GRSB's Carbon Footprint Guideline – Frequently Asked Questions

1. What is the reference flow used?

The reference flow is a quantitative measure of the function of the system. *All inventory data is collected in alignment to the reference flow. All results are calculated for this reference flow.* Throughout this document the reference flow can be defined two ways: per kg live weight at the farm gate and per kg of beef carcass weight.

2. Why was a reference flow based on per gram of protein or nutritional value not used?

The recommended reference flow is kg of carcass weight or kg live weight, as the focus of the GRSB goal is reducing emissions at the farm level. We recognize that there is value in using nutritional value when comparing to other commodities, however, that is not the motivation behind the document.

3. Why is the methodology based on attribution methods and not consequential?

Attributional LCAs focus on describing the environmentally relevant physical flows to and from the product or process; this contrasts with consequential assessments, which describe how relevant environmental flows change in response to, for example, changes in demand.

For more detail on the use of attributional and consequential LCA modelling approaches, see Appendix 16 of the FAO LEAP guidance, 'Environmental performance of large ruminant supply chains: Guidelines for assessment'.

4. Why did this methodology not cover the entire supply chain?

The carbon footprint for beef is dominated by the farm stage, where 90% or more of the GHG emissions occur. While it is recognized that food waste and other factors further down the supply chain are important and need to be addressed, it was agreed to start with the farming stage and expand in the next update if needed.

5. How is this different from existing international guidelines?

From the outset, the GRSB is committed to summarizing the existing information available in international LCA methodology guidelines that address issues related to the beef industry. However, many of those guidelines provide multiple options for practitioners, depending on the goal and purpose of their research. This guideline streamlines the number of options available to ensure greater consistency and alignment for those creating a benchmark assessment for the purpose of monitoring a GHG reduction goal.

6. How many production systems needed to be covered in a national assessment or within a supply chain?

The number of production systems to model a specific national production or supply chain shall be determined based on an initial analysis of the main production practices at the national/supply chain level and the goal & scope of the study. Practitioner shall make a comprehensive overview of:

i) Which types of production system are present in the nation/supply chain?
ii) What is the share of the production from the production systems to the total national/supply chain production (live weight or carcass weight)?
iii) How do flows occur into and among production systems?
iv) Register common production activities and specific production activities occurring in the systems present (organic, nature conservation, welfare other production criteria)
v) What are typical production routes for further quantification?

It is advised for the practitioner to make a flow diagram including the insights of this overview. Once this has been mapped for the nation/supply chain in scope of the study, practitioner shall decide on the systems that shall be included in the overview in order to fulfill the scope of the study. E.g. if the scope of the study is to get an insight in the carbon footprint at National level, then practitioner may choose to select systems that make up to 80% of the total beef production (by live or carcass weight) in the nation, however, if the goal of the study is to get insights on the main contributors to the national impact and how different systems vary in carbon footprint, the practitioner should model most of the types of production systems prevailing in the nation of assessment.

7. How many representatives are needed from a producer survey for a national assessment or within a supply chain?

The representativeness for a producer survey can be subject to the goal and scope of the study. This means that a sample may or may not be representative, depending on the goal and scope set for the study. It is therefore difficult to provide a general rule of thumb to define a representative sample.

- Practitioner shall consider if the sample covers enough (% live or carcass weight) of the national/supply chain production.
- Practitioner shall put together a sample ensuring that all production systems within a population (national or supply chain) are represented proportionally in the sample.
- The defined sample shall be aligned to the goal and scope of the study and this shall be justified in its definition.

Generating a representative sample can be refined over the years as practitioner gets more insights in the population under study.

8. Why not just use the GHG Protocol being developed?

The Greenhouse Gas Protocol (GHG Protocol) is the most widely used international accounting tool and allows businesses to understand, quantify and manage GHG emissions. It is a partnership between the World Resources Institute (WRI) and the World Business Council for Sustainable Development (WBCSD) and brings together stakeholders from business, government, NGOs and academic institutes to develop internationally accepted GHG accounting and reporting standards.

The GRSB guideline is sector-specific and therefore more precise than the current GHG Protocol (see Figure 1). The GRSB membership has cross-over with the WBCSD process and will continue to do so in the future as developments in this field unfold.

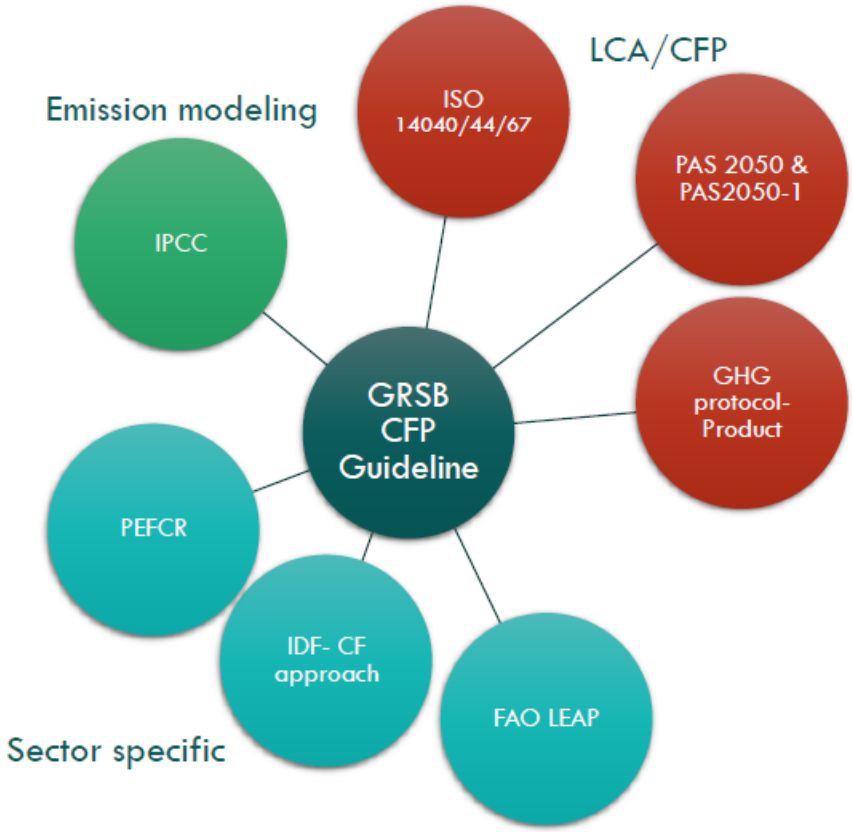


Figure 1. International standards and guidance referenced and implemented in the GRSB Carbon Footprint Guideline

9. What are the steps of a Carbon Footprint with a Life Cycle Assessment (LCA) perspective?

LCA is a framework implemented in the evaluation of the environmental footprint of a product or system. The GRSB follows an LCA approach focusing only on climate change (also known as carbon footprint). The LCA framework consists of a series of iterative steps described below:

1) Identify the **goal** of the project, which includes the intended application; reasons for carrying out the study; intended audience; and intended communication (e.g., whether the results are intended to be used in for internal business literature only, or for public comparisons).
2) Define the **scope** of the project including the **production system, system boundary and reference unit** that will be used (e.g., kg of live weight at farm gate or kg of beef after first processing). The scope should also identify the time frame, assumptions and limitation as well as allocation procedures used (see section 2.1 of the guideline).
3) **Data collection** and modelling of the production system, along with description, and verification of data. All data related to processes within the study boundaries must be verified to ensure that the data outputs from the LCA are accurate, defensible and evidence-based. The use of assumptions should be minimized at all times (see section 3.1 of the guideline which outlines representative sampling for national assessments and supply chains).
4) **Calculate the carbon footprint** using the information gathered (see Table 2, 3, 4, 5 and 7 for data requirements). All the GHG emissions are reported individually to allow for future desktop calculations into different units. They are then converted into CO2e figures according to the latest IPCC global warming potentials, and summed to give the carbon

footprint, which can then be divided by the total production yield to give the footprint per reference unit.

5) **Evaluate and report**. Results should be evaluated for accuracy and sensitivity to any changes in assumptions that had to be used. Results are then presented clearly in order for accurate conclusions to be drawn and benchmarking to occur.

Figure 2. Steps of a Carbon Footprint with a Life Cycle Perspective

10. Is transportation to the processing plant included or excluded?

With a cradle to farm gate study we recommend excluding transport to the processing plant.
When using the reference unit of kg of beef after first processing, transportation is included. When beef is processed on-farm, transportation is counted as zero.

11. Is feed included in the beef carbon footprint?

Yes, both purchased and homegrown feed to get the beef animal to the farm gate or first processing is included. For grains (e.g. corn, barley, etc.) life cycle inventories can be sourced from the region to utilize in the beef carbon footprint (see sections 3.2.3 and 3.3 of the guideline).

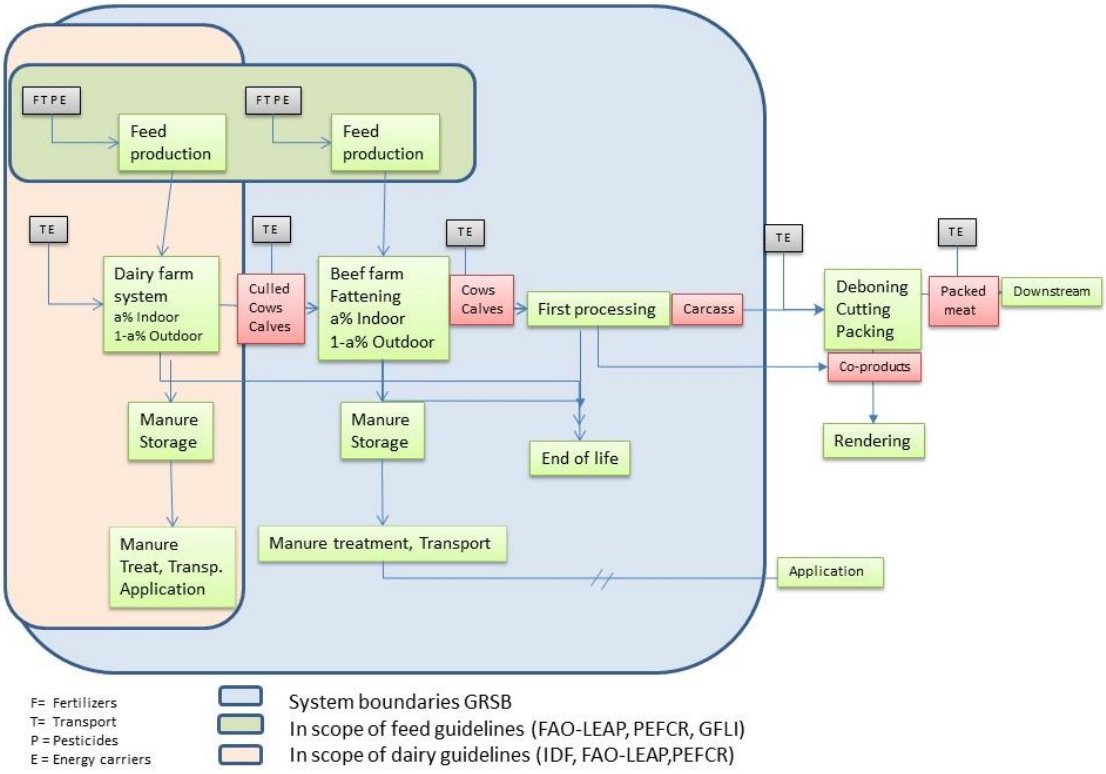


Figure 3. System Boundaries

12. When grain co-products are used in feed, how is the carbon footprint allocated?

Many feed ingredients are co-products from food production, and therefore in LCA accounting the environmental burden should be distributed between the co-products. Some of the more commonly used feed ingredients for beef cattle where allocation situations occur are:

- Dried distiller's grains with solubles (DDGS, co-product of ethanol, produced from various grains)
- Brewer's grain (co-product of brewing alcohol product, produced from various grains)
- Grain screenings and pellets (from grain cleaning at elevators, sometimes processed into pellets)
- Rapeseed meal (co-product of rapeseed oil, produced from rapeseed/canola)
- Soy meal (co-product of soy oil and soy hull, produced from soybeans)

The guidance is to use economic (revenue) allocation for co-products in feed production. Because producers tend to value each co-product based on its nutritional value, which varies significantly from product to product, and its desirability in the ration this is identified as the most feasible allocation method at this stage. For example, soy meal is typically used for its protein content, whereas soy oil is used for its energy content, hence applying allocation based on protein content or energy does not give an allocation factor that is relevant for both products. In addition, the economic allocation reflects the market signal back to grain producers to continue producing that specific commodity based on its various sources of demand.

As many feed ingredients are produced regionally or locally, five-year averages of prices are recommended to minimize fluctuations between years caused by extreme weather.

13. How is meat from dairy systems allocated?

A physical allocation method is used that aligns with step two in ISO 14044 and reflects the underlying use of feed energy by the dairy animals and the physiological feed requirements of the animal to produce milk and meat. The feed consumption by animals is also the main determinant of enteric methane emissions, and of nitrous oxide and methane emissions from animal excreta, which together can make up about 80% of total on-farm GHG emissions. The allocation factor for milk and meat can be calculated following the approach of Thoma, Jolliet and Wang.

$$AF_{milk} = 1 - 6.04 \times M^{meat}/M_{milk}$$

AF is the allocation factor for milk; M^{meat} is the sum of live weight of all animals sold (including bull calves and culled mature animals); and M_{milk} is the sum of milk sold corrected to 4% fat and 3.3% protein (FPCM).

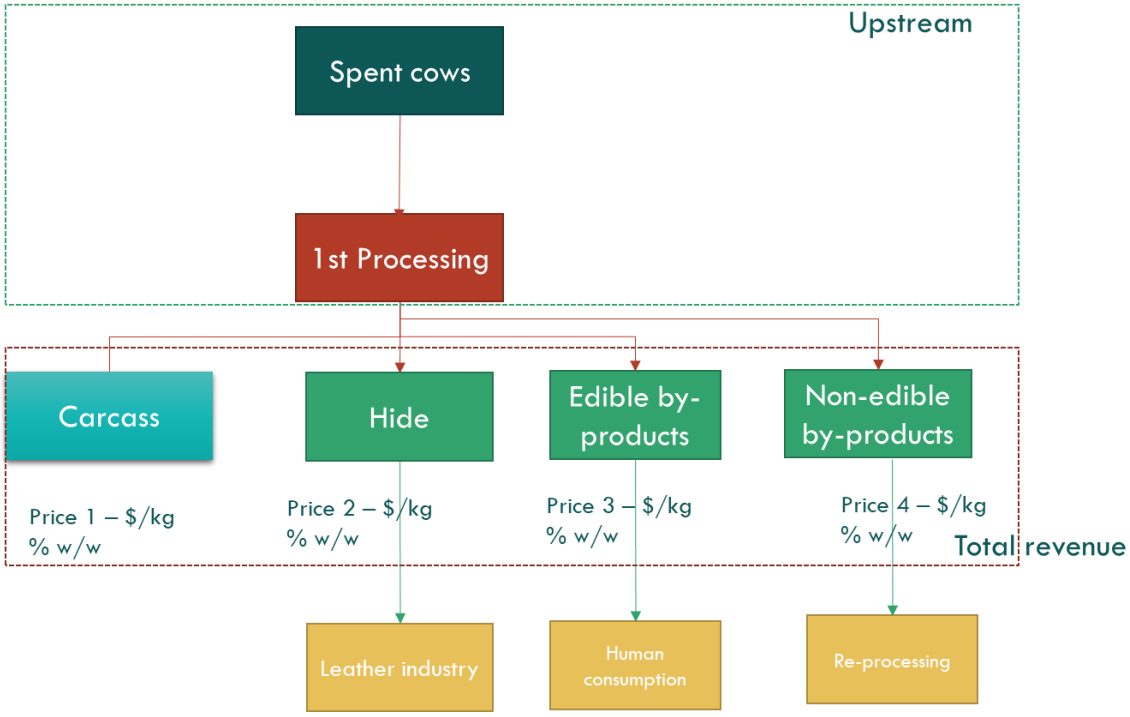
Note that this allocation factor should only be applied to emission sources that cannot be attributed unequivocally to either meat or milk production.

14. How is manure treated?

The GRSB guideline adopts a residual approach. This means that no impact from the animal system is attributed to the manure leaving the farm. All treatment/management of manure before leaving the farm is also fully attributed to the animal system.

15. How are by-products handled at first processing?

By-products at first processing are handled using economic allocation. This means that all upstream impacts are attributed to the carcass and by-products on their share in the total revenue of beef cattle after first processing.



E.g. The fraction of the upstream impact attributed to the carcass is : (P1*carcass weight)/total revenue.

Figure 4. Allocation of By-Products at First Processing

16. Is it appropriate to use different types of allocation in different places of the carbon footprint?

In general, allocation can be done by mass/volume, economic value, and residual.

An overview of allocation approaches is provided in Table 1 of the guideline and includes:

- Feed – economic
- Meat/Milk – physical
- Manure – residue/waste
- By-product at first processing - economic

The differences in allocation approaches used for each item is designed to reflect what is occurring within the supply chain and the drivers behind demand for each product (see Table 1 for rational of each).

17. Are emissions from Land Use Change included?

Yes, direct land use change (dLUC) is included. dLUC refers to the GHG emissions associated to the recent (< 20 years) change from one land use category to another. dLUC refers only to the direct conversion of land or land management practices as a direct consequence of activities in the system under study. Land use change encompasses changes in land use categories as well as changes in land management.

Indirect land use change (iLUC) occurs when the agricultural activity under study, induces changes in land use outside the system boundary. There is currently no single agreed upon methodology to deal with this type of land use change, as it is very complex to determine.

Suggested frameworks for including iLUC range from attributing a share in land use change to all land-based production to evaluating in more detail how increased demand for certain products or functions may cause land transformation via compensation (see Brandao et al. 2021 for a discussion).

For the time being a decision is made to exclude iLUC form the GRSB carbon footprint calculation.

18. Land use change and use of the C.Sequ Guideline, does it result in double counting?

No, this does not result in double counting as land use change and soil carbon sequestration deal with different sources of GHG emissions/ removals. On one hand, dLUC deals with the GHG emissions occurring as a result of a conversion in the type of land and management practices (e.g. emissions due to above/below ground biomass loss). On the other hand, soil carbon sequestration refers to the accumulation process of organic carbon in the soil, dealing to a removal or sink associated to a specific land type and management over the years.

19. Is carbon sequestration included?

No. For more detail on calculating carbon sequestration see the FAO's "Measuring and modelling soil carbon stocks and stock changes in livestock production systems: Guidelines for assessment (Version 1)" from the Livestock environmental assessment and performance (LEAP) partnership and for details on calculating net emissions, see the "C-Sequ: LCA guidelines for calculating carbon sequestration in cattle production systems" lead by the Global Dairy Platform.

20. What is excluded or cut-off based on a threshold?

A specific threshold was not set, as it is difficult to estimate. Processes to determine this are mandatory in the guideline. There are many inputs that have a negligible contribution to the overall animal production footprint and shall not be included in the inventory (cut-off). These are capital goods depreciations (e.g., buildings and infrastructure), production of semen for artificial insemination, antibiotics and other veterinary products and services.

There are also other types of inputs that shall be excluded since they are out of the scope of the animal product supply chains; this is relevant for non-agricultural activities related to the producing company (e.g., accounting departments). Capital goods and ancillary activities (such as veterinary services or office management) are excluded from the system boundary.

21. What tier of emission factors should be used?

Emission factors provide an indication of the amount of GHGs emitted from a particular source or activity. There are various methods and sources for determining emission factors, which are tiered according to their accuracy and detail. Going from the simplest and progressing to a more detailed approach, tier levels are defined as follows:

- Tier 1 emissions model: calculations make use of default parameters and emission factors, based on the previous studies.
- Tier 2 emissions model: parameters are often country-specific and emission factors are calculated based on full or partial balances.
- Tier 3 emissions model: uses complex biophysical model to estimate excretions, together with emission factors that are measured or based on more advanced country-specific methodologies, compared to the defaults.

For the purposes of achieving consistency in beef carbon footprints, the practitioner shall use Tier 2 approach when calculating the emissions from the animal farm. When calculating emissions from

cultivation, Tier 2 approach should be used; however, when country-specific data are not available, the practitioner may adopt Tier 1 approach.

The IPCC Guidelines for National Greenhouse Gas Inventories and its refinements have described all three tiers for estimating methane emission from enteric fermentation. Countries that don't have Tier 2 emission factors could consider this an area for research activities.

22. What scope does this guideline apply to?

GHG emissions are categorized into three groups or 'Scopes' by the most widely-used international accounting tool, GHG Protocol.

- Scope 1 covers direct emissions from owned or controlled sources
- Scope 2 covers indirect emissions from the generation of purchased electricity, steam, heating and cooling consumed by the reporting company
- Scope 3 includes all other indirect emissions that occur in a company's value chain.

The GRSB Beef Methodology covers the beef supply chain. This is scope 1 for a beef producer, and scope 3 for retailers, packers, and processors.