

# APS-footprint tool

## General methodology

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<b>Title</b>	APS-footprint tool general methodology	
<b>Date</b>	21-1-2021	
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# 1. Introduction

## 1.1 Background and document outline

Making animal production more sustainable is critical for transforming to a more sustainable food production system. Meat and animal-derived products have a significant contribution to the environmental impact of diets (FABLE Consortium, 2019)(Broekema et al., 2020). The animal production sector is therefore a key sector for action. APS-footprint is a web application that aims to support the animal production sector with a practical and insightful tool to evaluate environmental performance of animal products like milk, beef, pork, and chicken meat.

This document describes the generic principles and setup of the APS Footprint tool. This chapter introduces the goals of the tool, its intended use, and change log. Chapter 2 introduces the lifecycles stages and the types of animal production systems (modules) currently available in the tool. The third chapter explains the methodological framework of the APS-footprint tool. In addition to this general documentation, the methodology for each module of the APS-footprint tool is documented in a separate report.

## 1.2 Intended use and user groups

APS-footprint is a tool for computing lifecycle environmental impacts of animal production systems, as well as the effects of changing system parameters, such as feed composition or the number of animals.

It is meant to evaluate changes in animal production for decision support on level A, C1 and C2 according to the classification of the ILCD guidelines (JRC-IES & European Commission, 2010). Type A refers to “Micro level decision support”, C to “Accounting” applications, including interactions with other systems (C1) as well as isolated systems (C2). These decision support levels are also classified as attributional LCA, which is supported by the main methodologies of FAO and the connected EC databases (European Commission, 2018c, 2018a; FAO, 2014; FAO LEAP, 2016a, 2016b). The APS-footprint tool does not support type B decisions (“Meso/macro-level decision support”) since this would require adaptation of underlying data and consequential dynamic modelling.

The APS-footprint tool can be used to compare different production systems, and evaluate innovative technologies and other types of management interventions in an animal production system. In case an LCA should be used to make public and/ or comparative claims, it is the responsibility of the practitioner to ensure ISO 14040:2006/14044:2006 compliance through an ISO review of the study.

Intended users of the tool include all persons with technical knowledge of animal production systems and with a conceptual understanding of LCA principles.

## 1.3 APS methods

The APS-footprint tool calculates impacts according to well-defined LCA-standards and guidelines regarding methodology and data. APS-footprint consists of several so-called APS methods. An APS method is a combination of an LCA-standard, an emission model, a background database and an LCIA method. All of these are based on specific guidelines, which will be further explained in this document. The APS methods are defined per animal production system (per module). The number of APS methods will be expanded in the future, and available methods will be updated if needed.

## 1.4 APS-footprint reference systems

The APS-footprint tool contains data for several typical animal production systems, called *reference systems*, that can be used as a starting point for an assessment. These reference systems are realistic for a certain time period and represent a common form of production system in a given country or region. With these reference systems (cf. Table 2.), a user can easily start exploring potential improvements by changing parameters of the animal

production system. Data sources for the reference systems are documented in the reports of the specific animal module (Blonk Consultants, 2020a, 2020c, 2020b).

## 1.5 Review and review process

The implementation of APS-footprint methods and the available reference animal production systems are reviewed on a regular basis.

The review involves the following elements:

1. The correct implementation of the calculation rules prescribed in the APS-footprint methods.
2. Review of the reference systems regarding representativeness of farm infrastructure, technical parameters, and feed rations for the specific country/ region.

The review is a continuous process and is related to the implementation and updating of new modules, methods, and reference systems. In the Tables 1 and 2 the reviews are listed.

Only reviewed databases are used, such as Agri-footprint 5.0 and the GFLI database which is reviewed against its methodology report (Blonk, van Passen, & Broekema, 2020; Van Paassen, Braconi, Kuling, Durlinger, & Gual, 2019).

## 1.6 Versioning and Change log

Significant updates and changes of the APS methods and the reference systems are shown in Table 1 and Table 2, respectively.

*Table 1 Version history and change log for APS methods implementation.*

Module	LCA-methods	Emission model	Background database	Implemented in APS-footprint	Reviewed
Dairy	PEFCR dairy	IPCC 2006 & EMEP/EEA 2016	Agri-footprint 5.0	Version 1 1 May 2020	external January 2021
Pig	PEFCR red meat	IPCC 2006 & EMEP/EEA 2016	Agri-footprint 5.0	Version 1 1 May 2020	external January 2021
Piglets	PEFCR red meat	IPCC 2006 & EMEP/EEA 2016	Agri-footprint 5.0	Version 1 1 May 2020	No
Broilers	LEAP guidelines further elaborated by Blonk	LEAP 2016 & IPCC 2006 & EMEP/EEA 2016	Agri-footprint 5.0	Version 1 1 May 2020	external January 2021
Layers	LEAP guidelines further elaborated by Blonk	LEAP 2016 & IPCC 2006 & EMEP/EEA 2016	Agri-footprint 5.0	Version 1 1 May 2020	No
Feed	PEFCR feed		Agri-footprint 5.0	Version 1 1 May 2020	internal
Cultivation	PEFCR feed	IPCC 2006, EMEP/EEA 2016, PAS 2050, PEFCR guidance 6.3, GFLI methodology, AFP	Agri-footprint 5.0	In development	No

*Table 2 Version history and change log for APS-reference system data implementation.*

Reference system	Implemented in version	Reviewed
Dairy Dutch typical APS system	Version no 1 1 May 2020	Yes [date]
Dairy California typical APS system	Version no 1 1 May 2020	No

Pigs Dutch typical APS system	Version no 1 1 May 2020	No
Piglets Dutch typical APS system	Version no 1 1 May 2020	No
Broilers Dutch typical APS system	Version no 1 1 May 2020	No
Layers Dutch typical APS system	Version no 1 1 May 2020	No
Dairy Italian typical APS system	To be implemented	Yes [date]
Dairy French typical APS system	To be implemented	Yes [date]

## 2. Life cycle stages and available modules

The life cycle stages included in the APS-footprint tool are (Figure 1): the production of feed ingredients, the animal farm, and slaughtering of animals. It can therefore currently be used for calculating the environmental impact of products coming from:

- The animal farm
- The compound feed mill

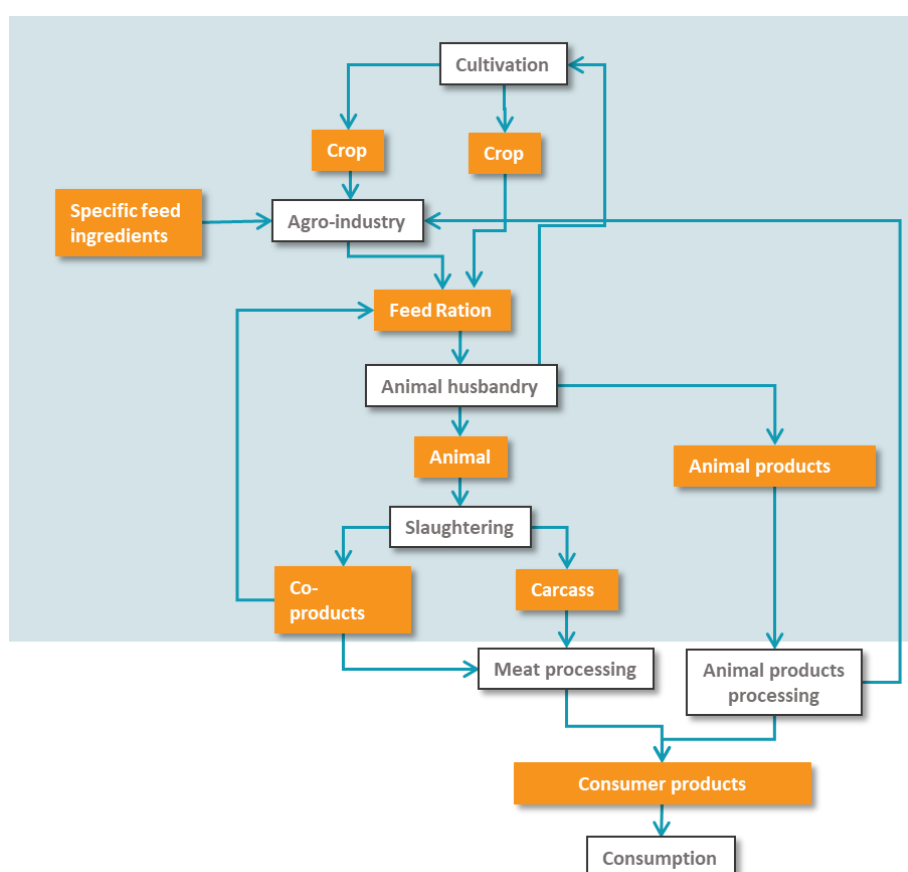


Figure 1: Life cycle stages relevant for animal production systems.

At this moment, the following modules are available:

- Compound feed - defining feed composition and the impact of production and transport of compound feed and feed materials

- Dairy - defining animal herd composition, housing system, manure management, yields, ration and inputs
- Fattening pigs - defining housing systems, yields, ration and inputs
- Piglets - defining housing systems, yields, ration and inputs
- Broiler fattening - defining housing systems, yields, ration and inputs
- Layers - defining housing systems, yields, ration and inputs

To be included soon:

- Cultivation
- Manure management

### 3. Methodological framework

APS-footprint is a complete Life Cycle Assessment (LCA) tool for evaluating animal production systems.

LCA is the method for assessing the environmental impact related to the life cycle of a product or service. LCA is a holistic approach that considers all relevant inputs and outputs; therefore, it shows where and to which extent environmental impacts occur.

There are several standards and guidelines for LCA for animal products. Some of these standards and guidelines are relatively generic and mainly provide process related guidance, while others include specific guidance in terms of emission models, data requirements and data quality measurement. Important LCA standards and guidelines that are used as a basis for the APS-footprint tool methodological framework are:

- The ISO 14040/44 series (ISO, 2006a, 2006b) describes the basic requirements for performing an LCA study. This includes directions on how to define the functional unit of a product, how to determine which processes need to be included or excluded, and how to deal with co-production situations where elementary flows need to be allocated to the different products. However, the ISO standard can still lead to different methodological decisions, depending on the LCA practitioner's interpretation. This means that applying the ISO standards properly may still result in different approaches and different quantitative results.
- The ILCD handbook (JRC-IES & European Commission, 2010) provides more detailed guidelines compared to ISO 14040/44 series. One of the most valuable methodological additions in the ILCD handbook is the division between consequential and attributional LCA, which is not made in the ISO standard. The APS-footprint tool follows mostly an attributional approach. There is a possibility to add consequential modelling in case of manure processing and application.
- The Product Environmental Footprint (PEF) framework defines general requirements and principles to calculate the environmental impact of products and services (European Commission, 2017). It was developed by the European Commission with the aim of defining Category Rules (PEFCRs) for specific product groups. For the APS-footprint tool, the relevant PEFCRs are the PEFCR for feed for food producing animals (European Commission, 2018a), the PEFCR for dairy products (European Commission, 2018b) and PEFCR for red meat. The PEFCRs provide detailed guidance in terms of emission models and methodological choices like functional unit, system boundaries and selection of background databases.
- The LEAP Guidelines are handbooks developed by FAO, with the aim to guide livestock industries in the measurement of their life-cycle impact. These guidelines cover different animal production systems and/or on various impact categories. The guidelines of main interest for the APS-footprint tool are:
  - Greenhouse gas emissions and fossil energy use from poultry supply chains (FAO, 2016),
  - Environmental performance of large ruminant supply chains (FAO LEAP, 2016a),
  - Environmental performance of pig supply chains (FAO LEAP, 2016b),
  - Nutrient flows and associated environmental impacts in livestock supply chains (FAO, 2018),
  - Environmental performance of feed additives in livestock supply chains (FAO, 2019),
  - PEFCR Feed for food producing animals (European Commission, 2018a).

- IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Agriculture, Forestry and Other Land Use (IPCC, 2006). The Intergovernmental Panel on Climate Change (IPCC) developed calculation methods and guidelines to estimate the climate change impact for various industry sectors. Of special interest is chapter 10 that focuses on enteric methane production of animal farms and methane and dinitrogen monoxide emissions from manure management and manure/ fertilizer application. Also, of particular interest is chapter 11, focusing on dinitrogen monoxide emissions from managed soils and carbon dioxide emission from lime and urea application.
- The EMEP/EEA air pollutant emission inventory guidebook (European Environment Agency, 2016) was published by the European Environment Agency in order to help government bodies to measure air pollution. It proposes calculation methods for nitrogen volatilization, Non-Methane Volatile Organic Compounds (NMVOC) emissions and Particulate Matter (PM) emissions from many industry sectors, including livestock.
- The National Inventory Submissions of different countries by the United Nations Framework Convention on Climate Change (UNFCCC) report the yearly evolution of climate change emissions for a specific country. Some countries developed advanced methodologies and country-specific emission factors. The Dutch National Emission Model for Agriculture (NEMA) (Lagerwerf et al., 2019) is particularly relevant for APS-footprint.

The APS-footprint tool is designed to allow switching from one methodological framework to another. This is an innovative and useful feature that gives the user flexibility, since often a specific methodological framework is required for a certain type of compliance. It also allows for sensitivity analyses resulting from specific methodological choices.

The guidelines previously listed are regularly updated and revised. APS-footprint is therefore continuously updated to account for such methodological changes. Please note that in order to maintain compliancy with e.g. PEFCR, updates of IPCC and EEA/EMEP methodology will be performed only when indicated by the most recent PEFCR document.

Another important aspect is that it is not always possible to apply a methodological framework in a fully consistent way. Since the methodologies do not always cover all emissions and impact categories, it is sometimes necessary to compute LCIA results based on a mix of different guidelines. Blonk Sustainability Tools has in-depth knowledge in LCA and agricultural systems. Methodological choices in APS-footprint are implemented only after thoughtful consideration, and are subject to the review of the APS-footprint tool. More detailed information for the specific modules is available in the accompanying reports (Blonk Consultants, 2020b, 2020a, 2020c).

Depending on the LCIA method, different environmental indicators can be calculated. For the EF2.0 method these are:

- Climate change – kg CO<sub>2</sub> eq
- Ozone depletion – kg CFC11 eq
- Ionising radiation – kBq U-235 eq
- Photochemical ozone formation – kg NMVOC eq
- Respiratory inorganics – disease inc.
- Non-cancer human health effects – CTUh
- Cancer human health effects – CTUh
- Acidification terrestrial and freshwater – mol H<sup>+</sup> eq
- Eutrophication freshwater – kg P eq
- Eutrophication marine – kg N eq
- Eutrophication terrestrial – mol N eq
- Ecotoxicity freshwater – CTUe
- Land use – Pt
- Water scarcity – m<sup>3</sup> depriv.
- Resource use, energy carriers – MJ
- Resource use, mineral and metals – kg Sb eq

## 3.1 Standards, guidelines and LCA methodology

The APS-footprint tool enables the user to conduct an environmental assessment of an animal production system, compliant to a certain standard or guideline. The selection of a standard/guideline prescribes specific methodological choices for the LCA with respect to:

1. Functional unit
2. System boundaries
3. Allocation
4. Emission modelling rules and Tier levels
5. Impact categories
6. Use of primary data
7. Use of background data

### 3.1.1 Reference unit

The functional unit of a product depends on the context in which the product is used. The purpose of the functional unit is that products are compared based on equal functions. The functional unit can vary based on the purpose and goal of the analysis. In APS-footprint, the output flows of the animal systems are not functional units but reference units expressed in units of mass or volume. The environmental impact results are always expressed per unit of the main product (Table 3).

Table 3 Reference flows of the different APS-footprint tool modules.

System	Reference unit
Cultivation (on farm)	1 kg of cultivated crop
Compound feed	1 ton of compound feed
Dairy	1 kg of Fat-Protein Corrected Milk
Broiler	1 kg of broiler live weight
Layers	1 kg of eggs
Pig	1 kg of pig live weight
Piglet breeding	1 kg of piglet live weight
Beef	1 kg of beef live weight
Fish	1 kg of fish live weight

### 3.1.2 System boundaries

In the APS-footprint tool, the system boundaries of the animal farm modules are from cradle to farm gate (Figure 2). Some inputs can be parameterized and modelled by the user, while others are derived from background databases. For example, cultivation at farms (e.g. roughages) can be modelled in the “Cultivation – on farm” module, while the cultivation of ingredients outside of the farm are based on default background data. Table 4 summarizes the processes and activities that are included in the APS-footprint LCA.

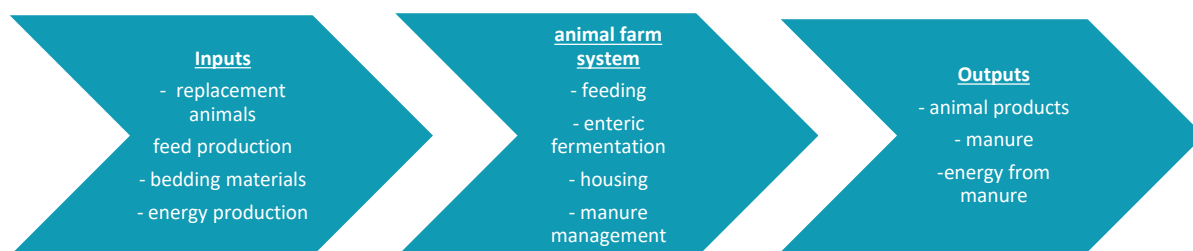


Figure 2 System boundaries of the animal farm modules in the APS-footprint tool.

The production of agricultural inputs (e.g. fertilizers, seed, pesticide), crop cultivation, other feed ingredient processing, transportation, water and energy production are based on background LCI-databases that use the system boundaries as shown in Table 4 All used background data is compliant to PEF methodology(European Commission, 2018c).

The choice for inclusion or exclusion of the processes is based on the recommendations in PEFCR's or LEAP guidelines. The process of determining inclusion or exclusion in PEFCR's was based on impact contribution (significance) and data availability.

Table 4 System boundaries.

Activities/ processes	Included (activity data including production)	Excluded
Crop cultivation	<ul style="list-style-type: none"> <li>Fuel use</li> <li>Electricity use</li> <li>N, P, K fertilizer use</li> <li>Organic fertilizer (manure and others) use</li> <li>Lime use</li> <li>Use of pesticides on the field and at storage</li> <li>Use of irrigation water</li> <li>Seed use</li> <li>Depreciation of capital goods for machinery and storage</li> <li>Packaging of fertilizers and pesticides</li> </ul>	<ul style="list-style-type: none"> <li>Other consumables used during cultivation (farm plastics, materials used for maintenance, cleaning materials, etc.)</li> <li>Activities related to living at the farm</li> <li>Activities related to other business (e.g. producing wind energy)</li> <li>Non-agricultural activities related to the producing company (e.g. accounting department).</li> </ul>
Processing of feed materials	<ul style="list-style-type: none"> <li>Crop input mix of originating countries</li> <li>Transport (distance per transport mode)</li> <li>Fuel use</li> <li>Heat/ electricity use</li> <li>Water use</li> <li>Wastewater treatment only for wet processes</li> <li>Organic waste &amp; losses</li> <li>Auxiliary materials (processing aids)</li> </ul>	<ul style="list-style-type: none"> <li>Some auxiliary materials adding up to less than 1% of mass contribution</li> <li>Consumables used at the plant not used as a raw material or auxiliary material</li> <li>Depreciation of capital goods</li> <li>Non-agricultural activities related to the producing company (e.g. accounting department).</li> </ul>
Animal farm (no cultivation)	<ul style="list-style-type: none"> <li>Replacement animals</li> <li>Feed materials</li> <li>Transport (distance per transport means)</li> <li>Fuels use</li> <li>Electricity use</li> <li>Use of water</li> </ul>	<ul style="list-style-type: none"> <li>Other consumables used at the farm than animals and feed (e.g. plastics used for covering of silage)</li> <li>Depreciation of capital goods</li> <li>Veterinary service</li> <li>Non-agricultural activities related to the producing company (e.g. accounting department).</li> </ul>

The compound feed formulation, energy consumption for processing the compound feed and transportation of feed ingredients are modelled in the compound feed module of the APS-footprint tool. In the different animal production system modules, it is possible to model the farm inputs, herd composition, feed conversion, manure management system and emissions. The environmental analysis currently stops at the animal farm gate. There will be a separate module for slaughtering (to be developed).

### 3.1.3 Allocation

According to the ISO14044:2006 standard (ISO, 2006a, 2006b), allocation should be avoided whenever possible by dividing the unit multi-output process into two or more sub-processes and collecting the inventory data related to these sub-processes separately. If this is not possible allocation may be avoided by expanding the product system to include the additional functions related to the co-products. If 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. If 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 or another property (e.g. (dry) mass or energy content).

Allocation is also a topic that is covered by many LCA-standard and guidelines. In the APS-footprint tool, economic allocation is used as default allocation method for feed, following the PEFCR for feed for food producing animals (European Commission, 2018a). In the LEAP feed guidelines, economic allocation is also set as the default option, since allocation on physical characteristics would not capture easily the variable functionality connected to the co-products produced by processing facilities (FAO, 2014). This is therefore applied in the background database (Agri-footprint) and the on-development “on-farm cultivation” module. “Animal production system” modules use allocations dependent on the guidance defined in the reference standard or guideline used for the development of the APS method. Currently, all animal systems default APS methodologies use economic allocation, with one exception (dairy APS). The price of the different co-products is multiplied by their mass to establish the revenue of the output streams. These are used to determine the economic allocation factors.

There is 1 exception to the use of economic allocation. The dairy module uses biophysical allocation, based on the energy required for the co-products production. This allocation was developed by the International Dairy Association (IDF, 2010) and was suggested by the dairy PEFCR (European Commission, 2018b), and is therefore extensively used in the dairy sector.

Please note that both the poultry and pig modules default APS methods need to be updated to follow the recommended biophysical allocation as defined by FAO (2016) and Technical Secretariat for the Red Meat Pilot (2019).

### 3.1.4 Emission modelling and TIER levels

The emission models are integrated into the APS-footprint tool. This means that emissions from enteric fermentation, from manure handling in the stable, during on-farm manure storage and during pasture are directly calculated by the tool. Emission of manure applied during cultivation are currently included in background data used for feed production either for dry feed materials or roughage.

The basic emission models used in the APS-footprint tool are the IPCC guidelines (IPCC, 2006, 2019), the LEAP guidelines (FAO, 2016) and the EMEP/EEA air pollutant emission inventory guidebook (European Environment Agency, 2016). These guidelines provide calculation rules for calculating emissions using various TIER levels. Depending on the LCA standard or guideline applied in APS-footprint, the TIER level implemented will vary. In the documentation per animal module, the APS methods are explained, including a more detailed explanation of the implemented emission models and TIER levels.

### 3.1.5 Impact categories

With the APS-footprint tool, it will be possible to apply different impact assessment methods. Currently, only the “EF 2.0 method (adapted)” method is used (Table 5). It identifies 16 different impact and differentiates impact on climate change due to fossil emissions, biogenic emissions and land use and transformation.

Table 5 Impact categories covered by the EF 2.0 LCIA method (Fazio et al., 2018).

Impact category	Indicator	Unit	LCIA method
<b>Climate change</b>	Radiative forcing as Global Warming Potential (GWP100)	kg CO <sub>2</sub> eq	Baseline model of 100 years of the IPCC (based on IPCC 2013)
<b>Ozone depletion</b>	Ozone Depletion Potential (ODP)	kg CFC-11eq	Steady-state ODPs as in (WMO 1999)
<b>Ionising radiation, Human Health</b>	Human exposure efficiency relative to U <sup>235</sup>	kBq U <sup>235</sup>	Human health effect model as developed by Dreicer et al. 1995 (Frischknecht et al, 2000)
<b>Photochemical ozone formation, Human Health</b>	Tropospheric ozone concentration increase	kg NMVOC eq	LOTOS-EUROS (Van Zelm et al, 2008) as applied in ReCiPe 2008

<b>Respiratory inorganics</b>	Human health effects associated with exposure to PM <sub>2.5</sub>	Disease incidences	PM model recommended by UNEP (UNEP 2016)
<b>Non-cancer human health effects</b>	Comparative Toxic Unit for humans (CTUh)	CTUh	USEtox model (Rosenbaum et al, 2008)
<b>Cancer human health effects</b>	Comparative Toxic Unit for humans (CTUh)	CTUh	USEtox model (Rosenbaum et al, 2008)
<b>Acidification terrestrial and freshwater</b>	Accumulated Exceedance (AE)	mol H+ eq	Accumulated Exceedance (Seppälä et al. 2006, Posch et al, 2008)
<b>Eutrophication freshwater</b>	Fraction of nutrients reaching freshwater end compartment (P)	kg P eq	EUTREND model (Struijs et al, 2009) as implemented in ReCiPe
<b>Eutrophication marine</b>	Fraction of nutrients reaching marine end compartment (N)	kg N eq	EUTREND model (Struijs et al, 2009) as implemented in ReCiPe
<b>Eutrophication terrestrial</b>	Accumulated Exceedance (AE)	mol N eq	Accumulated Exceedance (Seppälä et al. 2006, Posch et al, 2008)
<b>Ecotoxicity freshwater</b>	Comparative Toxic Unit for ecosystems (CTUe)	CTUe	USEtox model, (Rosenbaum et al, 2008)
<b>Land use</b>	Soil quality index (Biotic production, Erosion resistance, Mechanical filtration and Groundwater replenishment)	Dimensionless	Soil quality index based on LANCA (Beck et al. 2010 and Bos et al. 2016)
<b>Water scarcity</b>	User deprivation potential (deprivation-weighted water consumption)	kg world eq. deprived	Available WATER REMaining (AWARE) in UNEP, 2016
<b>Resource use, energy carriers</b>	Abiotic resource depletion (ADP ultimate reserves)	kg Sb eq	CML Guinée et al. (2002) and van Oers et al. (2002)
<b>Resource use, mineral and metals</b>	Abiotic resource depletion (ADP ultimate reserves)	MJ	CML Guinée et al. (2002) and van Oers et al. (2002)

LCA guidelines (e.g. PEFCRs) typically define certain most relevant impact categories. In APS-footprint, there is a special focus on these most relevant impact categories in reporting the results.

### 3.1.6 Use of primary data

The APS-footprint tool allows for the use of primary data. Examples of primary data are:

- Outputs of the farm, e.g. milk (specifying protein and fat content), liveweight, eggs
- Resource use on the farm (e.g. electricity, gas, diesel, water)
- Herd composition
- Feed intake
- Feed raw materials composition and feed nutritional parameters
- Performance parameters such as FCR or milk yields
- Housing type (incl. grazing time) and manure management system

### 3.1.7 Background databases

The production of agricultural inputs (e.g. fertilizers, seed, pesticide), outside-farm crop cultivation, feed ingredient processing, transportation, water and energy production are based on background LCI databases. The default background database is the Agri-footprint® LCI-database (version 5.0). Agri-footprint 5.0 is, except for the transport, energy and waste data, PEF-compliant.

In the future, it will be possible to link APS-footprint projects to other background databases, e.g. the GFLI or EF databases, or to link to client specific databases.

## 3.2 Data Quality Rating Methodology

Currently, there is no DQR system or uncertainty analyses in place for the APS. Methodology is in development for a system to qualify the data quality of sources used. In the future we want to update the tool functionality to explore variability and uncertainty.

## 3.3 Limitations

The LCA calculations in APS-footprint are based on an attributional modelling approach. This provides an estimation of the effects of a farm-level intervention on environmental impacts. In case large scale interventions are studied, other changes induced by the intervention should also be considered. Therefore, the APS tool does not simulate the impact mitigation/changes that the chosen sector has on other sectors (not included in the boundaries). This is especially relevant for changes that affect the use of co-products in feed, which are limited on the market and for which supply is not driven by demand for feed. Other examples are: changes in co-product amount, that could possibly influence other systems not included in the boundaries; changes in manure amount or manure nutrient composition, possibly affecting cultivation outside the farm.

The APS-footprint is an attributional method with some extensions to explore the impact of changes of interventions more completely. It is based on a mass balance approach, which makes it possible to identify the consequences of changes in feed composition for emissions and manure composition. However, the tool does not contain any predictive modelling of changes in herd composition or growth or animal product composition. Therefore, to properly model an animal system and to predict complex interventions primary measured data from trials would be needed, or alternatively a complex herd and animal metabolism model.

The prescribed land use change method for climate impact is retrospective rather than prospective. This means that these carbon emissions should be considered carefully. Therefore, they are reported separately (consistent with current guidelines and best practice). An important indicator of future land use change and related impacts is the quantity (and location) of land occupation, which is now not visible in the tool.


No carbon storage and delayed emissions are included in the methodology, since the methodology on this topic is still in development.

Lack of a Data Quality Rating (DQR) system, and lack of an uncertainty module are also limitations that will be coped in future updates.

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