to the economic value of the products

From ISO 14044:2006: Environmental management - Life cycle assessment - Requirements and guidelines

Allocation procedure according to the ILCD

The International Reference Life Cycle Data System (ILCD) Handbook, published by the Europen Commission:

- consists of a series of guidance documents to facilitate best life cycle assessment practice. http://eplca.jrc.ec.europa.eu/
- It is in line with the international standards on LCA (ISO 14040/44)

General guide for Life Cycle Assessment – Detailed guidance,

This document provides technical guidance for detailed Life Cycle Assessment (LCA) studies and provides the technical basis to derive product - specific criteria, guides, and simplified tools.

General guide for Life Cycle Assessment – Provisions and Action Steps,

This 'cook-book' style document provides the provisions and action steps for daily reference when performing ILCD-compliant, detailed Life Cycle Assessment (LCA) studies.

Framework and principles: from ISO 14040-14044

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General guide for Life Cycle Assessment – Provisions and Action Steps,

Provisions: 7.9.2 Avoiding allocation by subdivision or virtual subdivision

7.

Applicable to Situation C2. Applicable to cases of Situation A, B, C1 only if subdivision, virtual subdivision and substitution/system expansion were not possible or feasible, as identified along the specific provisions for these Situations (see 6.5.4).

Applicable only to attributional modelling, unless in consequential modelling substitution is not possible or feasible.

7.

I) SHALL - **Analyse whether allocation can theoretically be avoided by subdivision:** Investigate whether the analysed unit process is a black box unit process (concept see Figure 7): does it contain other physically distinguishable sub-process steps and is it theoretically possible to collect data exclusively for those sub-processes? Next, check whether subdivision can solve the multifunctionality of this black box unit process: can a process or process-chain within the initial black box unit process be identified and modelled separately that provide only the one required functional output?

II) SHALL - **Aim at avoiding allocation by subdivision or virtual subdivision:** Based on the outcome, the following steps shall be followed:

II.a) **Subdivision:** If it is possible to collect data exclusively for those included processes that have only the one, required functional output: inventory data should be collected only for those included unit processes.

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Allocation in legislation: the Renewble Energy Directive

(90) Co-products from the production and use of fuels should be taken into account in the calculation of greenhouse gas emissions. The substitution method is appropriate for the purposes of policy analysis, but not for the regulation of individual economic operators and individual consignments of transport fuels. In those cases the energy allocation method is the most appropriate method, as it is easy to apply, is predictable over time, minimises counter-productive incentives and produces results that are generally comparable with those produced by the substitution method. For the purposes of policy analysis the Commission should also, in its reporting, present results using the substitution method.

(91) Co-products are different from residues and agricultural residues, as they are the primary aim of the production process. It is therefore appropriate to clarify that agricultural crop residues are residues and not co-products. This has no implications on the existing methodology but clarifies the existing provisions.

Allocation in legislation: the Renewble Energy Directive

(92) The established method of using energy allocation as a rule for dividing greenhouse gas emissions between co-products has worked well and should be continued. It is appropriate to align the methodology for calculating greenhouse gas emissions coming from the use of cogeneration of heat and electricity (CHP) when the CHP is used in processing biofuels, bioliquids and biomass fuels to the methodology applied to a CHP being the end use.

(93) The methodology takes into account the reduced greenhouse gas emissions arising from the use of CHP, compared to the use of electricity- and heat-only plants, by taking into account the utility of heat compared to electricity, and the utility of heat at different temperatures. It follows that higher temperature should bear a larger part of the total greenhouse gas emissions, than heat at low temperature, when the heat is co-produced with electricity. The methodology takes into account the whole pathway to final energy, including conversion to heat or electricity. (exergy)

Case studies

	Unit	Farm A	Farm B	Farm C	Farm D
No allocation					
GHG emissions without LUC and C seq.	kg CO_2 eq.	1.21	1.31	1.66	1.40
GHG emissions with LUC and C seq.	kg CO_2 eq.	1.73	1.60	1.97	1.75
Acidification	mmol of H^+ eq.	13.1	12.0	14.3	11.6
Fresh water eutrophication	g P eq.	0.17	0.15	0.26	0.19
Marine eutrophication	g N eq.	9.4	14.8	17.2	15.4
Non-renewable energy use	MJ	3.68	3.96	4.57	4.44
Land occupation	m^2	1.00	1.50	3.65	1.64
Total biodiversity loss	DS	0.75	1.08	2.40	1.17
Mass allocation					
Milk allocation factor	%	97.4	97.4	95.9	97.6
GHG emissions without LUC and C seq.	kg CO_2 eq.	1.18	1.28	1.60	1.36
GHG emissions with LUC and C seq.	kg CO_2 eq.	1.69	1.56	1.89	1.71
Acidification	mmol of H^+ eq.	12.7	11.6	13.7	0.0113
Fresh water eutrophication	g P eq.	0.17	0.14	0.24	0.18
Marine eutrophication	g N eq.	9.1	14.4	16.5	15.1
Non-renewable energy use	MJ	3.59	3.86	4.39	4.34
Land occupation	m^2	0.98	1.46	3.50	1.60
Total biodiversity loss	DS	0.73	1.06	2.30	1.14
Economic allocation					
Milk Allocation factor	%	93.9	93.8	91.2	94.4
GHG emissions without LUC and C seq.	kg CO_2 eq.	1.14	1.23	1.52	1.32
GHG emissions with LUC and C seq.	kg CO_2 eq.	1.63	1.50	1.80	1.65
Acidification	mmol of H^+ eq.	12.3	11.2	13.0	11.0
Fresh water eutrophication	g P eq.	0.16	0.14	0.23	0.18
Marine eutrophication	g N eq.	8.8	13.9	15.7	14.6
Non-renewable energy use	MJ	3.46	3.72	4.17	4.19
Land occupation	m^2	0.94	1.41	3.33	1.54
Total biodiversity loss	DS	0.70	1.02	2.19	1.10
Biological allocation					
Milk allocation factor	%	84.6	84.6	75.5	85.9
GHG emissions without LUC and C seq.	kg CO_2 eq.	1.02	1.11	1.26	1.20
GHG emissions with LUC and C seq.	kg CO_2 eq.	1.47	1.35	1.49	1.50
Acidification	mmol of H^+ eq.	11.1	10.1	10.8	10.0
Fresh water eutrophication	g P eq.	0.15	0.12	0.19	0.16
Marine eutrophication	g N eq.	7.9	12.5	13.0	13.3
Non-renewable energy use	MJ	3.11	3.35	3.45	3.82
Land occupation	m^2	0.85	1.27	2.76	1.41
Total biodiversity loss	DS	0.63	0.92	1.81	1.01

MASS 97,4

ECONOMIC 93,9

BIOLOGICAL 84,6

Conclusions, personal views, food for thought

Conclusions: one size does not fit all

- Different approaches are available for solving multifunctionality. The choice of the most appropriate approach depends on
  - the goal of the study,
  - available data and information,
  - and the characteristics of the multifunctional process or product.

- The most appropriate way how to solve multifunctionality has to be identified already in the scope phase of the LCA (or at least in the inventory phase when planning data collection), as it affects which inventory data and other information are required.

- No need to reinvent the wheel, the are recommendation from the Scientific Community working on LCA Guidelines which can be used to develop specific guidelines.

Conclusions, personal views, food for thought

Personal views

Economic activities

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primary driver of human actions

↓↓

pressures on the environment

Money is the way humans measure the value of products and services

The pressures generated by a multifunctional process shall be allocated according to the economic value of the functions for which the process takes place.

However, market distortion, local circumstances, prices volatility may lead to misleading results.

The use of underlying physical relationships is recommendable as far as it somehow represents the drivers of a given human action, and therefore the economic value of product or functions which produced.

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