BEVERAGE INDUSTRY
ENVIRONMENTAL ROUNDTABLE

Beverage Industry Greenhouse Gas (GHG) Emissions Sector Guidance

(Version 4.0)

December 2018

Acknowledgements

Participants at the October 2017 BIER Meeting in Guadalajara, Mexico.

This *Beverage Industry Sector Guidance* document was developed through a collaborative effort of the Beverage Industry Environmental Roundtable (BIER). The global beverage companies which participate in BIER have developed this protocol to better understand, measure and report on the GHG emissions associated with our industry. This work product supports BIER's mission of establishing a common framework for stewardship in the realm of energy efficiency and climate change mitigation.

BIER also acknowledges the technical contributions of:

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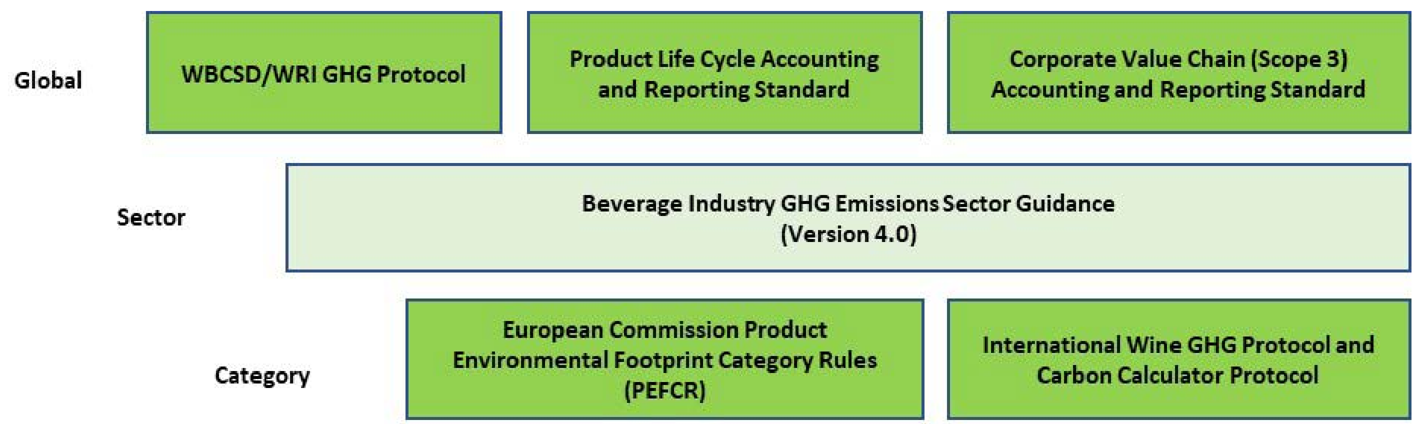
Introduction & Purpose

This is the fourth version of the BIER Greenhouse Gas (GHG) Emissions Sector Guidance. The purpose is to provide beverage companies with supplemental guidance specific to the sector, which supports beverage companies with alignment to global GHG reporting protocols and more granular guidance to drive additional consistency, accuracy, and leadership across the sector. Maintaining this Sector Guide is an important initiative for BIER as it completes a comprehensive approach to GHG emissions calculation and reporting for the beverage sector in terms of global standards, this sector specific guidance, and beverage category specific rules and protocols, as illustrated below:

There are three primary protocols in the field of GHG emissions reporting which should be considered by beverage companies as the first level or overarching guidance:

- World Business Council for Sustainable Development (WBCSD) and World Resources Institute (WRI) GHG Protocol[1]
- The Corporate Value Chain (Scope 3) Accounting and Reporting Standard[2]
- The Product Life Cycle Accounting and Reporting Standard[3]

These three protocols are all intended to drive global consistency on GHG estimation, tracking, and reporting for organizations across all industries. In other words, these represent the overarching ‘top down’ enterprise and product life cycle frameworks.



1 World Resources Institute and World Business Council for Sustainable Development, The Greenhouse Gas Protocol, http://www.ghgprotocol.org/.
2 Pankaj Bhatia, et al., The Greenhouse Gas Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard (October 2011).
3 Pankaj Bhatia, et al., Greenhouse Gas Protocol Product Life Cycle Accounting and Reporting Standard (October2011).

There are also beverage category-specific rules and protocols that represent the 'bottom up' guidance. The most widely acknowledged are the:

- European Union has facilitated standard setting efforts for the European Commission on Product Environmental Footprint Category Rules (PEFCR) for beer, wine and packed water[4] which were supported by BIER and guidance consensus approach to defining category-specific rules.

- International Wine GHG Protocol and Carbon Calculator Protocol were developed to facilitate further alignment across all segments of the wine industry (e.g., growers, wineries, contract bottlers, etc.), These beverage category specific protocols were developed by FIVS, a global organization designed to serve the wine, spirits, and beer sectors from around the world on public policy issues.

The BIER Sector Guidance supports alignment with both the top-down leading protocols and the bottom-up rules and protocols by providing insights, clarifications, and consensus on beverage sector specific application.

Why is a Comprehensive Approach to GHG Emissions Calculation and Reporting Important to the Beverage Industry?

As the issue of climate change continues to advance on the list of global priorities, businesses must develop effective and fact-based strategies to reduce their GHG emissions. For the beverage industry, as for all industries, a critical first step in reduction efforts is to properly inventory all relevant GHG emissions associated with a company and its value chain, as well as the GHG emissions associated with the life cycles of its products. The beverage industry has been very proactive with inventorying, taking action, and reporting GHG emissions in a way that will help to create meaningful value and meet expectations and growing demands from key stakeholders, such as:

- Individual consumers who are increasingly aware of the environmental impacts of the products they purchase and of the businesses that provide them. Consumers can choose, and are choosing, to buy environmentally-friendly products and to avoid companies that are less sensitive to reducing their environmental footprint;
- Investors looking for increasingly granular and company-specific insights on GHG-related risk and opportunity management;
- Supply chain partners, such as packaging and equipment suppliers, who are critical to inventorying and reducing GHG footprints;
- Trade organizations that represent a broader base of companies' active in the beverage industry; and
- Relevant external programs, initiatives, and frameworks that require robust reporting of baselines and performance (e.g. Science-Based Targets; CDP, DJSI, Climate Savers, Task Force on Climate Related Financial Disclosures).

BIER member companies believe uniformity in data collection, recording and communication is of particular importance to our industry. As consumer-facing organizations, uniformity in GHG reporting will provide our consumers, as well as other third-party organizations, with a consistent, comparable and transparent source of important environmental information, while simultaneously safeguarding sensitive and/or proprietary data. BIER has maintained this guidance document based upon a belief that disjointed efforts by individual companies may lead to complications later on, such as competing or incompatible methodologies; accounting practices not aligned with emerging legislation; the inability of the industry to influence emerging regulation; and/or confusing and potentially misleading product carbon labels. Therefore, the work to maintain this guidance represents a united approach, a "common voice", to measuring and reporting GHG emissions and the industry's intent to play a constructive role in reducing GHG emissions.

4 European Commission, PEFCR Guidance document, - Guidance for the 13 development of Product Environmental Footprint Category Rules (PEFCRs), version 6.3 (December 2017).

Why was the Sector Guidance Updated?

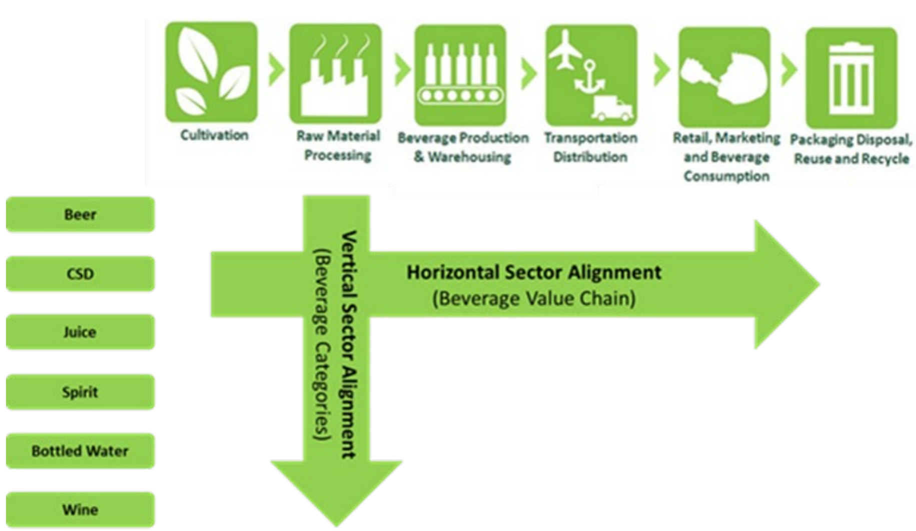
BIER identified that this was an important time to update the previous version of the sector guidance (Version 3.0) to:

- Ensure alignment with The Corporate Value Chain (Scope 3) Accounting and Reporting Standard and The Product Life Cycle Accounting and Reporting Standard, published by WRI/WBCSD;
- Reflect method changes adopted from the European Union PEFCR effort, most notably changes to recycling content allocation for packaging materials and select footprint boundary conditions/definitions;
- Demonstrate further leadership by the beverage sector through early adoption of the European Union PEF Circular Footprint Formula (CFF); and
- Provide standard methods and boundaries for calculating GHG emissions within beverage categories (horizontal alignment), and standard methods for common processes and value chain elements shared by all beverage categories (vertical alignment). Achieving further horizontal and vertical alignment will help the industry with future development and consensus on product category rules for environmental foot printing.

In developing the Sector Guidance, BIER has also elaborated on the areas where beverage-specific guidance was needed most: recycling allocation, transportation logistics, maturation of distilled spirits and cooling models.

What is Intended and Not Intended by this Sector Guidance?

- The guidance incorporated within this document makes no attempt to modify or amend the methodologies of primary global GHG reporting protocols. For example, beverage companies can choose which method – market-based, location-based or both—to use for performance tracking based upon the GHG Protocol Scope 2 Guidance and must disclose this in their inventory. In other words, the BIER Sector Guide is intended to be a value-added, supplementary guidance to primary global protocols, which standardizes calculation steps, provides a directory of data requirements, and creates consensus on boundaries and scope setting specific to the beverage industry.



Alignment Disclaimer: *BIER acknowledges that significant variability exists across company structures, value chains, and product categories. While this Sector Guide promotes greater consensus and an aspiration to pursue full and transparent practices, it is up to individual companies to define and document their company-specific scope boundaries, assumptions, and data availability for specific emission calculations and reporting.*

- The guidance within this document is intended to support companies across a broad spectrum of business drivers for calculating and reporting GHG emissions, from pragmatic internal strategy and decision making to external disclosures and product declarations.
- This document accommodates enterprise inventory and beverage product carbon footprints, but no guarantee is made on behalf of individual BIER members to complete or publicly report the results of such an assessment.
- This document allows for a consistent approach to identifying life cycle impacts, but is not designed to be used to directly compare products. Its purpose is to clarify the perspective of the industry and drive a greater level of consistency with what is included in GHG emission reporting and how boundaries are set.
- Although complete enterprise-level reporting includes all operations or divisions of an organization (which may include media, entertainment, or foods), this sector guidance addresses only the beverage-related operations. Users of this Sector Guidance should consult the WRI/WBCSD protocols to clarify any issues not addressed by this Sector Guidance, as it is only meant to supplement or clarify existing protocols. Leading protocols should be seen as the first level or overarching requirements for GHG emissions calculation and reporting, while this document gives further clarification and explanation specific for the beverage industry.

This is the fourth version of the sector guidance produced by BIER and should therefore be considered a “living document.” As GHG data collection, estimation and reporting guidelines continue to evolve, BIER will continue to review the information contained within this Sector Guidance, and, as new standards and reporting protocols become final, the beverage industry will respond with updates to this Sector Guidance document as needed.

Beverage Sector GHG Emissions and Value Chain Overview

As context for this sector guidance, it is important to have a base understanding of two foundational elements:

1. The GHG Protocol Scope 1, 2, and 3 categories
2. The Overall Beverage Value Chain

Both of these elements are described within this section and will be continuously referred to throughout this document.

Scope 1, 2, and 3 Emissions Overview

The GHG Protocol defines three 'scopes' for consistent calculations and reporting of GHG emissions as follows:

Scope 1 Beverage Industry Emissions

Beverage industry Scope 1 emissions are the direct GHG emissions resulting from company operations (including generation of electricity, heat, or steam; physical or chemical processing; and fugitive emissions).

Scope 2 Beverage Industry Emissions

Beverage industry GHG emissions sources included under Scope 2 (indirect emissions) generally fall into one of the following two categories:

Emissions from directly purchased utilities such as electricity, steam, chilled water, refrigeration, or compressed air used at company-owned or controlled facilities must be reported within Scope 2 emissions.

When purchasing electricity, heat or steam from a CHP plant, it is necessary to allocate emissions generated according to the proportion of each stream purchased or sold. Use the efficiency method as defined in the WRI/ WBCSD Protocol Initiative Calculation Tool to allocate emissions. This method calculates GHG emissions according to the amount of fuel energy used to produce each final energy stream based upon primary data specific to the Scope 2 source.

Emissions from indirectly purchased utilities at controlled facilities, such as the energy used to run leased buildings and operations within them, must be included. For leased buildings accounted for under this Sector Guidance, the preferred data sources are as follows: 1) actual metered usage from leased space; 2) percentage of actual metered usage for entire building based on percentage of building leased; and 3) U.S. Environmental Protection Agency's Commercial Building Energy Consumption (CBEC) tool. Outside of the United States, companies choosing to use this EPA tool should substitute the energy emissions factor for the country in which the operation is located. The tool uses square footage and type of leased space to estimate energy consumption.

Also, according to the Scope 3 protocol, the indirect emissions (e.g. upstream emissions such as pre-combustion emissions) of all fuel sources need to be addressed and accounted for as well.

Scope 3 Beverage Industry Emissions

Scope 3 emissions include relevant emissions in the company's value chain not accounted for under Scopes 1 and 2. The distinction between scopes is unique to each beverage company depending on its operational boundaries. As mentioned earlier, Section 5 presents more detailed value chain descriptions and process maps for each beverage category.

Note that items under the operational control of the company will count towards Scope 1 emissions; purchased energy associated with these activities would count towards Scope 2 emissions. The emissions included in the Scope 3 inventory should include the direct emissions (such as fuel combustion in a truck owned by a third-party distributor) and indirect emissions (such as electricity used during production of packaging materials) associated with these value chain activities.

Beverage Value Chain Overview

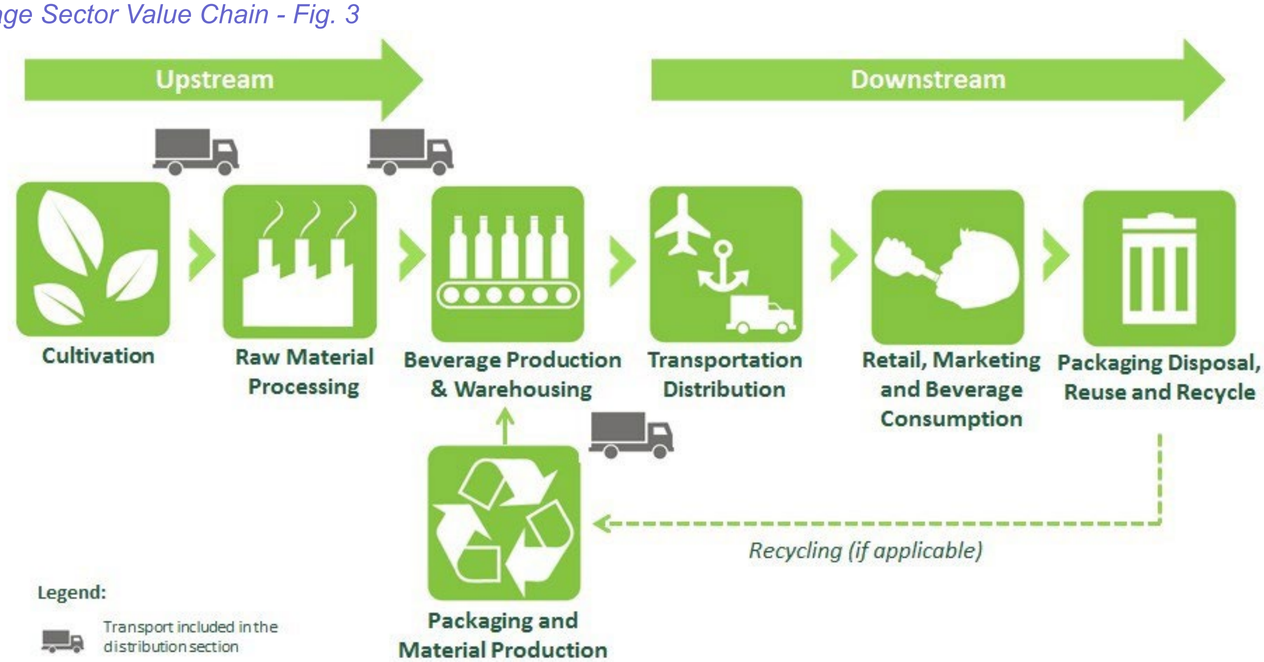
A beverage company's GHG emissions (Scope 1, 2, and 3) inventory encompasses all relevant upstream and downstream activities related to the raw material processing, production, use, and disposal of the beverage products, as well as their associated packaging and waste streams. For each value chain component, these emissions are included in the inventory based on the fraction associated with the beverage company's manufacturing and operations versus those total emissions associated with a particular supplier. All BIER members align across the complete value chain per beverage category (horizontal alignment) as well per value chain element (vertical alignment).

Figure 3 below visualizes the overall beverage value chain moving from raw material or ingredient processing, to beverage production where separately produced packaging materials are added, to distribution of the packed product to first users, and finally the disposal of the packaging which can serve as a raw material stream to the packaging production in case of recycling. Transportation is an item attributable throughout the complete value chain and is described as a separate element.

Some further explanation and clarification of the beverage sector value chain is given below.

- *Cultivation:* Includes relevant emissions associated with the cultivation of crops used by the enterprise (fertilizer production and GHG emissions after application, harvesting, irrigation, crop management, land use change, pesticide application, etc.).

Beverage Sector Value Chain - Fig. 3



- *Raw material processing:* Includes relevant emissions associated with the processing of the crops and other raw materials (preservatives, sweeteners, etc.) used by the enterprise.
- *Beverage production and warehousing:* Includes any beverage production and warehousing activities which are under and not under the operational control of the reporting company. Common examples of activities not under the direct operational control of the company are co-pack operations and distribution networks, unless they are wholly controlled by the beverage company. Activities under direct control are reported under the scope 1 and 2 emissions.
- *Packaging materials:* Includes emissions associated with the production of primary, secondary, and tertiary packaging used by the enterprise as well as the mining and pre-processing of these materials.
- *Retail, marketing and consumption:* Includes the point-of-sale retailer, display cases, adware, refrigeration units, vending machines, restaurants, and end use by the consumer based on the proportion used by all enterprise products.
- *Disposal, reuse and recycling:* Includes emissions associated with the disposal of packaging and other waste streams generated throughout the value chain for all materials/processes relating to the enterprise's operations.
- *Transportation and distribution:* Include emissions generated as a result of transportation of all products, packaging materials, beverage ingredients, fuels, and wastes.

Details of contributing sources and boundary conditions for each value chain element are presented below and are very similar for every beverage category.

Beverage Ingredients: Cultivation and Raw Materials Processing

This includes relevant emissions associated with the growing, processing and transportation of ingredients used in the company's products in the Scope 3 inventory. Examples include:

- Emissions associated with energy use by third-party agencies for extraction, transportation, and treatment of ingredient and process water.
- Emissions associated with the manufacture, transport and storage of chemical materials such as preservatives and other artificially synthesized flavors.
- Emissions resulting from agricultural processes, including tilling, planting, irrigating, harvesting, fertilizing, and transporting agricultural products used by the beverage industry.

Beverage Production and Warehousing

For the beverage industry, the beverage production process will typically be accounted for as Scope 1 and 2 activities. Co-packing operations, however, should be accounted for in the Scope 3 inventory when the reporting organization has no operational control over the production operation. For example, a soft drinks company may own and distribute a brand globally. In a specific location, however, they contract with a third-party to produce and package the same product, without assuming direct control over the operations of that production and bottling facility. The emissions associated with the third-party owned and controlled facility would be accounted for as Scope 3 emissions. The same principles apply to joint ventures over which the reporting organization does not have operational control.

For instances where a co-packer produces beverages for more than one company, it is necessary for the reporting organization to estimate the portion of GHG emissions from the co-packer's facility which represents the fraction of their beverage versus all beverages produced at the third-party production facility.

GHG emissions from warehouses controlled by a third party which store a beverage company's products should also be included in the Scope 3 inventory, in proportion to the fraction of the warehouse occupied by the reporting company's products.

Packaging Materials and Use

This includes all GHG emissions associated with the production of the company's packaging materials in the Scope 3 inventory. Types of packaging include primary (e.g., the container enclosing the liquid, such as a bottle), secondary (e.g., a case of bottles/cans), and tertiary (e.g., a pallet of cases with shrink wrap that is prepared for transportation and storage).

In certain sectors of the beverage industry, other packaging containers may be used during the product life cycle for aging (e.g., barrels). Where barrels or other packaging materials are reusable, their associated embedded carbon can be amortized over several life cycles.

GHG emissions estimates should include the initial extraction of the raw materials from the earth or forest (incorporating recycled stock). The inventory should include packaging materials for all products made by the company, as well as marketing materials such as game pieces, point-of-sale displays, or promotional items that are added to packages.

In the case of materials which are recycled and used in another product's life cycle (such as PET, which may be used in future PET bottles or for another use), use an allocation method based on the sales market. Depending on local market conditions, this approach affords the environmental benefits of recycling either to the recyclers or to the beverage producer.

Details into recycling allocation methods are provided in *Appendix I, Guidance for Calculation of Packaging Material Emissions.*

Beverage Retail and Consumption

GHG emissions are generated during the retail sale phase of products, as well as during the beverage end use by consumers. Emissions associated with cooling must be calculated for all beverages that are sold below ambient temperature at the point of sale, regardless of the manufacturer's recommended temperature of consumption.

GHG emissions associated with beverage retail and consumption that should be accounted for in the Scope 3 inventory include the following:

- Electricity used to run the cooler or vendor (potentially included in Scope 2 inventory; see *Appendix K, Guidance for Beverage Retail and Home Consumption* for details);
- GHG emissions from the production and losses of refrigerants used at retail or point-of-sale establishments;
- Purchased CO2 used at retail establishments to run draft products or soda fountains;
- GHG emissions from the production of cups and other packaging materials used to consume draft products delivered by the reporting company; and
- The energy used to heat, cool and light the fraction of retail space where equipment is located (hotel load).

For further detail on this topic and calculation methods, see *Appendix K, Guidance for Beverage Retail and Home Consumption.*

Production Waste and By-Products

By-products and waste are generated at each point in the beverage value chain. Include GHG emissions associated with the treatment, recycling, and/or disposal of all waste products and waste water generated by the beverage company. GHG emissions associated with waste disposal at other points in the value chain should also be included in the Scope 3 inventory.

GHG emissions associated with generation of by-products should be accounted for up to the point where the by-product can be beneficially reused (i.e product can be sold) and when there is transition of ownership. The beverage production process also generates a number of by- products which are often beneficially reused, such as bagasse, pumice, spent grains, and spilled product. Account for "waste products" that become co- products by virtue of them having a beneficial use (such as composting or feed material) up to the point of product differentiation (i.e. a new product that can be sold, leading to transition of ownership). For example, if spent grains from beer production are sold for cattle feed, the emissions from the processing of the grains at the time they become spent are allocated for instance based on economic value of the two products - that is, the spent grain and the beer. Another example includes the manufacture of orange juice; the oranges are squeezed to make juice and the peels are then sold for cattle feed. Any emissions associated with the peels are allocated based on the economic value of the juice and the cattle feed. Any emissions associated with transporting or further processing of the sold co-product (and the new owner) are allocated to the co-product and not the original product from which it was derived.

Evaluate wastewater streams coming from a beverage production facility or other locations in the life cycle to identify the energy demand associated with wastewater treatment. For example, non-contact cooling water will require significantly less energy to treat than wastewater streams leaving fermentation process areas. In some cases, wastewater treatment will be performed at a company-controlled facility, and the purchased energy used in wastewater treatment is considered a Scope 2 emission.

When wastewater is sent off site to a third-party treatment site, such as publicly owned treatment works, however, include the energy use associated with transportation and treatment in Scope 3 emissions.

Distribution

The Scope 3 inventory should include all GHG emissions associated with all transportation streams in the company value chain which are not controlled by the reporting company. Examples common to beverage companies include:

- Transportation of raw agricultural products to processing facilities;
- Transportation of all raw material inputs to the production facility, such as packaging materials, process chemicals and beverage ingredients;
- Product distribution including direct delivery from retailer to shops. Emissions from empty return journeys are included;
- Transportation of wastes to their final disposal location or point of beneficial reuse; and
- Employee commuting and business travel (if relevant).

Include GHG emissions associated with refrigeration use in transport.

Common forms of transport used in the beverage value chain include locomotives, passenger vehicles, trucks, planes, and cargo ships and barges.

Published emissions factors may be used in calculating transportation□related emissions. Additional guidance on transportation logistics and product distribution is included as *Appendix J, Transportation Logistics and Product Distribution.*

Energy

The Scope 3 inventory on energy emissions is applicable to all pre-combustion emissions of the different sources.

Many energy suppliers are offering a “green tariff,” or energy from renewable sources sold at an additional cost. Purchased energy which is claimed to be ‘renewable’ is assumed to be a low GHG emissions source, if the energy supplier can document (CO2 intensity (gCO_2/kWh, or gCO_2/MJ), in the form of an accredited certificate. Further, the beverage company must assure this low emissions source is not counted elsewhere in the product carbon footprint.

Additionally, many sites make use of self-generated biogas from their waste water treatment plants. This is also a low GHG emission source.

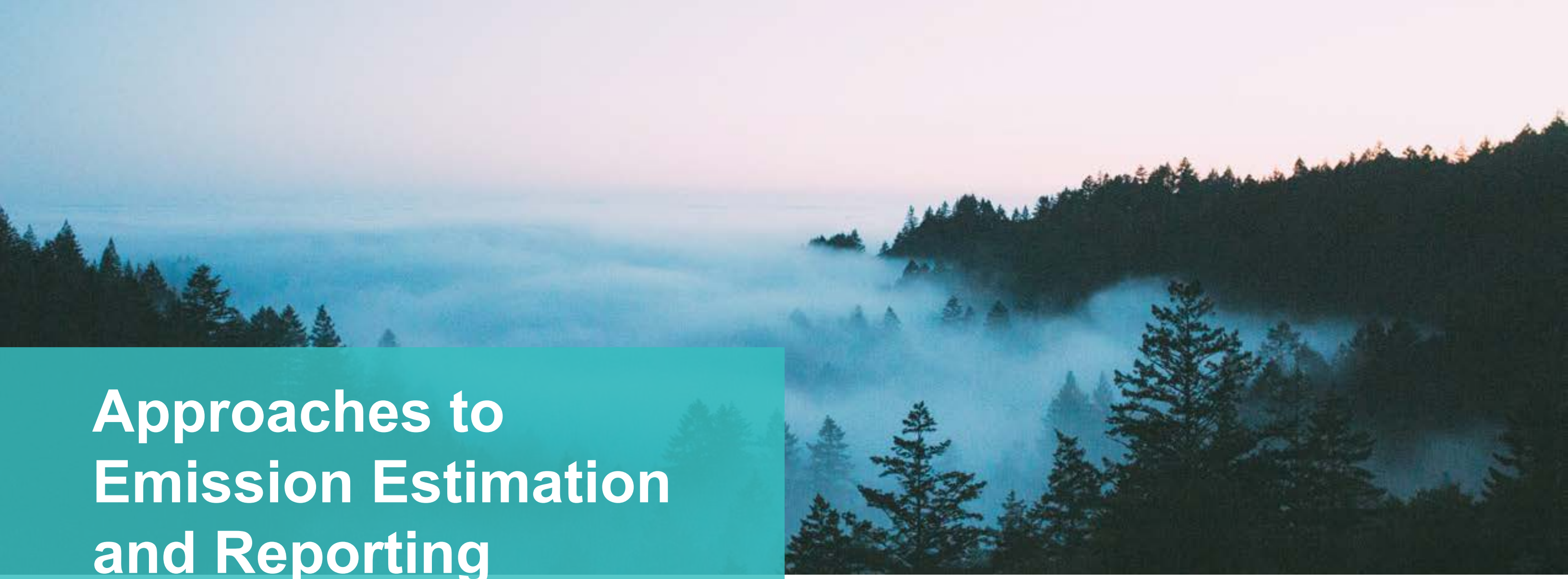
Finally, as stated in the WBCSD Scope 3 protocol, the fuel and energy related emissions that are not covered in the Scope 1 and 2 activities need to be addressed as well.

De Minimus Usage

Any GHG emission source, when evaluated in terms of CO_2eq, representing less than 1% of the total GHG emissions emitted during a product life cycle is considered *de minimus*.

Any such source can be removed from that product life cycle after using GHG emission data to demonstrate that the source meets this definition. When aggregated, however, if *de minimus* sources exceed the 5% materiality threshold, they shall then be included as they are no longer *de minimus*.

All *de minimus* emissions excluded by a member company must be declared and explained.



Approaches to Emission Estimation and Reporting

There are two unique approaches to GHG emissions estimation and reporting:

1. Enterprise Inventory Reporting
2. Product-Level Reporting

This Sector Guidance document intends to provide standard boundary conditions and data sources specific to the beverage industry, where flexibility exists within these two approaches, meaning this guidance document will serve the needs for both types of reporting based upon individual company applicability.

Making Sense of Product and Enterprise Emissions

Both enterprise inventory and product carbon footprint (product level reporting) assessments use the beverage value chain as the basis for calculation, which was described in Section 2. All steps in the value chain, whether electricity used to cool a warehouse, fuel used in distribution trucks, or natural gas used in the manufacturing plant, have their place in each assessment. The difference, however, in enterprise and product reporting is in how pieces of the value chain are considered and in what proportions.

An enterprise inventory includes all emissions from the reporting company over a given period of time, as well as the proportion of emissions from value chain partners that are associated with the reporting company's products. A product carbon footprint includes all emissions from across the value chain required to manufacture a given product, normalized to a functional unit. Each approach is presented below in summary, while more details can be found in the aforementioned WBCSD/WRI GHG Protocol.

The *Product Life Cycle Accounting and Reporting Standards* describes the differences between the enterprise reporting and the product carbon footprint reporting in more detail. For the generalized beverage value chain, figure 4 on the following page describes the differences and shows the attributable and non-attributable scope 3 items for the product carbon footprint. The non-attributable items only need to be captured in the enterprise reporting. For specifics per beverage category, please refer to Section 5.

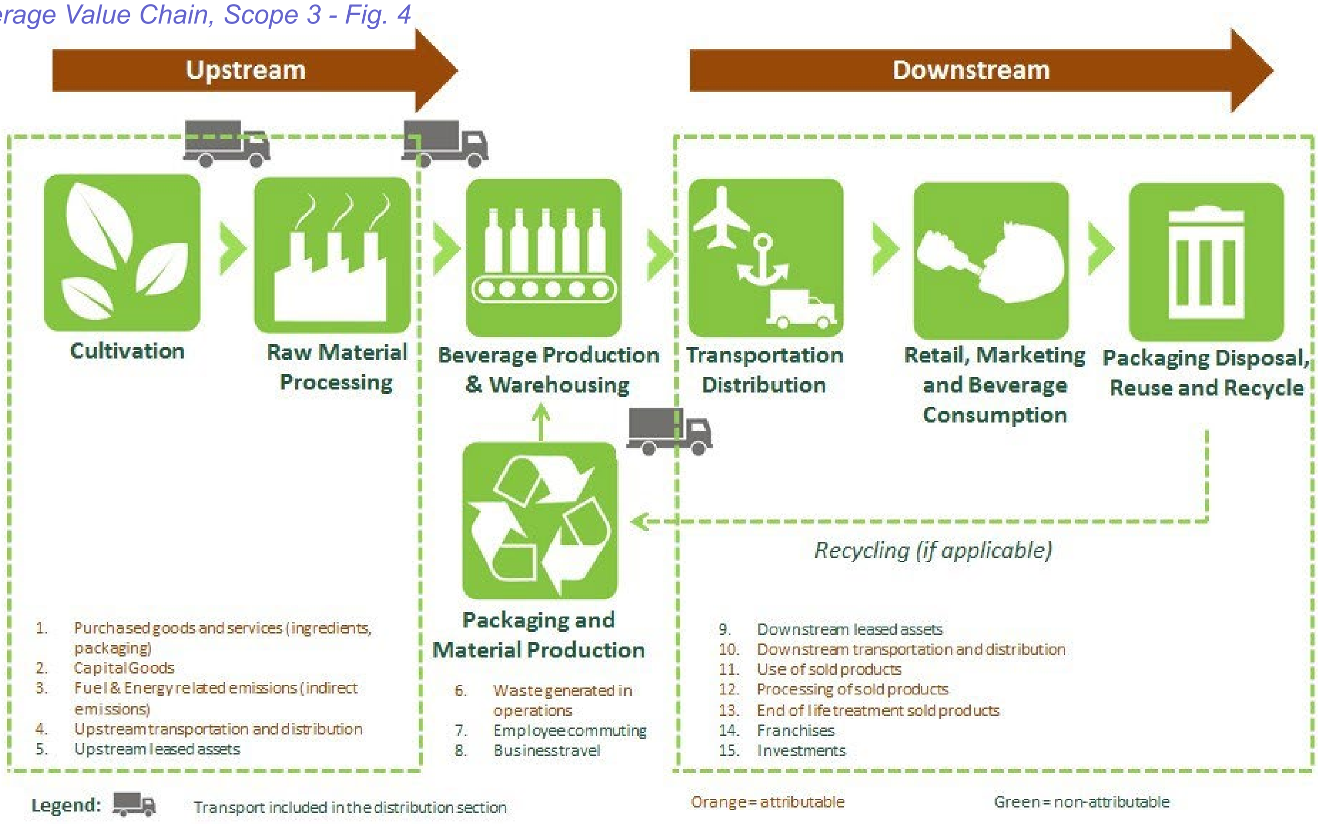
Enterprise Inventory

Enterprise reporting, as defined by The GHG Protocol and described in Section 2, is arranged in a series of three "scopes", or emissions categories (Scope 1, 2, and 3). Emissions included in an enterprise emissions calculation are for all products offered by the beverage company. Full reporting requirements are presented in *Section 4, Data Reporting*, with the following sections providing a basic introduction to Enterprise reporting.

Setting Organizational Boundaries

Use the **operational control approach** as defined by The GHG Protocol to define Scope 1 and 2 emissions. Include all GHG emissions from operating facilities which are wholly owned and for which the company has operational control in its Scope 1 and 2 calculations. Emissions from non-beverage operations such as

Beverage Value Chain, Scope 3 - Fig. 4



entertainment, media, or food businesses are not addressed within this Sector Guidance.

Clearly state any deviation from the Scope 1 and 2 inclusions/exclusions listed above when reporting GHG emissions. For example, some beverage companies consistently report any franchised or licensed operations as part of the reporting company for environmental reporting purposes. The latest Scope 3 protocol asks for reporting these emissions as Scope 3 emissions in case they are included in the Scope 1 and 2 reporting. A beverage company that elects to include GHG emissions associated with franchised and licensed operations (which are not controlled operations) under Scope 1 and Scope 2 is required to clearly state the deviation from the approach defined above.

Reporting the Enterprise Inventory

When reporting an enterprise inventory, the reporting company must report the complete inventory of Scope 1, 2 and 3 emissions according to the boundaries, scope and data requirements described in this Sector Guidance. While the finer boundary points between scopes are discussed within this document, consider that for a certain beverage company all production, packaging, and warehousing operations are under the company's control. All upstream beverage ingredients and packaging are purchased from third-party suppliers; similarly the company uses an external distributor to pick up beverages from the warehouse and deliver their beverages to the point of sale.

Only the fraction of GHG emissions from upstream and downstream value chain partners that are associated with the materials, products, or services provided to the beverage company are included in enterprise Scope 3 emissions.

Aggregation and Apportionment of Emissions

An enterprise inventory is typically created through the aggregation of emissions from various facilities, activities, and value chain components. For example, a given manufacturing facility can calculate its Scope 1 and 2 emissions using the same principles described above, and the manufacturing emissions inventory for an enterprise can be determined by aggregating emissions from all manufacturing locations.

Further description of aggregation methods can be found in *Appendix D, Aggregation and Apportionment of Emissions.*

Product Carbon Footprint

A product carbon footprint is an evaluation of GHG emissions across the life cycle of a specific product. Product-level emission reporting, as presented in *Product Life Cycle Accounting and Reporting*, requires a different evaluation of value chain emissions. Unlike an enterprise-based assessment, boundaries are not drawn within the value chain to assign emissions to scopes. Instead, all emissions within the value chain boundary of a specific product are accounted for and parceled to a functional unit, which could be a specific container, serving size, or case of product. For this approach (Product Carbon Footprint), it is irrelevant whether GHG emissions are associated with company controlled operations or by another entity, direct or indirect. Instead, the carbon life cycle is defined for an individual product category, and GHG emissions from across that life cycle are aggregated. Only the fraction of emissions from each value chain component that contributes to the specific product footprint is included in the product emissions total.

Although this document will commonly use the terminology "Product Carbon Footprint," the same GHGs that contribute to an enterprise inventory also contribute to the product carbon footprint, including the GHG emissions associated with cultivation, raw material inputs, transportation streams, manufacturing, and disposal/recycling of beverage materials. Aggregated GHG emissions from all activities related to a product, from the extraction of basic raw materials, through manufacturing and distribution and including consumer use and end of life (recycling/disposal), are included in the product carbon footprint. GHGs other than CO_2 are expressed in terms of CO_2eq using their global warming potential (GWP), such that the footprint of a product can be expressed as a single number.

For example, consider a beverage company with a single manufacturing location that makes two products: grape soda and lemon-lime soda. Emissions from the manufacturing location are allocated to the two products (as described later in this document). Each product individually, however, is not assigned the total emissions from that manufacturing location. Similarly, emissions from across the value chain are attributed to one of the two products. For example, all emissions associated with growing lemons and limes would be attributed to the lemon□lime soda; emissions associated with growing grapes would be attributed to the grape soda.

Product emissions are presented on a functional unit basis (i.e., per liter or per serving). Also, there are other ways to define a "product" – for example, the beverage company could separately calculate specific product footprints for packaging grape soda in a 20 oz. PET bottle or 33cl aluminum can, using the same principles.

It is important to recognize that a product carbon footprint is different from a full environmental Life Cycle Assessment (LCA). An LCA is a tool for quantifying the emissions, resources consumed and environmental and health impacts associated with all stages of the life cycle of a product; a product carbon footprint focuses solely on GHG emissions within the same product life cycle.

Alcohol Product Considerations

For some beverage alcohol products, including spirits, wines, and even beers, maturation is part of the beverage production process. Certain beverages, such as Scotch whisky, require years to fully mature before they are bottled for sale (maturation periods of over 10 years are common). During this time, the unfinished beverage is stored, usually in barrels and virtually untouched, until the maturation period is complete and the material is bottled.

The maturation process has significant implications for product carbon footprints, as certain steps in the product life cycle are completed many years before consumer use and end-of-life.

Account for GHG emissions associated with all processes up to the point of bottling as they occur in the year in which the product's carbon footprint reporting occurs. For example, if a 10 year-old Scotch whisky is bottled in 2008, emissions relating to growing of cereals during 2008 and emissions relating to distilling in 2008 would be used in addition to those from bottling and distribution. This approach affords several benefits:

- Primary data collected from company assets and value chain partners during a given year is used to calculate the product carbon footprint;
- Beverage companies can make decisions in their upstream value chain that will have an immediate impact, rather than waiting years for these improvements to be reflected in a product footprint; and
- The approach supports the spirit of GHG reporting, which is to promote transparency and drive improvements in environmental performance. In this way, the manufacturer becomes accountable for the environmental impacts of their product in the present day, rather than for those that occurred years before and over which they now have no control.

Another issue arising from the maturation process is that ethanol is lost to evaporation (commonly referred to as the "angels' share"). The final volume of product is often much less than the volume at the beginning of the maturation period. In lieu of primary data for loss percentages, apply an average annual loss to evaporation for the product and apply this loss factor to the total GHG emissions of the product up to and including distillation.

Beverage alcohol products may be blends from multiple producers (e.g., blended Scotch whisky), multiple product types (e.g., a liquor that uses both a grain neutral spirit and a wine), or products that have matured for different periods of time (e.g., Kentucky bourbon). For further detail on each of these practices, please see *Section 5.4: Spirit Alignment*.

Reporting the Product Carbon Footprint

As stated previously, companies reporting product carbon footprints must be transparent in disclosing any exclusions from the organizational boundary used in calculating the footprint, as well as any emissions sources determined to be *de minimus*. Full reporting requirements are presented in *Section 4, Data Reporting*. Future versions of this guidance may contain additional standardized reporting requirements for beverage industry product carbon footprint emissions reporting.

Data Reporting & Verification

This section outlines the data reporting requirements applicable to any company seeking to publicly claim compliance with this Sector Guidance.

Data Transparency

As the intention of this Sector Guidance is to achieve a common methodology for the beverage industry to account for and report GHG emissions, it is critical that companies are transparent in their reporting. Transparency includes describing any exceptions to this guidance, as well as how the reporting company's organizational structure impacts its ability to collect emissions data.

Alignment with Sector Guidance

Any company electing to publicly report GHG emissions in accordance with this Sector Guidance document must clearly state this in its report. Clearly document and explain each deviation from this guidance.

Boundaries

Clearly state organizational and operational boundaries. Present any changes in organizational boundaries or operational boundaries (due to acquisitions/divestitures, for example) to aid in a clear understanding of year-to-year performance changes.

Data Source Limitations

Data sources and any data limitations should be clearly listed. If data is excluded, then state the reasons for excluding. The sources of data should also be clearly defined to indicate ***primary*** (data specific to the enterprise or from specific suppliers) versus ***secondary*** (data obtained from a third-party source based upon proxy values, such as intensity factors from life cycle assessment databases). Where feasible, primary data should be utilized in all GHG calculations as it provides a more accurate portrayal of the organizations actual emissions, which can better distinguish performance achievements and provide insight on company-specific GHG reduction opportunities. Primary data is especially important where output values will be externally published and/or used for product declarations. Secondary sources are most commonly used where primary data is not readily available or feasible to collect (e.g., effort to collect does not sufficiently increase the accuracy of emission calculations) and/or for emission calculations and inventories that do not require precision (e.g., internal company use). When considering the use of primary versus secondary data, beverage companies should consider the intended use of the GHG inventory (e.g., internal vs external use, estimates vs declarations, regulatory vs voluntary reporting, etc.).

Purchase/Sale of Carbon Offsets

The GHG Protocol Scope 2 Guidance should be referenced with regards to incorporating the purchase or sale of carbon offsets/renewable energy certificates (REC) within a company's GHG inventory. Companies can choose which method total - market-based, location-based or both - to use for performance tracking and must disclose this in their inventory.

Data Verification

This Sector Guidance recommends several methods of data verification be completed to ensure that reported GHG emissions values are representative of actual conditions. Although not required, recommended verification steps are described below.

Recordkeeping Requirements

Maintain records of emissions calculations and data sources used in a manner that facilitates review by a third party. Document both primary and secondary data sources.

Internal Verification

Prior to going to a third party for verification, conduct internal verification of the GHG emissions estimation process. Internal verification will not necessarily increase credibility of reported data, but is a useful tool to raise awareness of GHG emissions within an organization and identify shortcomings in data collection activities prior to engaging a third-party verifier.

Third-Party Verification

Companies reporting emissions are encouraged, but not required, to conduct an objective third-party verification audit of reported GHG emissions. Verification by a third party increases the credibility of publicly reported emissions estimates as well as supports the establishment and acceptance of this document as the industry standard. Certain agencies and initiatives, including The Climate Registry, World Economic Forum Global GHG Registry, and the European Union Emissions Trading Scheme already require a form of emissions verification.

Material Discrepancies

Any verification activity, whether internal or external, should seek to identify material discrepancy, such as oversight, omission, or miscalculation, which leads to error in the formulation of an emissions footprint. A threshold of ±5% should be used to determine whether a discrepancy be considered "material" (as per The Climate Registry). Material discrepancies can take the form of a miscalculation, inability of management or sites to obtain GHG data, or unreliability of data collection sources (e.g., outdated meters). Any material discrepancies that cannot be resolved prior to publishing an emissions report must be clearly stated in the report. Material discrepancies do not include the margin of error associated with secondary data sources.

Reporting Requirements

We recognize that reporting formats may vary based on the program for which data are reported. State any deviations from the *Beverage Industry Sector Guidance for Greenhouse Gas Emissions Reporting* when referencing it in reports. Also, clearly state all internal and external verification efforts along with the statement and signature of the person(s) responsible for the verification process.

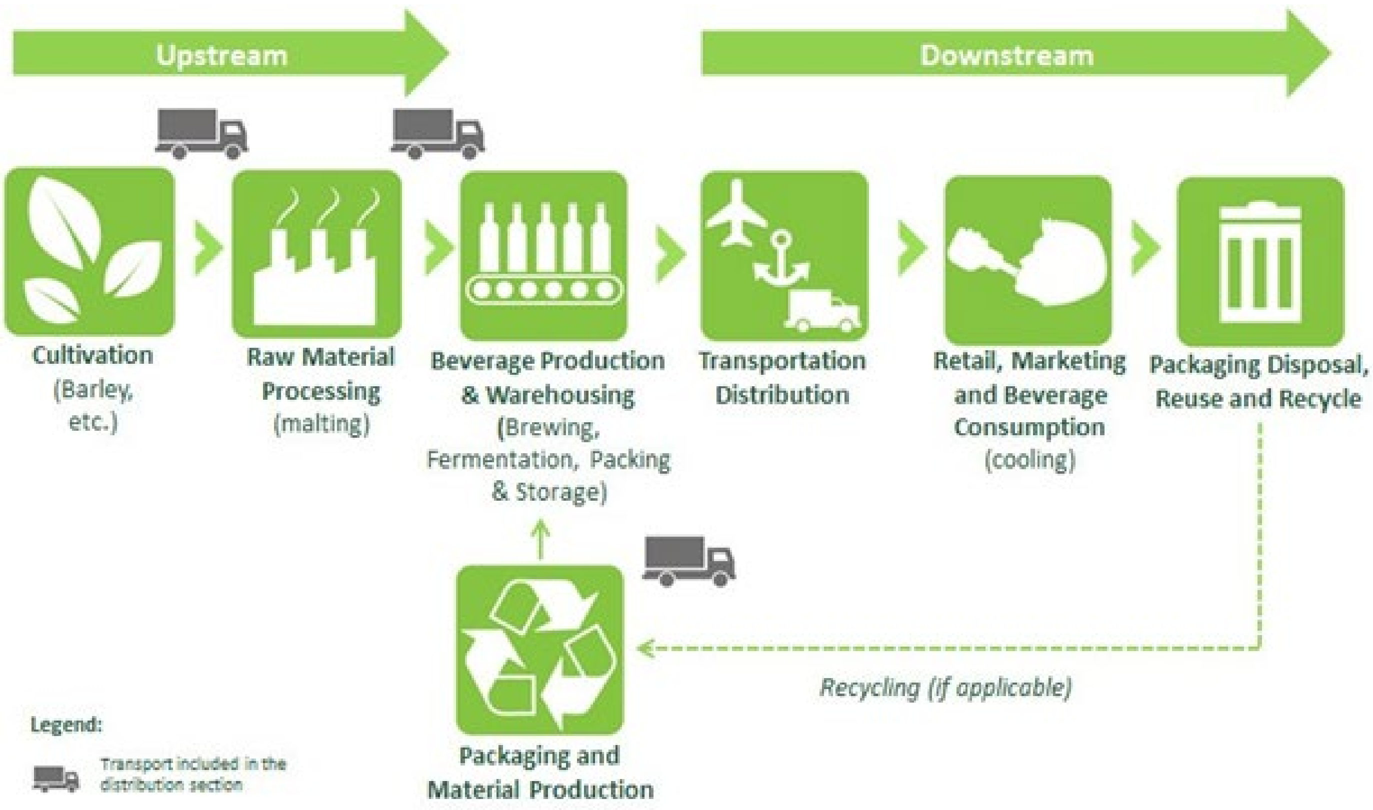
Beverage Category Alignment: Beer

In the following chapters the individual alignment per beverage category is presented in concise process maps and data requirement sets.

Beer Alignment

The overall *Beer Value Chain* is presented in figure 5. This value chain serves as the basis for more detailed description of the different value chain elements further on in this chapter.

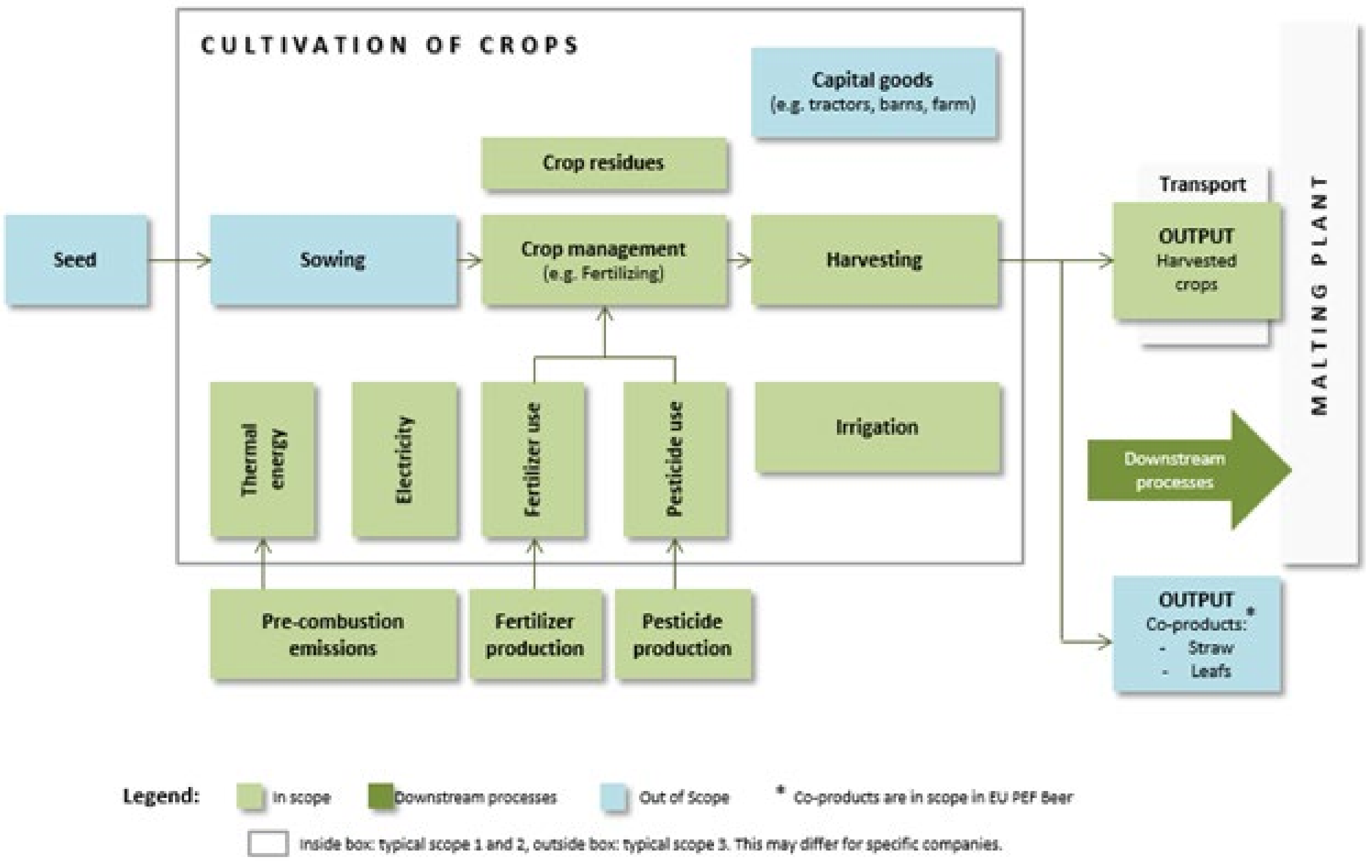
Beer Value Chain - Fig. 5



Cultivation

Figure 6 shows the cultivation process map for beer production. The agricultural process starts with seeds and ends with harvested product. The emissions related to transportation of the crops are included in the distribution GHG emissions.

Cultivation Process Map - Fig. 6



The cultivation of barley, hops, maize, wheat, sugars, sorghum, rice, etc. are taken into account. For these crops the GHG emissions from fertilizer and pesticide production and application, energy use (e.g. sowing, harvesting, and irrigation) and land use/land use change are taken into account. Upstream emissions of fuels and electricity shall be taken into account as well.

Processes Included

This scope is applicable to all significant ingredients (significant is > 99% based on mass of the overall emissions of all ingredients in the recipe), like barley, hops, maize, sugar, rice, wheat, etc.

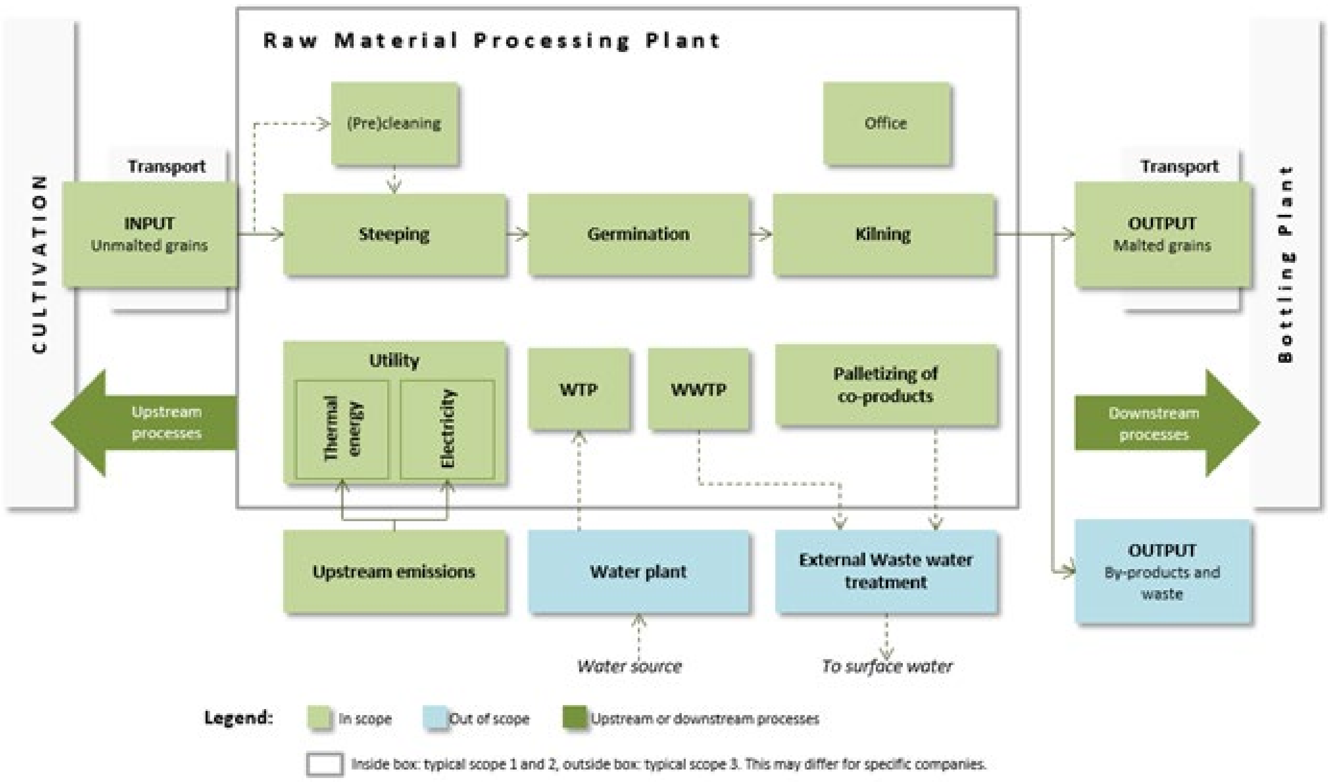
For all ingredients the contribution to the overall beer GHG emissions is calculated and those ingredients with the highest contribution to the overall CO_2 emissions (= 99% of all ingredients covered) are taken into account. The same approach is followed for the other cultivation elements, like irrigation, pesticide use and fertilizer use.

More information and an example on the calculation of emissions from cultivation can be found in *Appendix F*.

Raw Materials Processing

In figure 7 the processes and inputs of a malting site are summarized. The malting process starts with unmalted grains and ends with malted grains. The transportation processes of (un-)malted grains are included in the total GHG emissions and the calculation methodology is explained in the distribution reporting section.

Raw Material Processing Map - Fig. 7



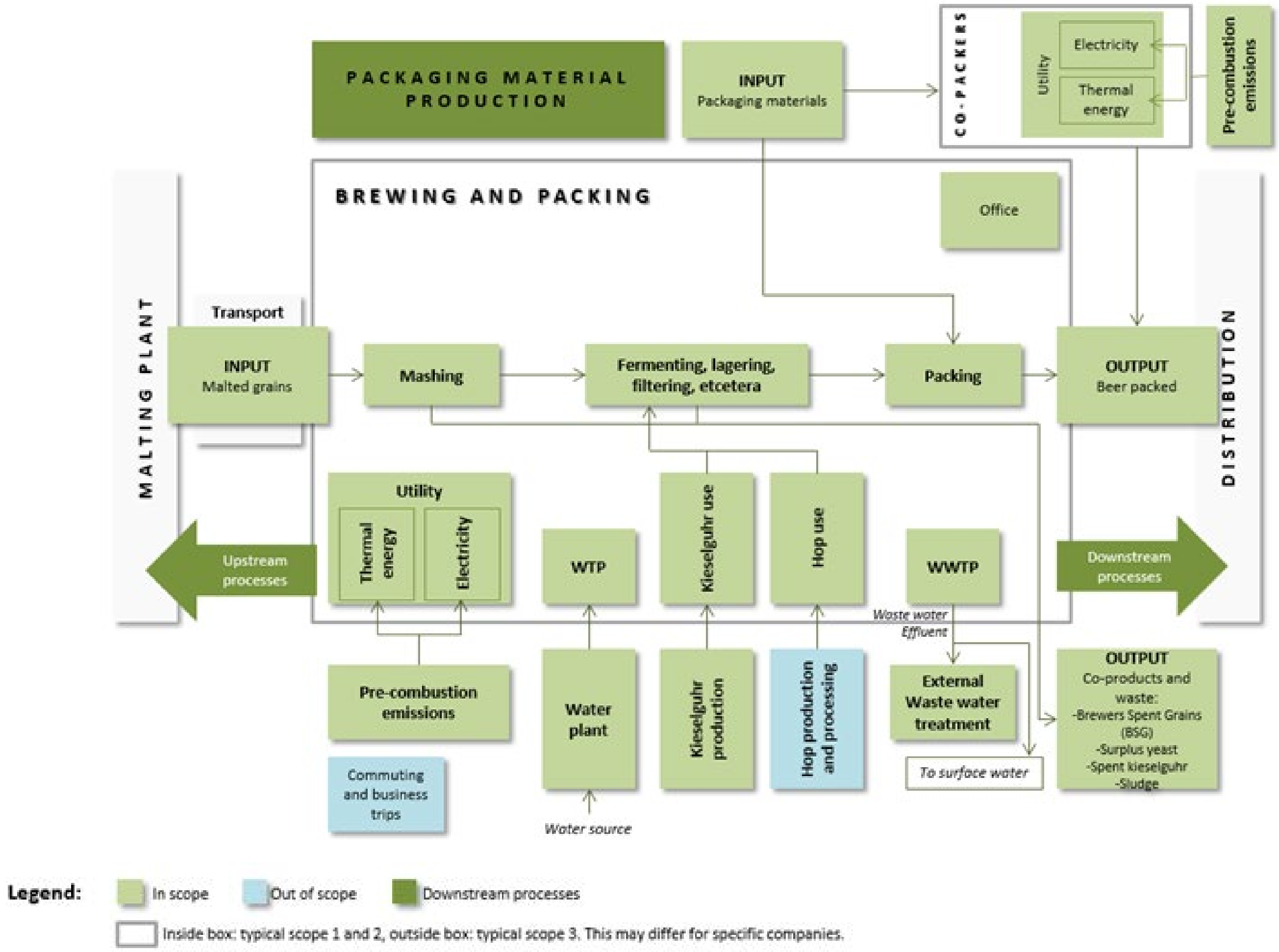
Processes Included

This scope is applicable to all ancillary GHG emissions from cleaning, office or "hotel load", water pre-treatment plant (WTP) and the waste water treatment plant (WWTP) inclusive of such items as the malting plant or CO_2 production plant. Upstream emissions of fuels and electricity also have to be taken into account. Upstream emissions are indirect emissions of fuels and electricity and consist of emissions due to mining, transportation, losses and purification. GHG emissions from external water plants and water treatment plants are not in scope.

Beverage Production

In figure 8 the processes and inputs of brewing and packing are summarized.

Beverage Production Process Map - Fig. 8



The brewing and packing process starts with raw materials intake (e.g., malted grains, unmalted materials, sugars, hops, syrups). The inbound transportation processes of these materials are included in the total GHG emissions and are explained in the distribution section of this guideline. GHG emissions are in scope from all processes: mashing, wort boiling, fermentation, lagering, filtration and packing beer. The emissions associated with utility processes and offices on site are also included. Upstream emissions of fuels and electricity also have to be taken into account. Upstream emissions are indirect emissions of fuels and electricity and consist of emissions due to mining, transportation, losses and purification.

The GHG emissions from the packaging material production are included in the packaging material value chain element section of this guideline.

Processes Included

This section is applicable to all company owned production units, co-packers, co-brewers, franchises and leased units (as defined in GHG inventory scope).

All GHG emissions which occur in the main process *Brewing and Packing* are allocated to the beverage produced (beer, cider or soft drinks). When recycled, the co-products (e.g., brewers spent grains, surplus yeast) leave the brewery with zero GHG emissions. The “recycling bonus” is for the user (normally a farmer) that actually recycles the co-products. If these co-products are dumped to landfill, however, there are (estimated) GHG emissions and these are accounted for in the brewery emissions.

The reasons for this pragmatic approach are:

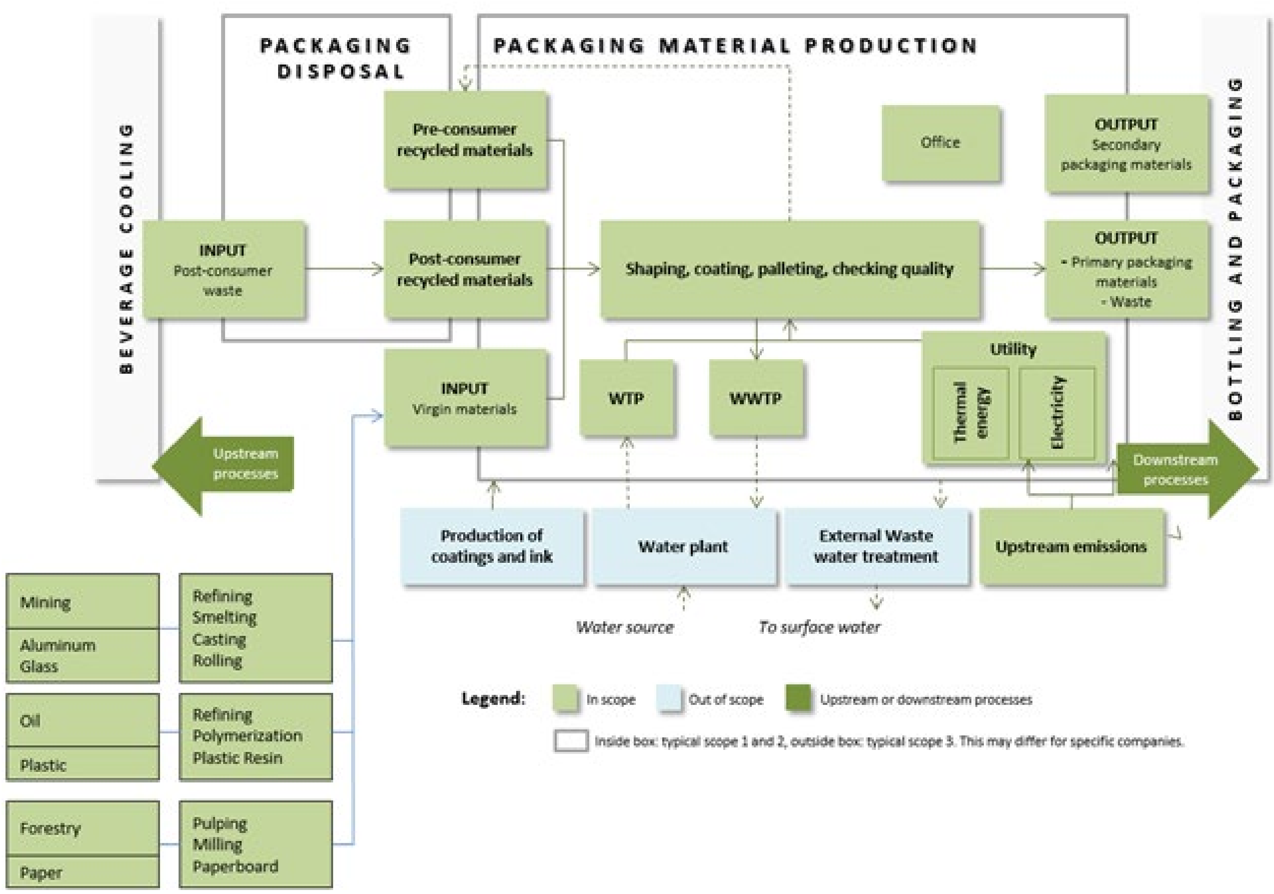
- The main product of a brewery is packed beer;
- The financial benefits of recycling spent grains and surplus yeast are insignificant when compared to financial value of the packed beer. So, economical allocation is not required; in addition it would not be very practical to use a “country specific economical allocation”; and
- The mass of the (wet) co-products is significant, up to 10-20% of the beer weight. Allocation of GHG emissions to co-products is not desirable since the environmental problems of our co-products are minor compared to the environmental impact of the main product. Taking landfill emissions on board quantifies the impact of these bad practices.

For the choice of the allocation of production materials, like filters cleaning and disinfectant materials, etc., the de-minimus rules apply.

Packaging Materials

Figure 9 below summarizes the inputs and outputs for the packaging disposal and packaging material production process.

Packaging Materials Process Map - Fig. 9



Process Included

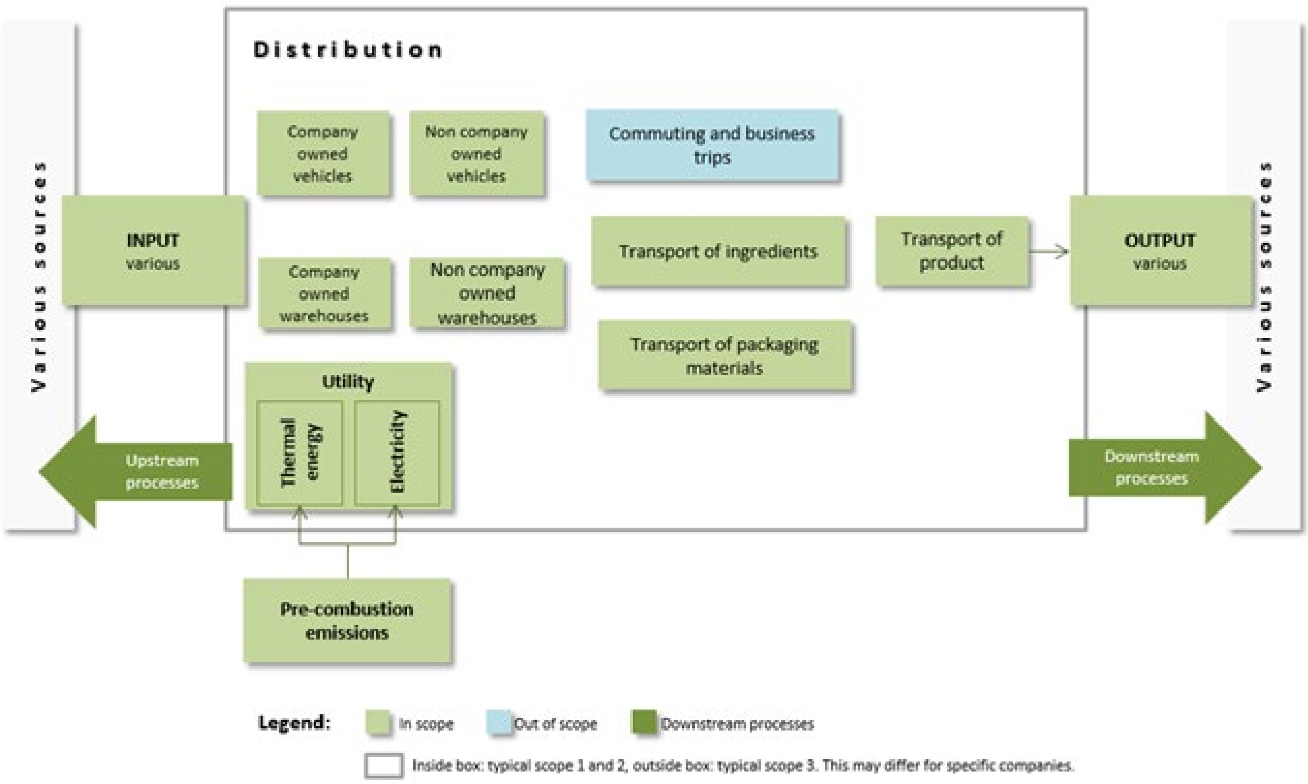
- All primary packaging materials: PET, aluminum, kegs, glass, can-ends, plastic/paper labels, crown caps, label glue.
- Secondary and tertiary packaging materials after the de minimus rule is applied (e.g. shrink foil, crates and pallet).

More information on how to calculate emissions from packaging materials (and the recycling allocation), including fictional calculation examples, can be found in *Appendix H*.

Distribution

Figure 10 below summarizes the key inputs and outputs for the transportation and distribution process.

Distribution Process Map - Fig. 10



Processes Included

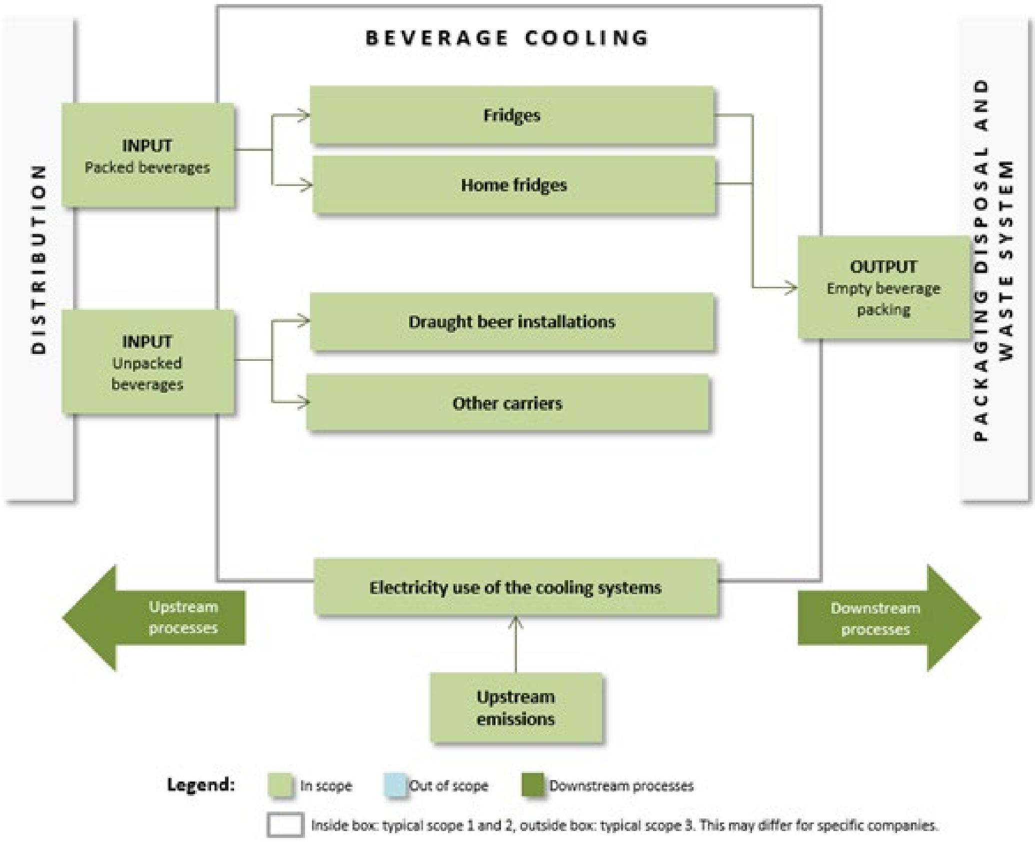
This element concludes all transport of product, ingredients and packaging materials within the complete value chain, indicated in the overall value chain process map with a **T**. Capital goods (trucks, barges, etc.) are excluded as well as transport from retailer store to final consumer.

More information on how to calculate emissions from transportation logistics and distribution, including a fictional calculation example, can be found in *Appendix I*.

Beverage Consumption

Figure 11 presents the key inputs and outputs for the beverage consumption process.

Beverage Consumption Process Map - Fig. 11



Processes Included

This scope and description is applicable to the cooling of the produced beer at retailers, restaurants, bars and home us-ers. In this scope the hotel load of the retail stores should also be included. It is the responsibility of the enterprise to determine if these sources are material and should be included within the boundary of their inventory.

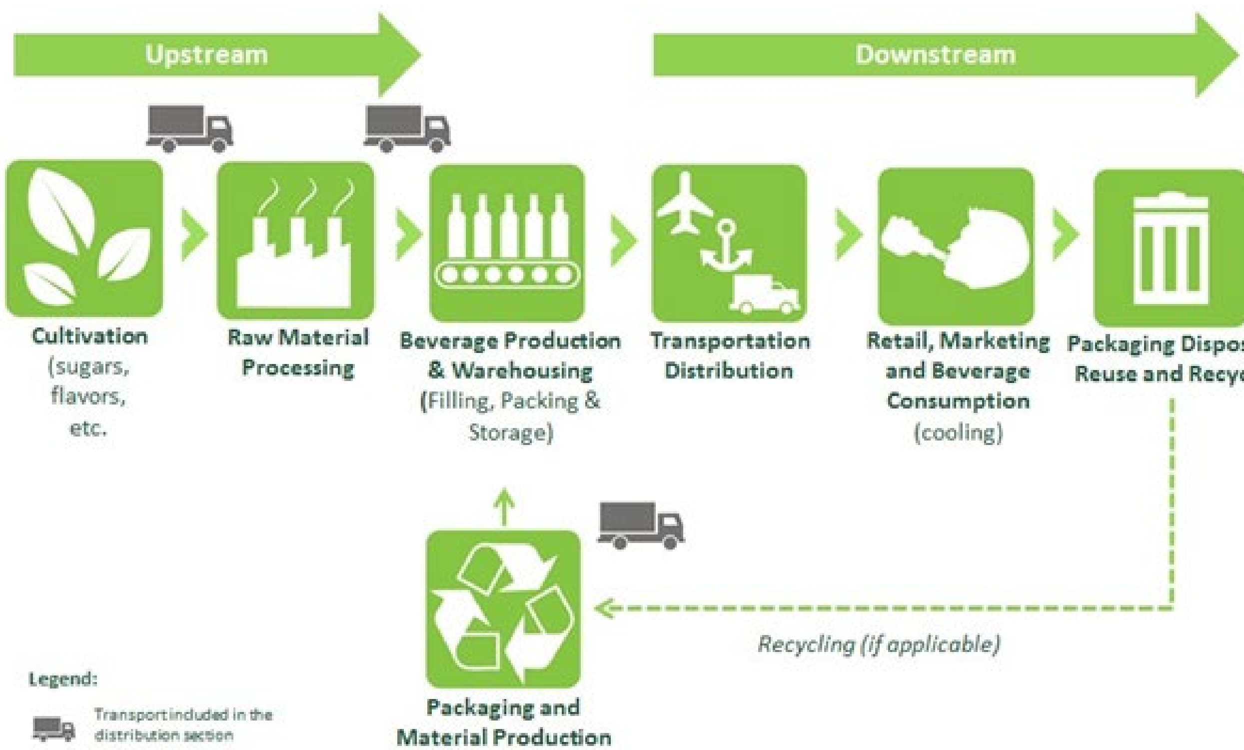
More information on how to calculate cooling emissions in the use phase (beverage consumption), including a fictional calculation, can be found in *Appendix J.*

Beverage Category Alignment: Carbonated Soft Drinks

CSD Alignment

The overall *CSD (Carbonated Soft Drinks) Value Chain* is presented in the figure below. This value chain serves as the basis for more detailed description of the different value chain elements further on in this chapter.

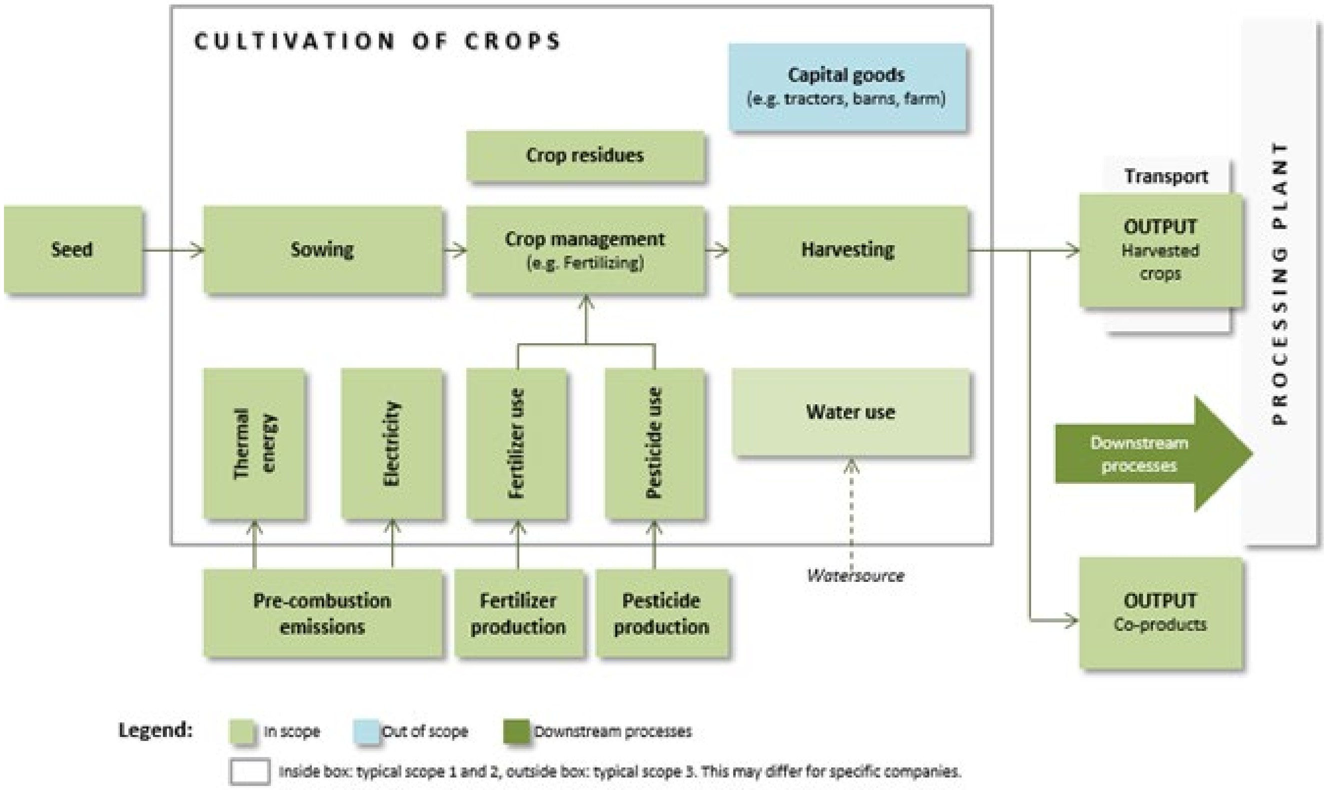
CSD Value Chain - Fig. 12



Cultivation

The figure on the following page shows the cultivation process map for soft drink ingredients. The agricultural process starts with seeds and ends with harvested product. The emissions related to transportation of the crops are included in the distribution GHG emissions. The calculation methodology for transportation is described in the distribution reporting guideline.

Cultivation Process Map - Fig. 13



The cultivation of fruits, flavors and sugar beet, etc. is taken into account. For these crops the GHG emissions from fertilizer and pesticide production and application, land use and change in land use, and the energy use (e.g., sowing and harvesting) are taken into account. Upstream emissions of fuels and electricity shall be taken into account as well. How to deal with CO_2 as ingredient is described in *Appendix E*.

Processes Included

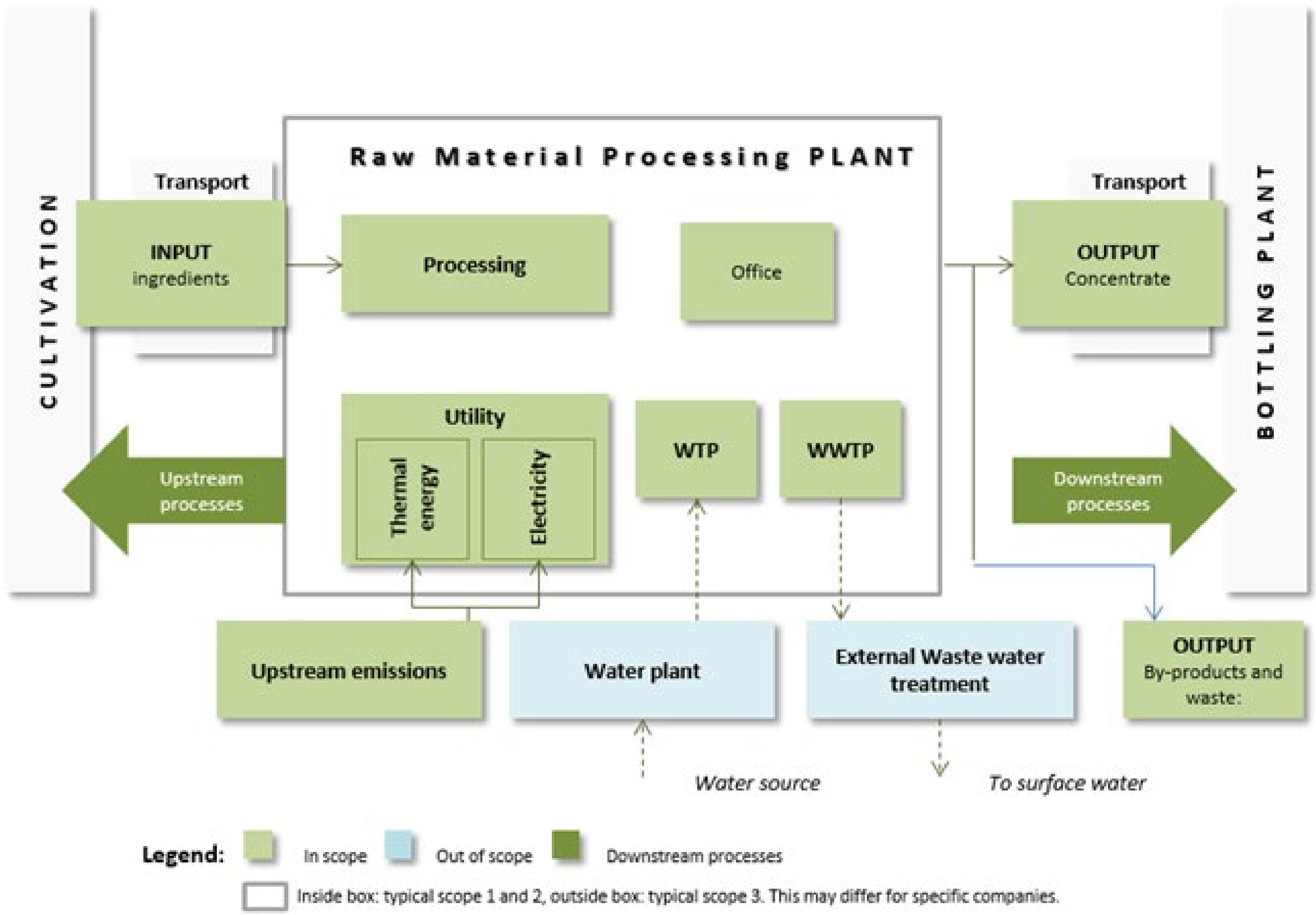
This scope is applicable to all significant ingredients (significant is > 99% of mass of the overall emissions of all ingredients), like sugar, fruits, etc. determined after de-minimus rule is applied.

More information and an example on the calculation of emissions from cultivation can be found in *Appendix F*.

Raw Materials Processing

The figure below shows the raw material inputs and outputs for soft drink ingredients.

Raw Material Processing Map - Fig. 14



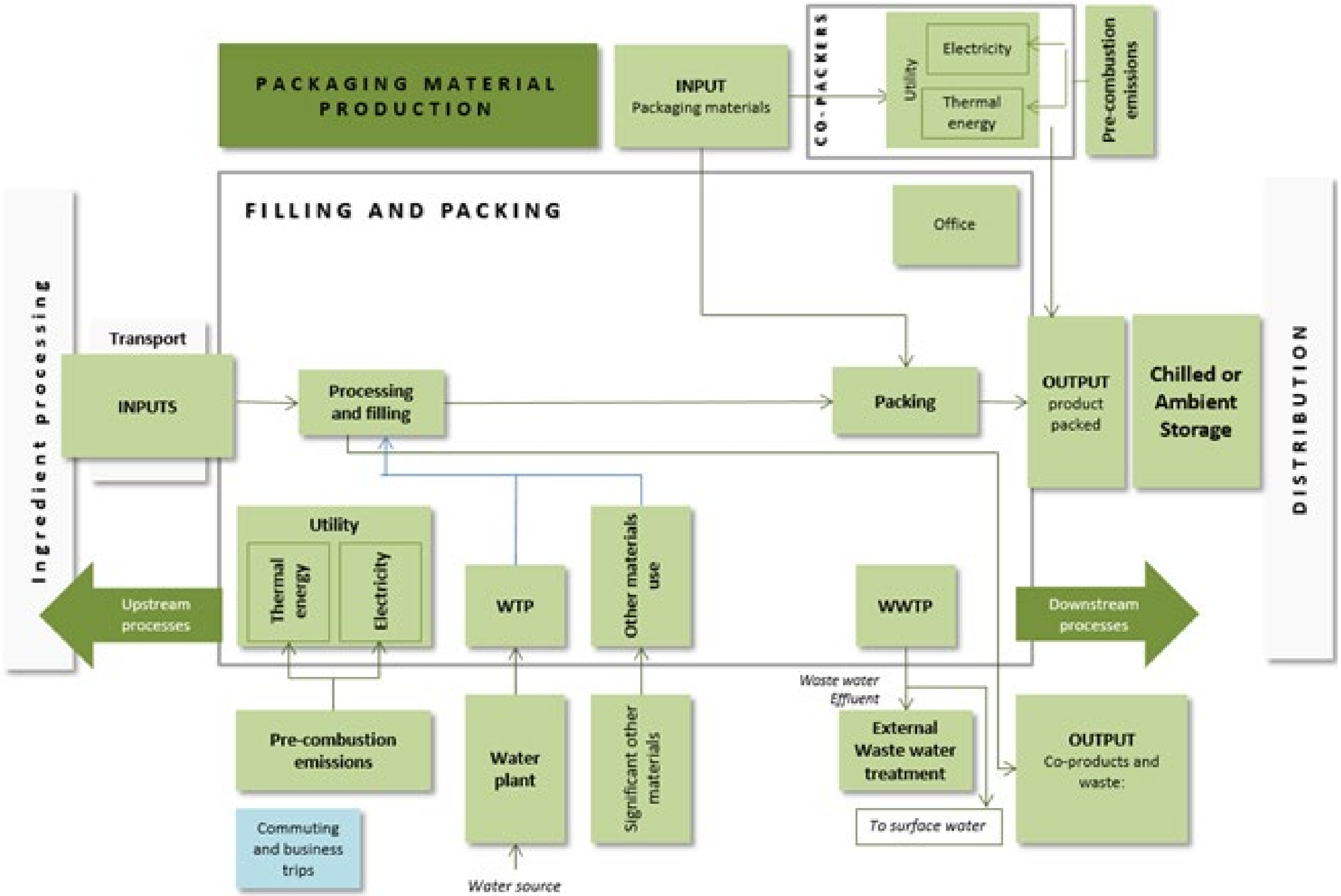
Processes Included

This scope is applicable to all significant raw materials like concentrates, (liquid) sugar, CO_2 and flavors.

Beverage Production

Figure 15 summarizes key inputs and outputs for the beverage production process of soft drinks.

Beverage Production Process Map - Fig. 15



Processes Included

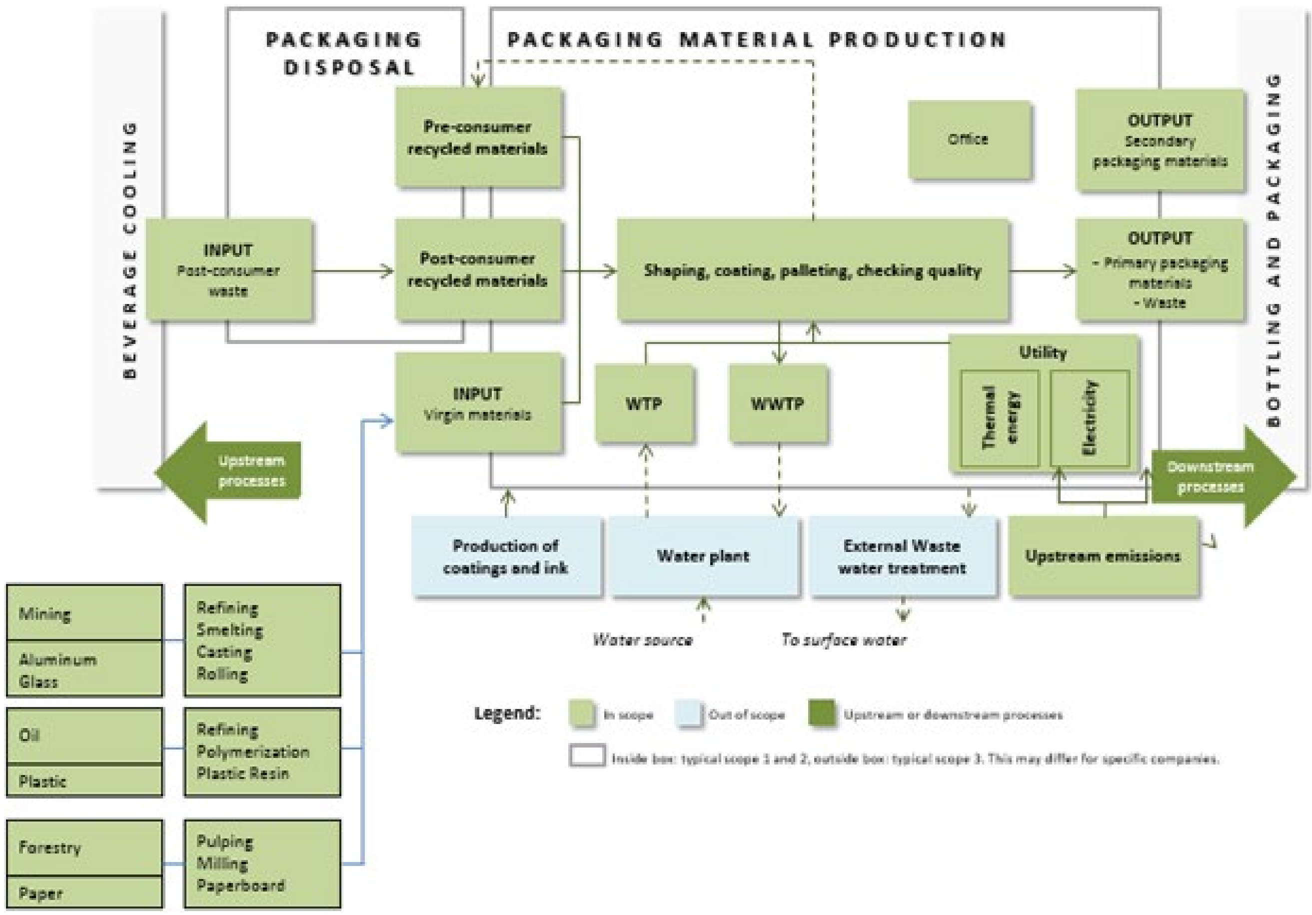
This scope is applicable to all company owned production units, co-packers, franchises and leased units (as defined in GHG inventory scope).

Additionally, processes related to warehousing and internal and external WWTP are included.

Packaging Materials

Figure 16 below summarizes the inputs and outputs for the packaging disposal and packaging material production process.

Packaging Materials Process Map - Fig. 16



Processes Included

This scope is applicable to:

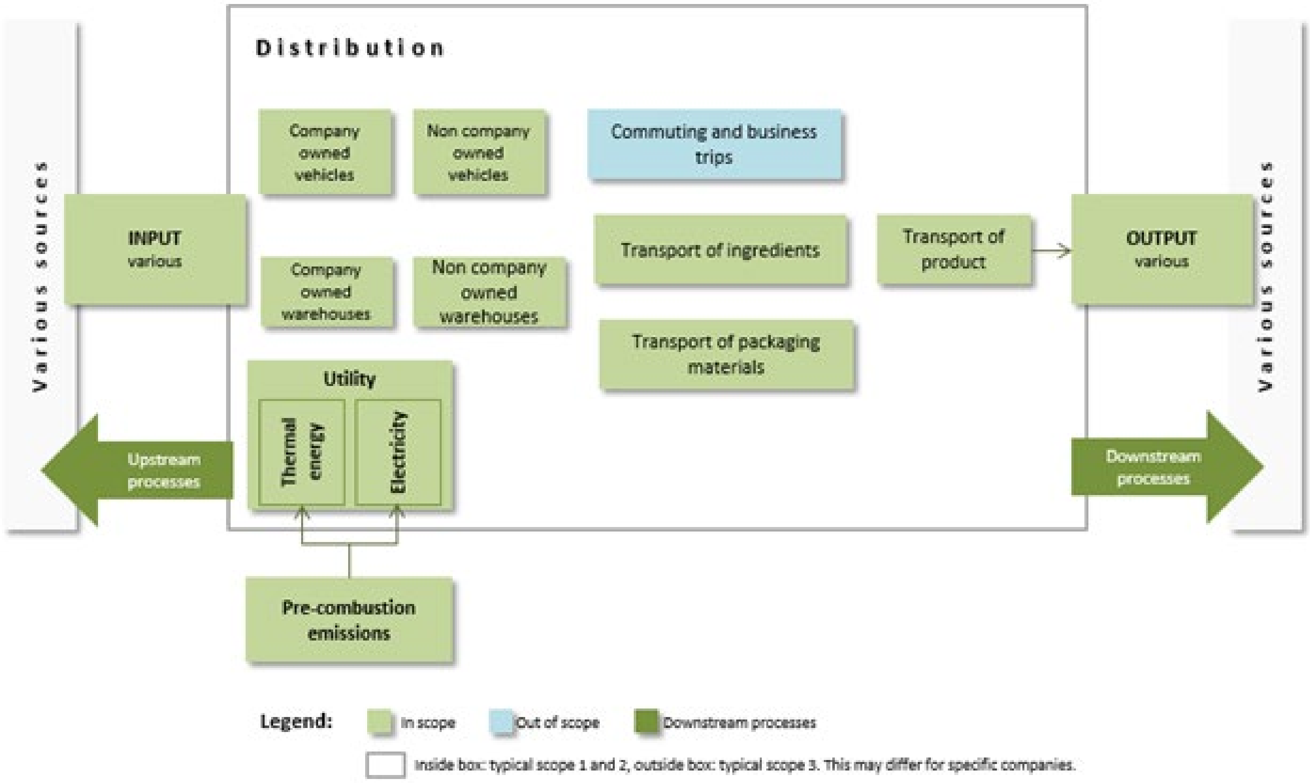
- All primary packaging materials: PET, aluminum, glass, LLPDPE, PE, PP, laminated film.
- All packaging types: bottle, Bag in Box, can, box, pad, can.
- Secondary and tertiary packaging materials, like crates and pallets after de-minimus rule is applied.

More information on how to calculate emissions from packaging materials (and the recycling allocation), including fictional calculation examples, can be found in *Appendix H*.

Distribution

Figure 17 below summarizes the key inputs and outputs for transportation and distribution of carbonated soft drinks.

Distribution Process Map - Fig. 17



Processes Included

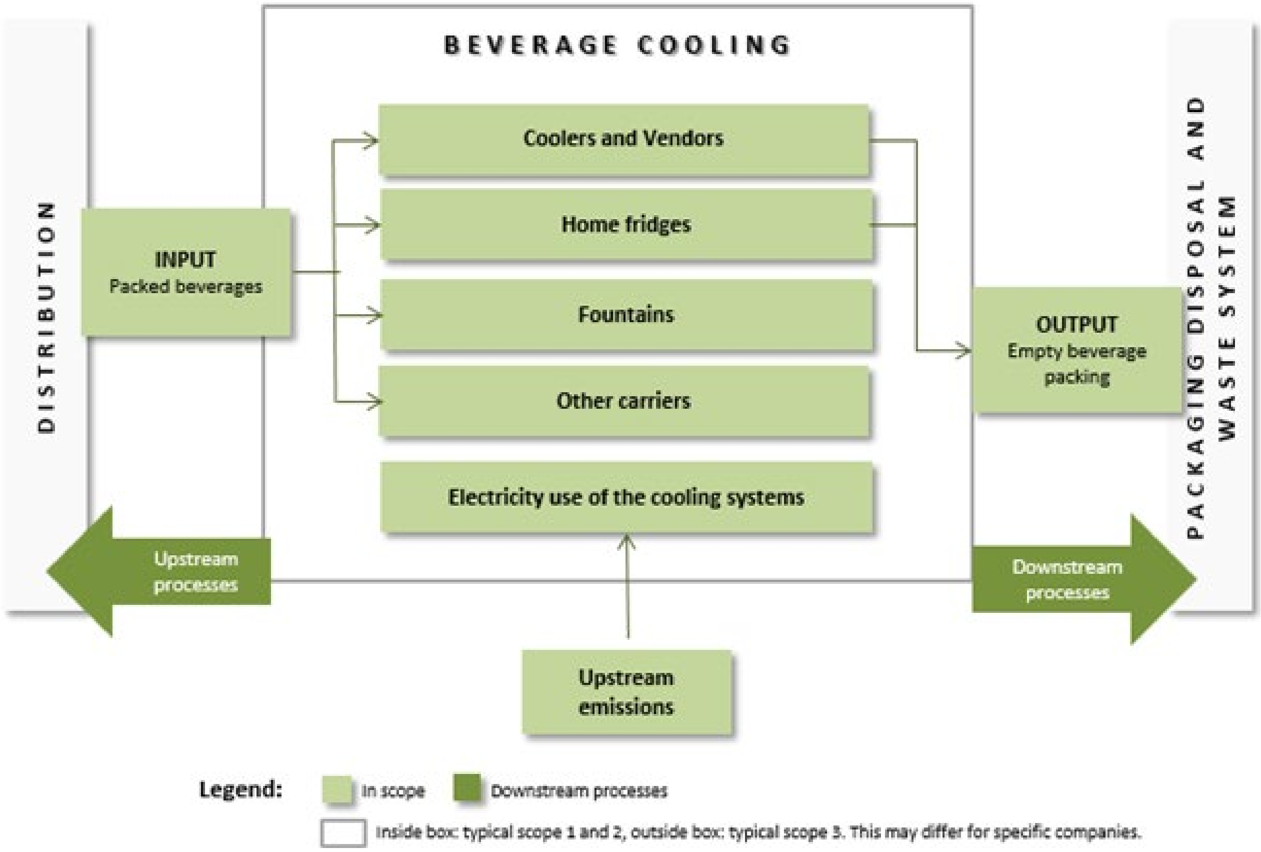
Applicable to all transport of product, ingredients and packaging materials within the value chain, indicated in the overall value chain process map with a **T** and after de-minimus rule is applied.

More information on how to calculate emissions from transportation logistics and distribution, including a fictional calculation example, can be found in *Appendix I*.

Beverage Consumption

Key inputs and outputs for the retail and beverage consumption process regarding carbon soft drinks are summarized as follows.

Beverage Consumption Process Map - Fig. 18



Processes Included

This scope and description is applicable to the cooling of the produced products at retailers, restaurants, bars and home users. In this scope the hotel load of the retail stores should also be included. It is the responsibility of the enterprise to determine if these sources are material and should be included within the boundary of their inventory. Please note that the functional unit will be as the sold consumer product (excl. ice cubes, including added water).

More information on how to calculate cooling emissions in the use phase (beverage consumption), including a fictional calculation example, can be found in *Appendix J*.

Beverage Category Alignment: Juice

Juice Alignment

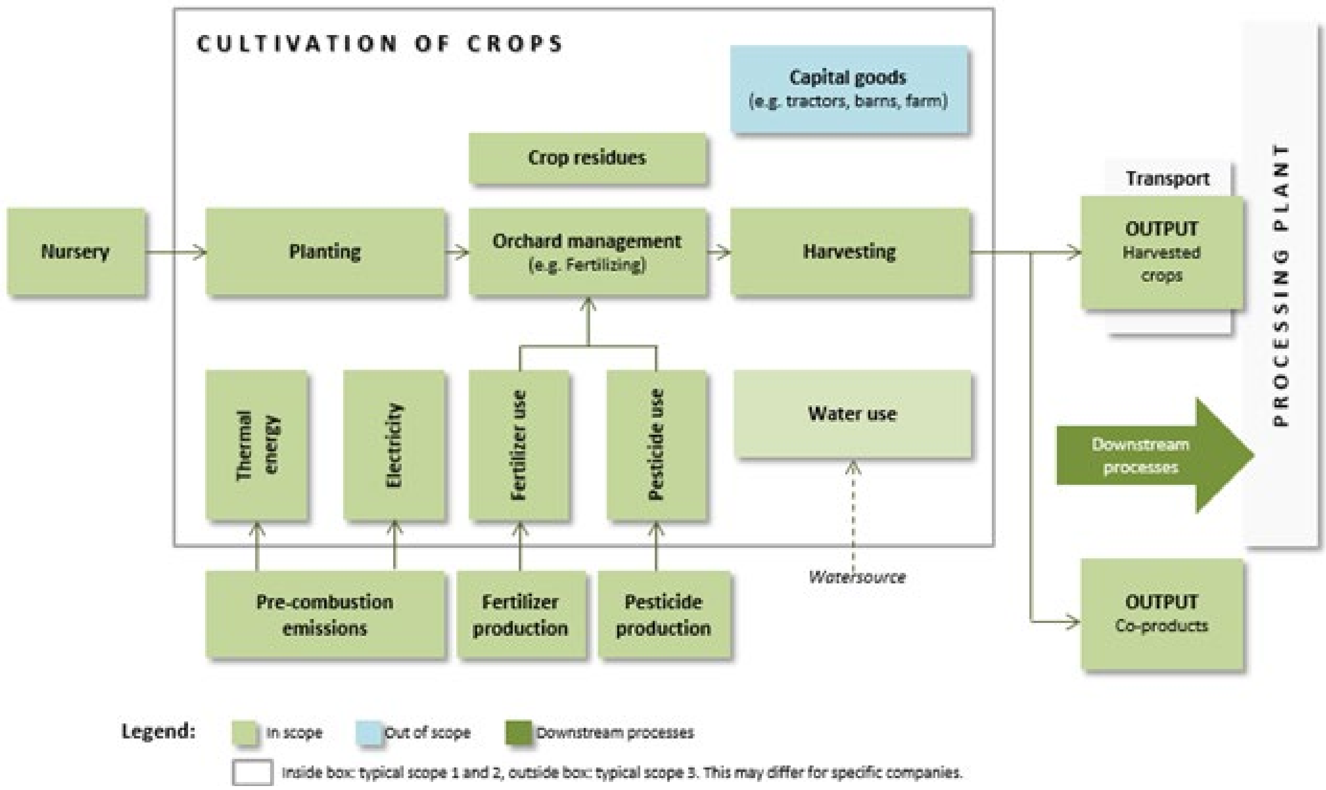
The overall *Juice Value Chain* is presented in the figure below. This value chain serves as the basis for more detailed description of the different value chain elements further on in this chapter.

Juice Value Chain - Fig. 19

Cultivation

The figure on the following page shows the cultivation process map for juice production. The agricultural process starts with seeds and ends with harvested product. The emissions related to transportation of the crops are included in the distribution GHG emissions. The calculation methodology for transportation is described in the distribution reporting guideline.

Cultivation Process Maps - Fig. 20



The cultivation of all fruits is taken into account. For these crops the GHG emissions from fertilizer and pesticide production and application, land use and change of land use and the energy use (e.g., harvesting) are taken into account. Upstream emissions of fuels and electricity shall be taken into account as well.

Processes Included

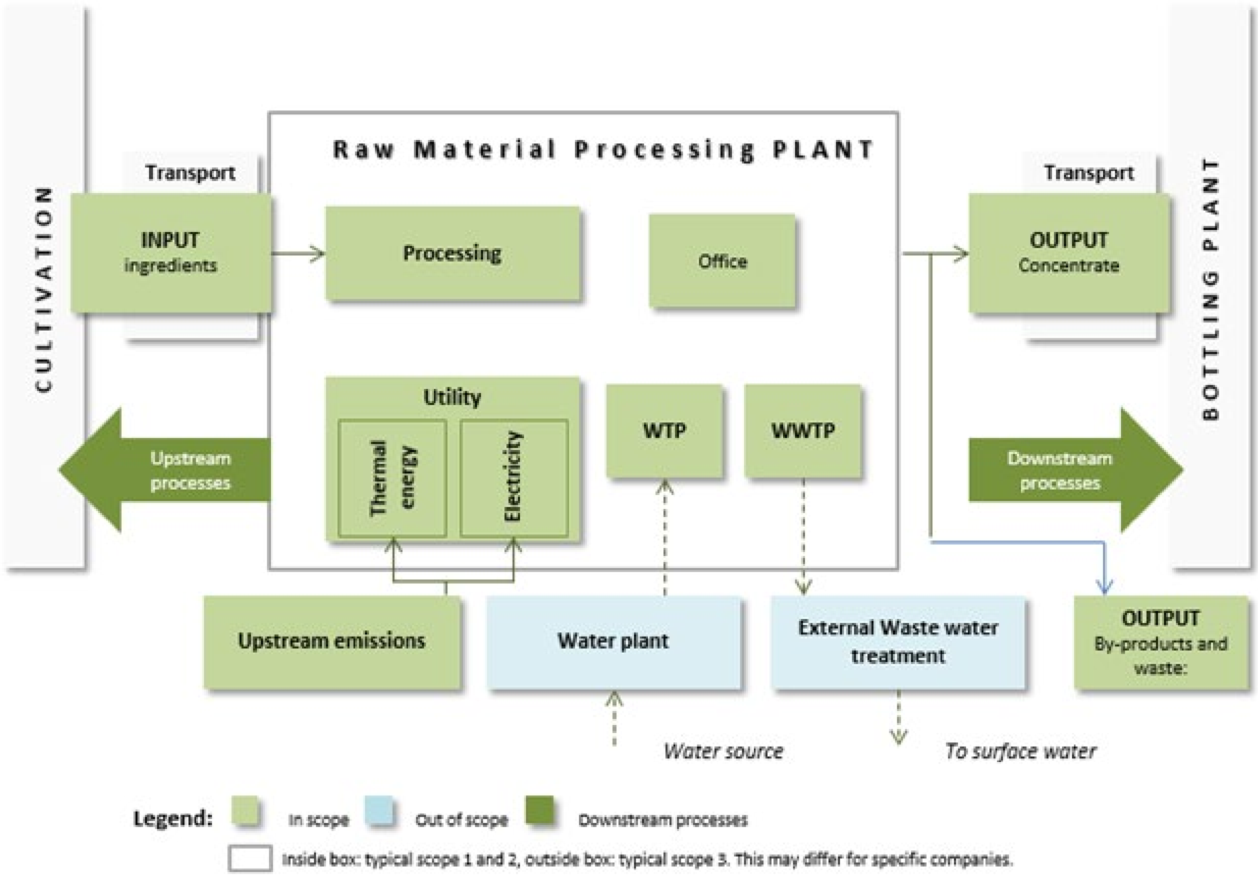
This scope is applicable to all significant ingredients (significant is > 99% of mass of the overall emissions of all ingredients), like sugar, fruits, etc. determined after de□minimus rule is applied.

More information and an example on the calculation of emissions from cultivation can be found in *Appendix F*.

Raw Material Processing

The figure below shows the raw material inputs and outputs for juice.

Raw Material Processing Map - Fig. 21



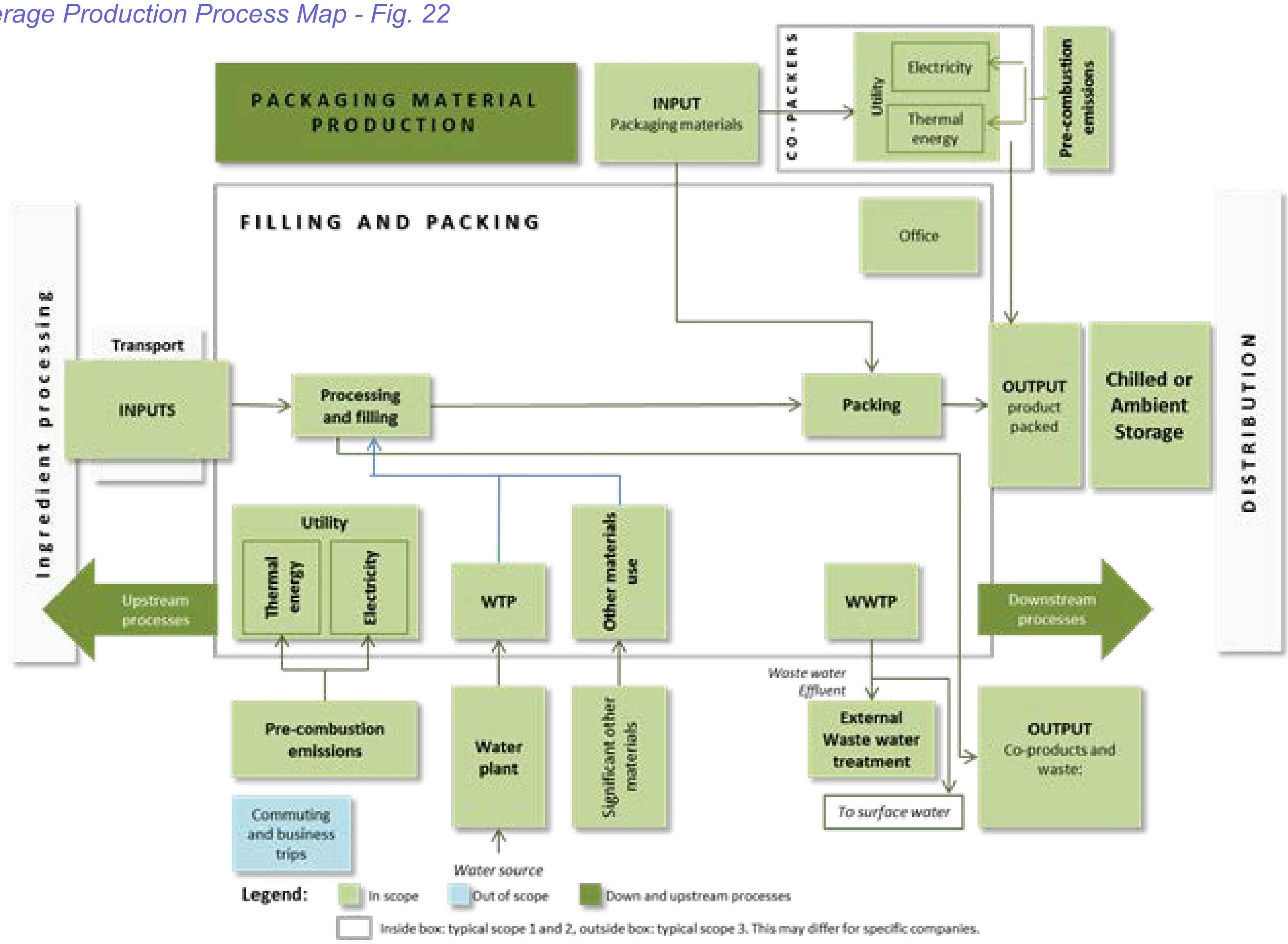
Processes Included

This scope is applicable to all significant fruits and other juice ingredients and the byproducts.

Beverage Production

The figure below includes primary outputs and inputs into the beverage production process for juice.

Beverage Production Process Map - Fig. 22



Processes Included

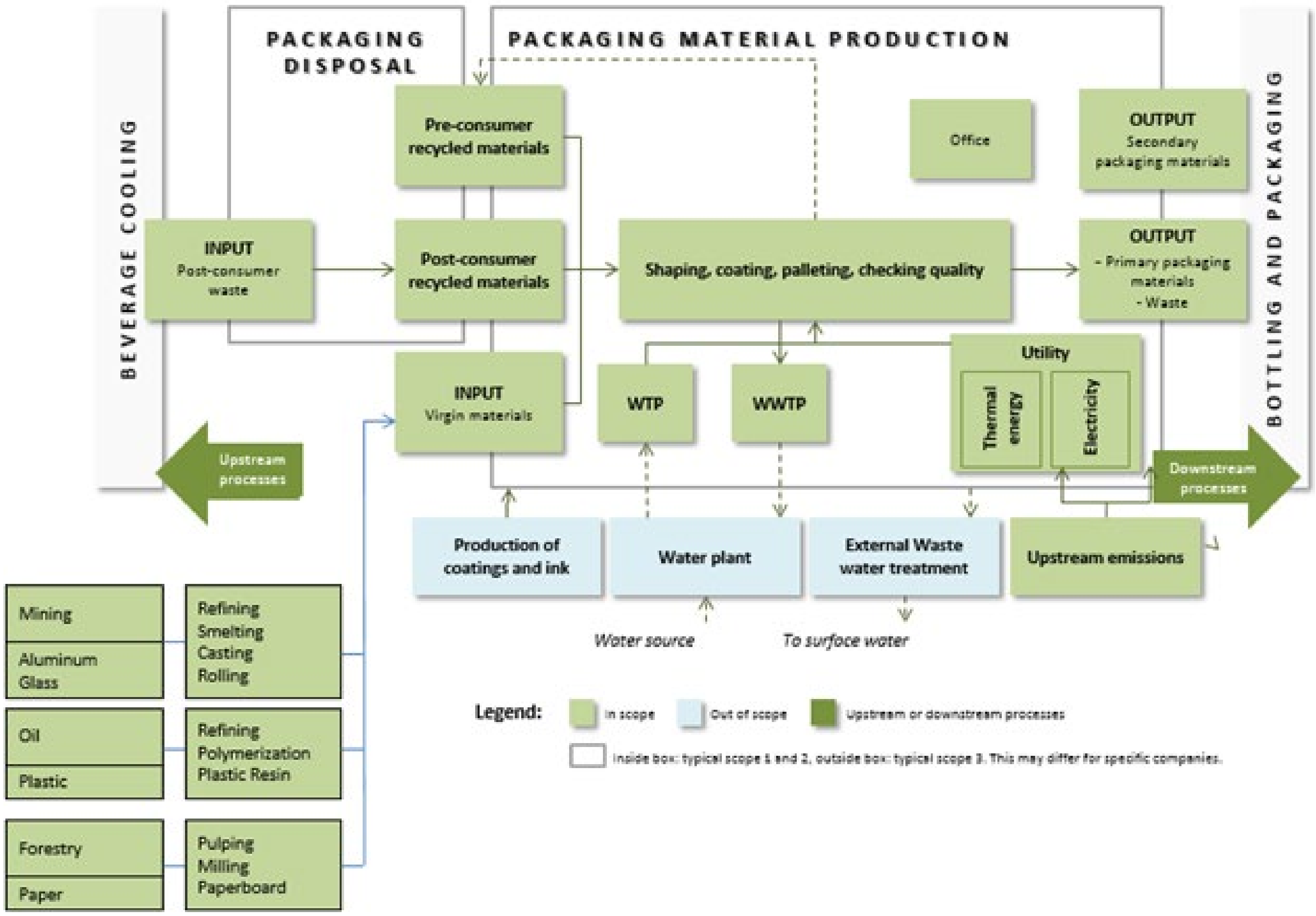
This scope is applicable to all company owned production units, co-packers, franchises and leased units (as defined in GHG inventory scope).

Additionally, processes related to warehousing and internal and external WWTP are included.

Packaging Materials

Figure 23 below summarizes the inputs and outputs for the packaging disposal and packaging material production process.

Packaging Materials Process Map - Fig. 23



Processes Included

This scope is applicable to:

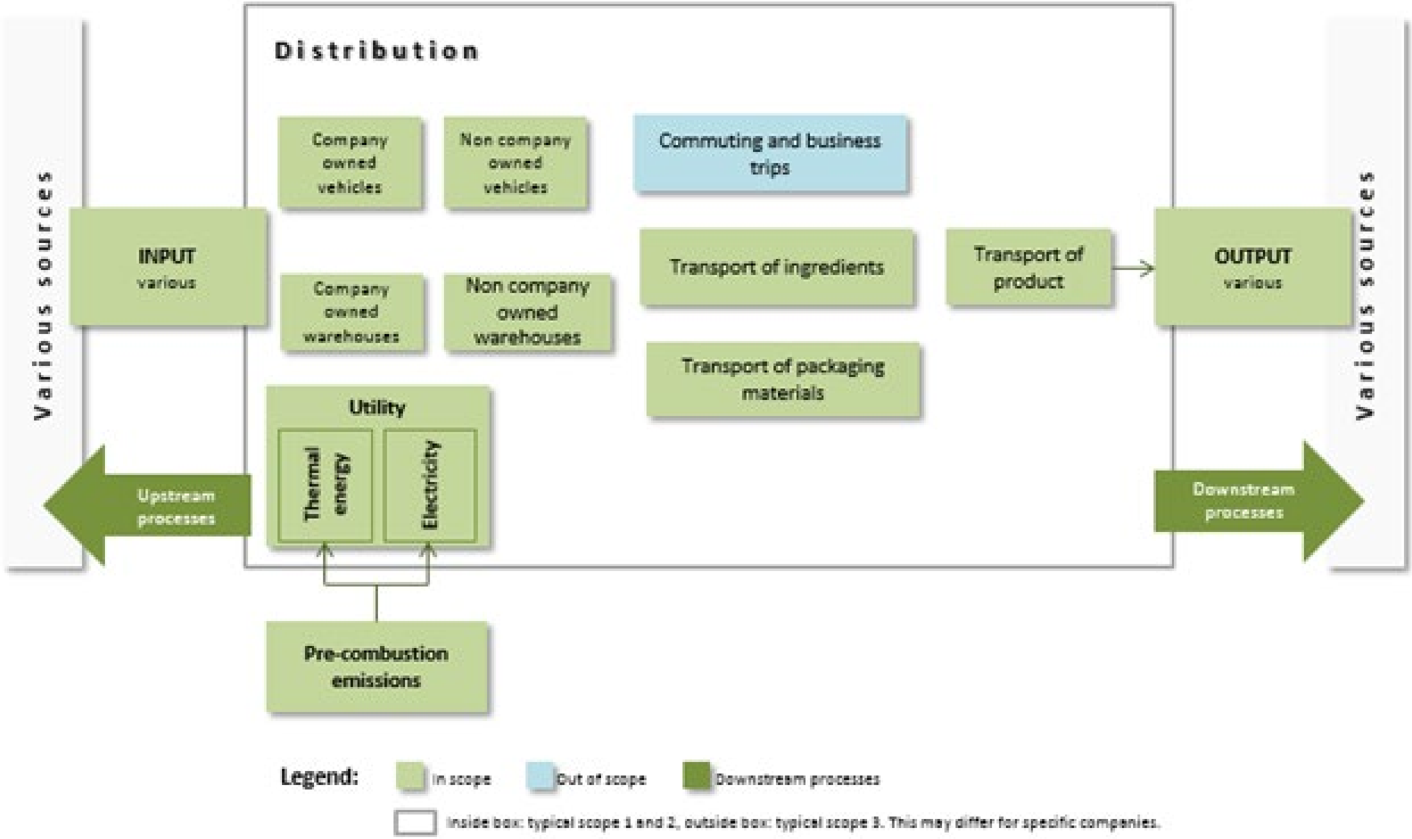
- All primary packaging materials: PET, aluminum, glass, LLPDPE, PE, PP, laminated film.
- All packaging types: bottle, Bag in Box, can, box, pad, can.
- Secondary and tertiary packaging materials, like crates and pallets, after de-minimus rule is applied.

More information on how to calculate emissions from packaging materials (and the recycling allocation), including fictional calculation examples, can be found in *Appendix H*.

Distribution

Figure 24 below summarizes the key inputs and outputs for transportation and distribution of juice.

Distribution Process Map - Fig. 24



Processes Included

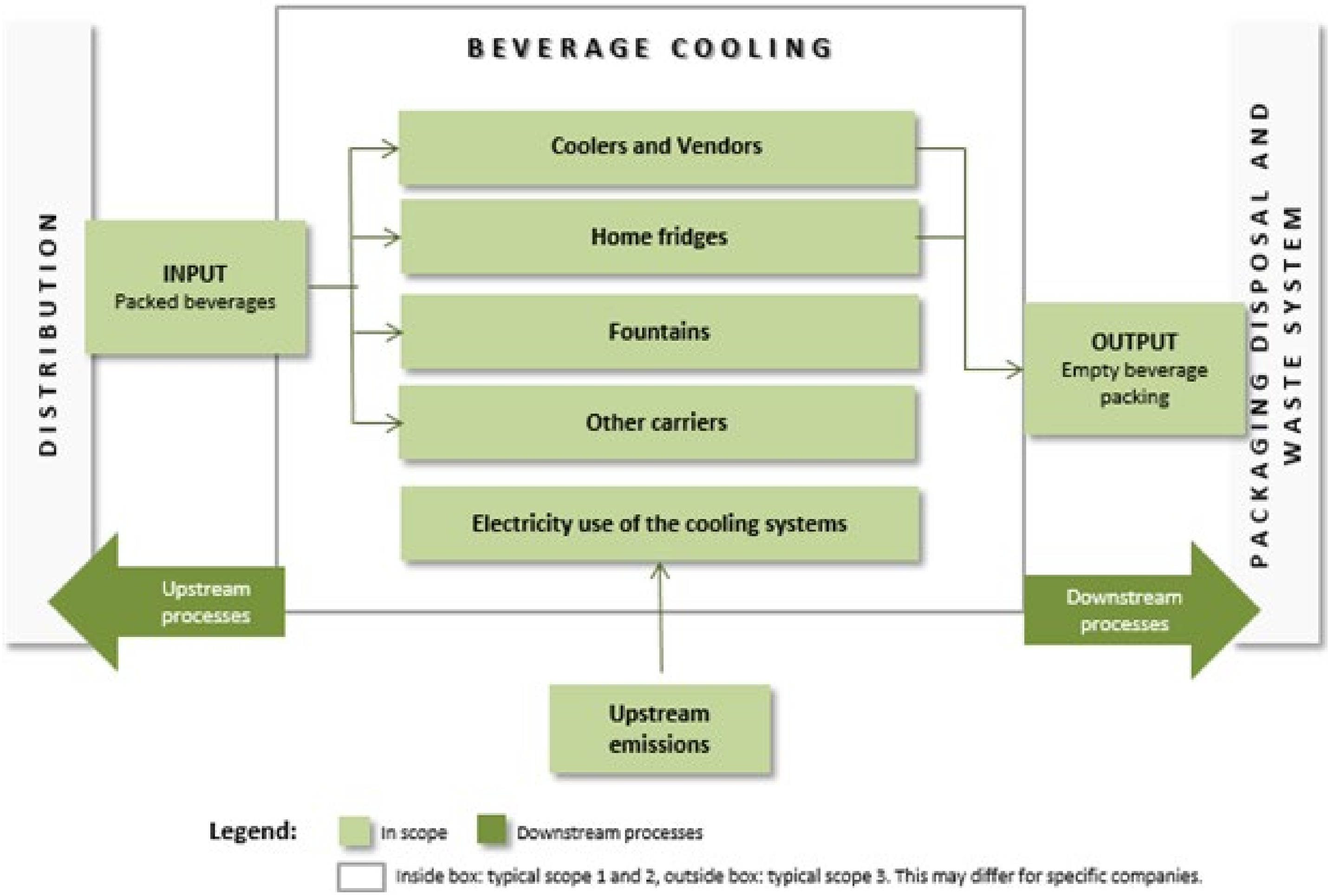
Applicable to all transport of product, ingredients and packaging materials within the value chain, indicated in the overall value chain process map with a **T** and after de-minimus rule is applied.

More information on how to calculate emissions from transportation logistics and distribution, including a fictional calculation example, can be found in *Appendix I*.

Beverage Consumption

Key inputs and outputs for the retail and beverage consumption process regarding juice are summarized as follows.

Beverage Consumption Process Map - Fig. 25



Processes Included

This scope and description is applicable to the cooling of the produced juice at retailers, restaurants, bars and home users. In this scope the hotel load of the retail stores should also be included. It is the responsibility of the enterprise to determine if these sources are material and should be included within the boundary of their inventory.

More information on how to calculate cooling emissions in the use phase (beverage consumption), including a fictional calculation example, can be found in *Appendix J*.

Beverage Category Alignment: Spirits

Spirit Alignment

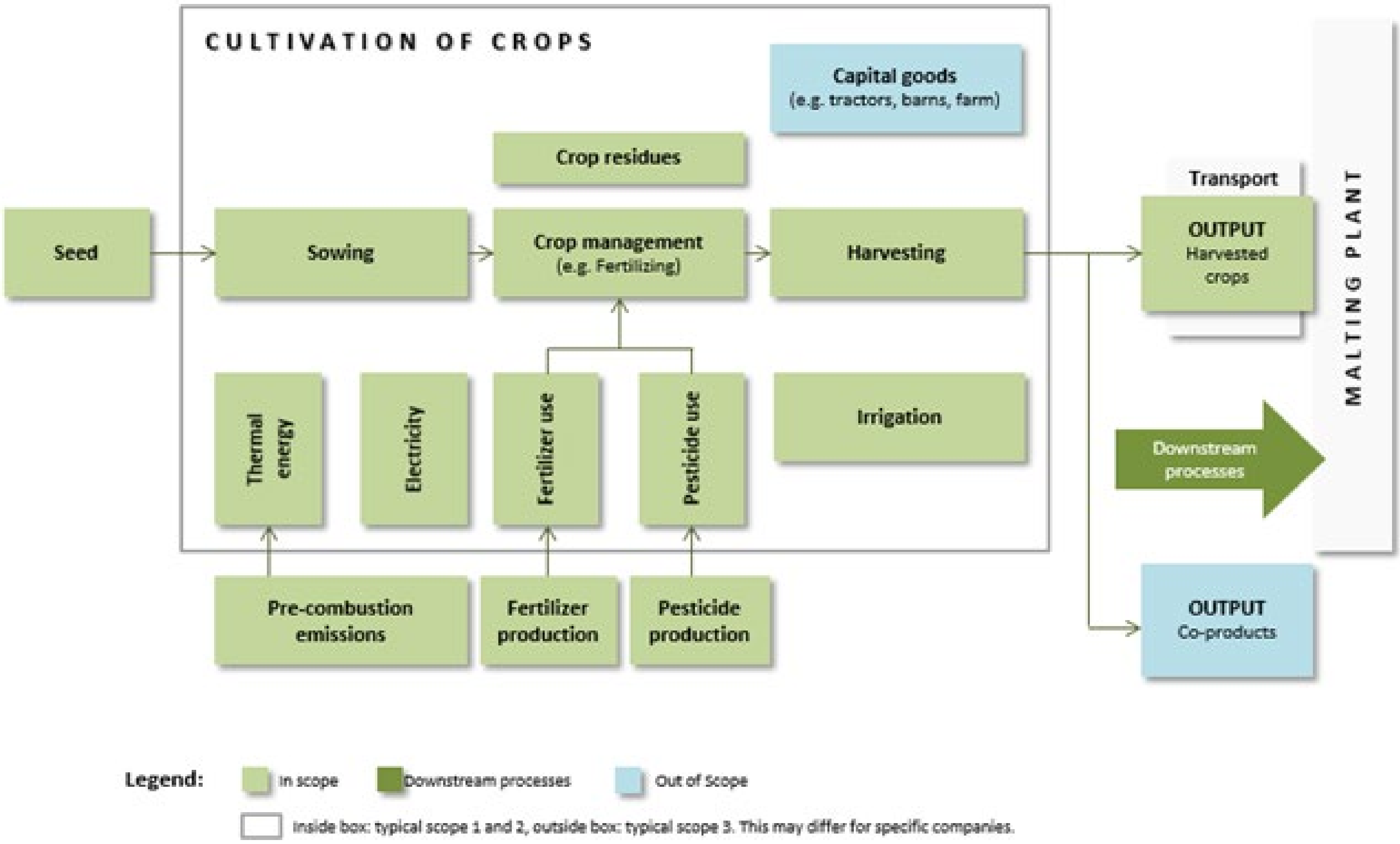
The overall *Spirit Value Chain* is presented in the figure below. This value chain serves as the basis for more detailed description of the different value chain elements further on in this chapter.

Spirits Value Chain - Fig. 26

Cultivation

Figure 27 on the following page shows the cultivation process map for spirits production.

Cultivation Process Map - Fig. 27



Processes Included

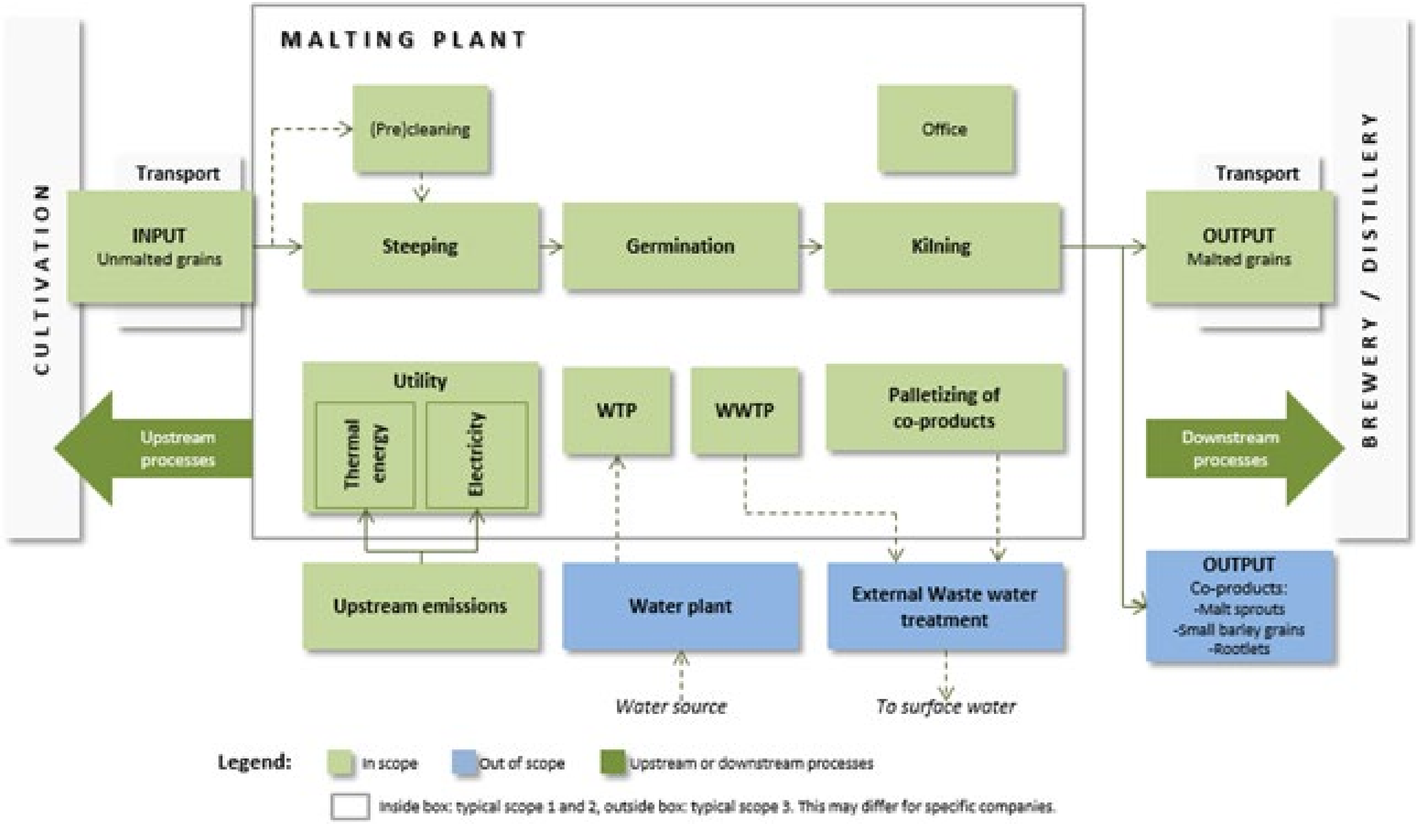
This scope is applicable to all significant ingredients (significant is > 99% of mass of the overall emissions of all ingredients), like barley, rye, corn, wheat, sugar, fruits, agave, etc. For these crops the GHG emissions from fertilizer and pesticide production and application, land use and change of land use, and the energy use (e.g., sowing and harvesting) are taken into account. Upstream emissions of fuels and electricity shall be taken into account as well.

More information and an example on the calculation of emissions from cultivation can be found in *Appendix F*.

Raw Material Processing

The figure below shows the raw material inputs and outputs for spirits like whiskey and vodka.

Raw Material Processing Map - Fig. 28



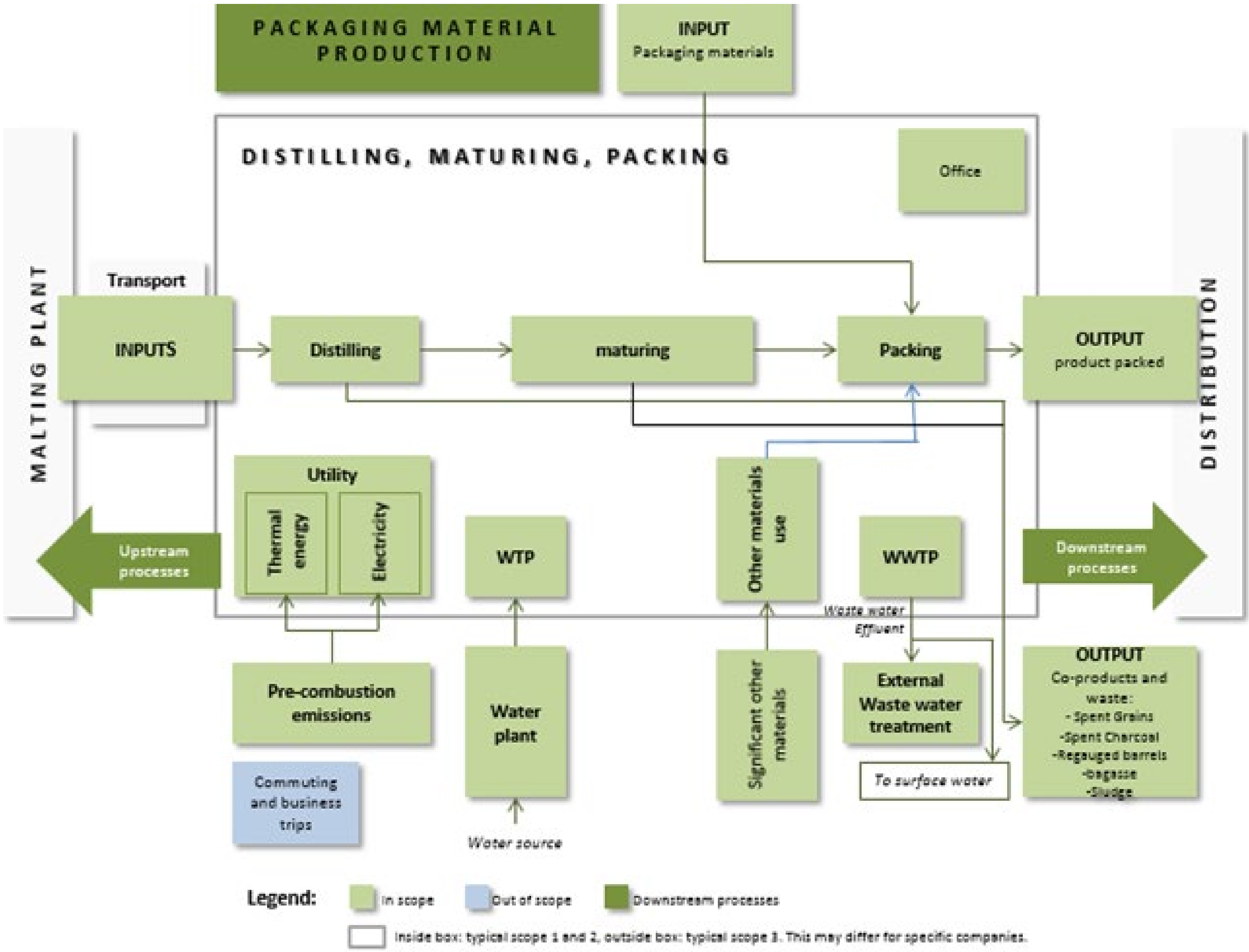
Processes Included

This scope is applicable to Malting or any other raw material processing.

Beverage Production

The figure below includes primary outputs and inputs into the beverage production process for spirits.

Beverage Production Process Map - Fig. 29



Processes Included

This scope is applicable to all company owned production units. It also includes the portion of GHG emissions from co-packers, co-brewers, franchises and leased units that is proportional to the percentage of the contracted production.

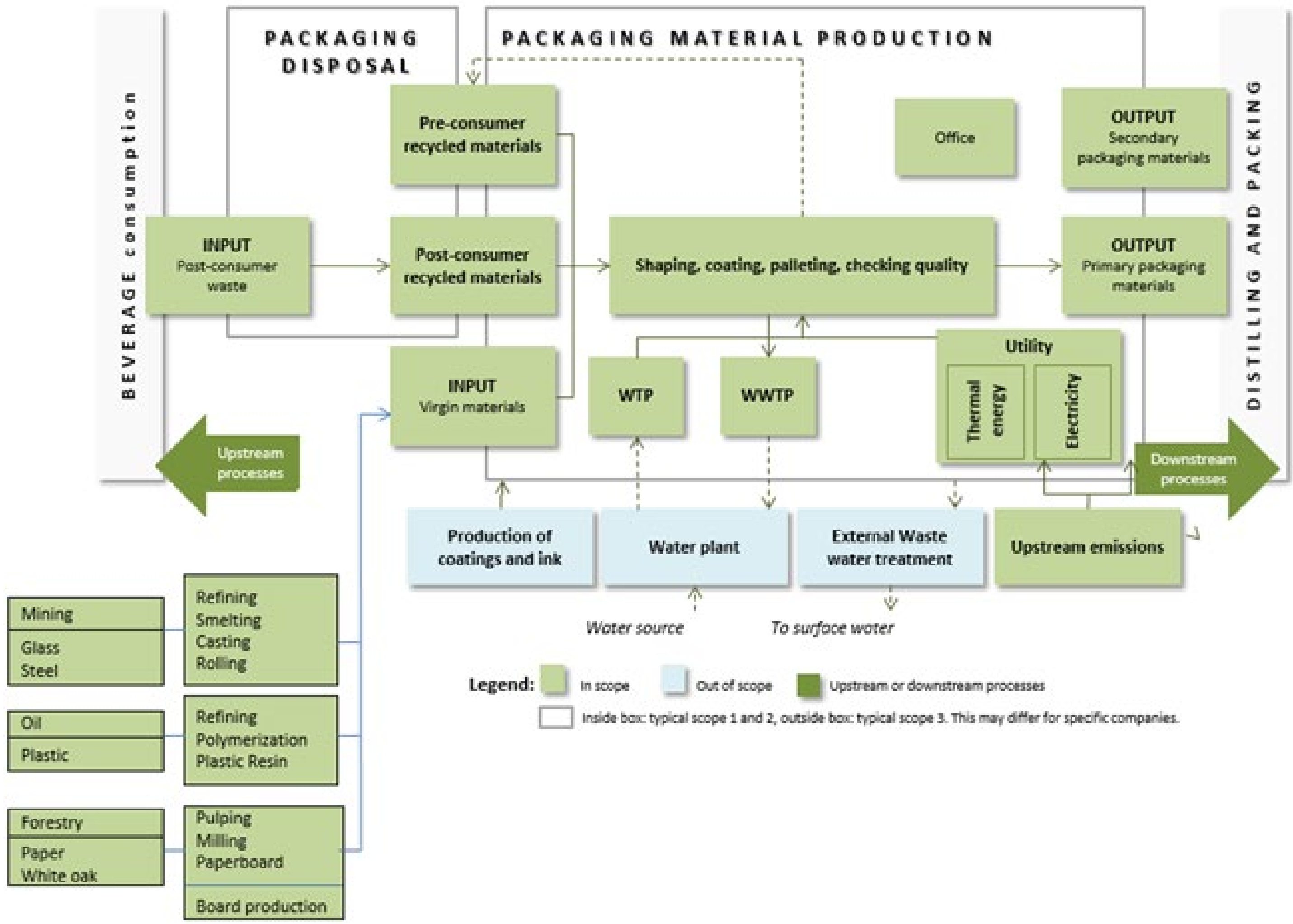
Relevant processes include distilling, maturing, filling, packing, warehouses, internal and external WWTP.

Calculation examples for emissions from product maturation and blended products can be found in *Appendix G*.

Packaging Materials

The figure below summarizes the inputs and outputs for the packaging disposal and packaging material production process.

Packaging Materials Process Map - Fig. 30



Processes Included

This scope is applicable to:

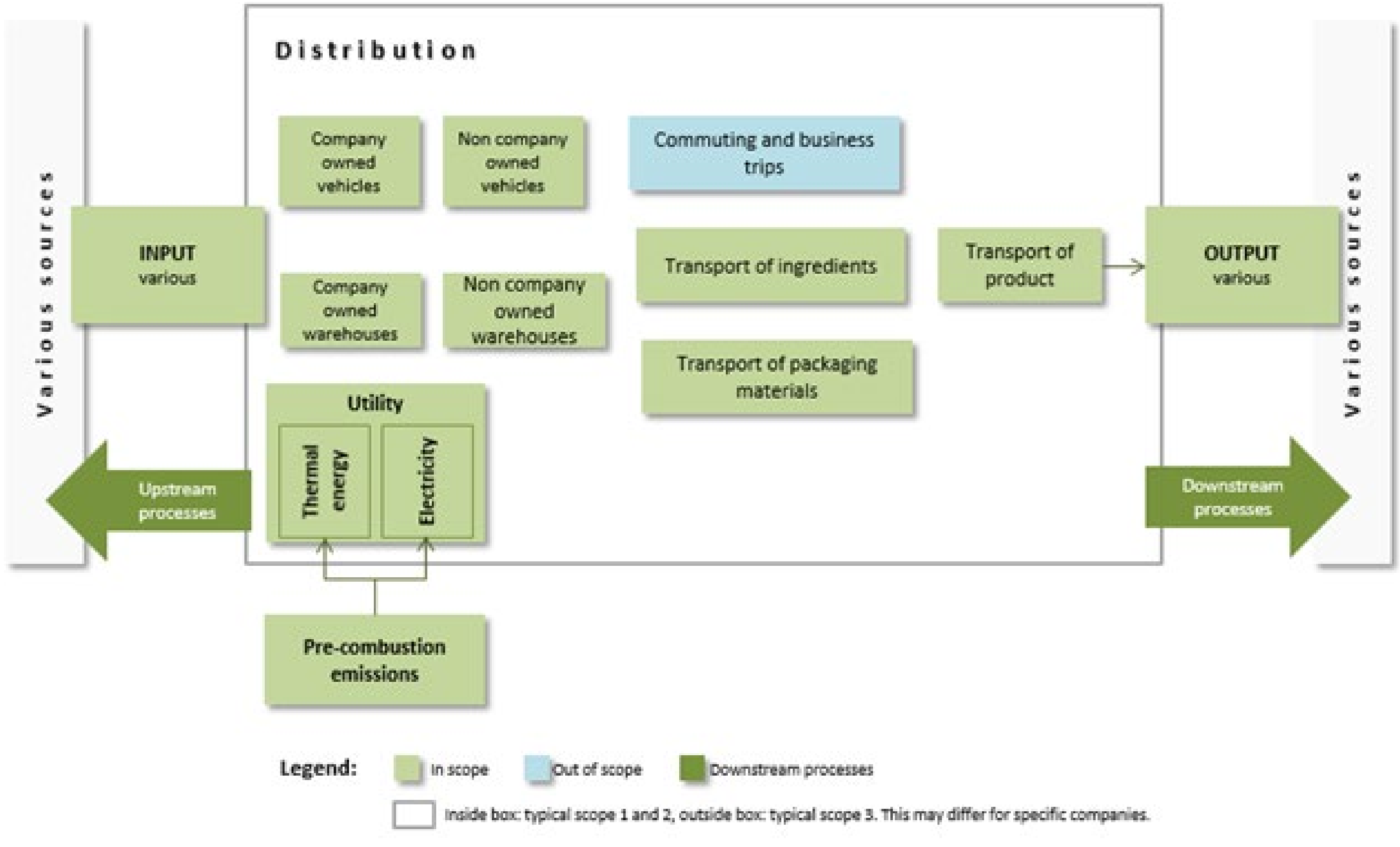
- All primary packaging materials: PET, aluminum, glass, LLPDPE, PE, PP, laminated film.
- All packaging types: bottles, Bag in Box, etc.
- Secondary and tertiary packaging materials, like crates and pallets, after de-minimus rule is applied.

More information on how to calculate emissions from packaging materials (and the recycling allocation), including fictional calculation examples, can be found in *Appendix H*.

Distribution

The figure below summarizes the key inputs and outputs for transportation and distribution of spirits.

Distribution Process Map - Fig. 31



Processes Included

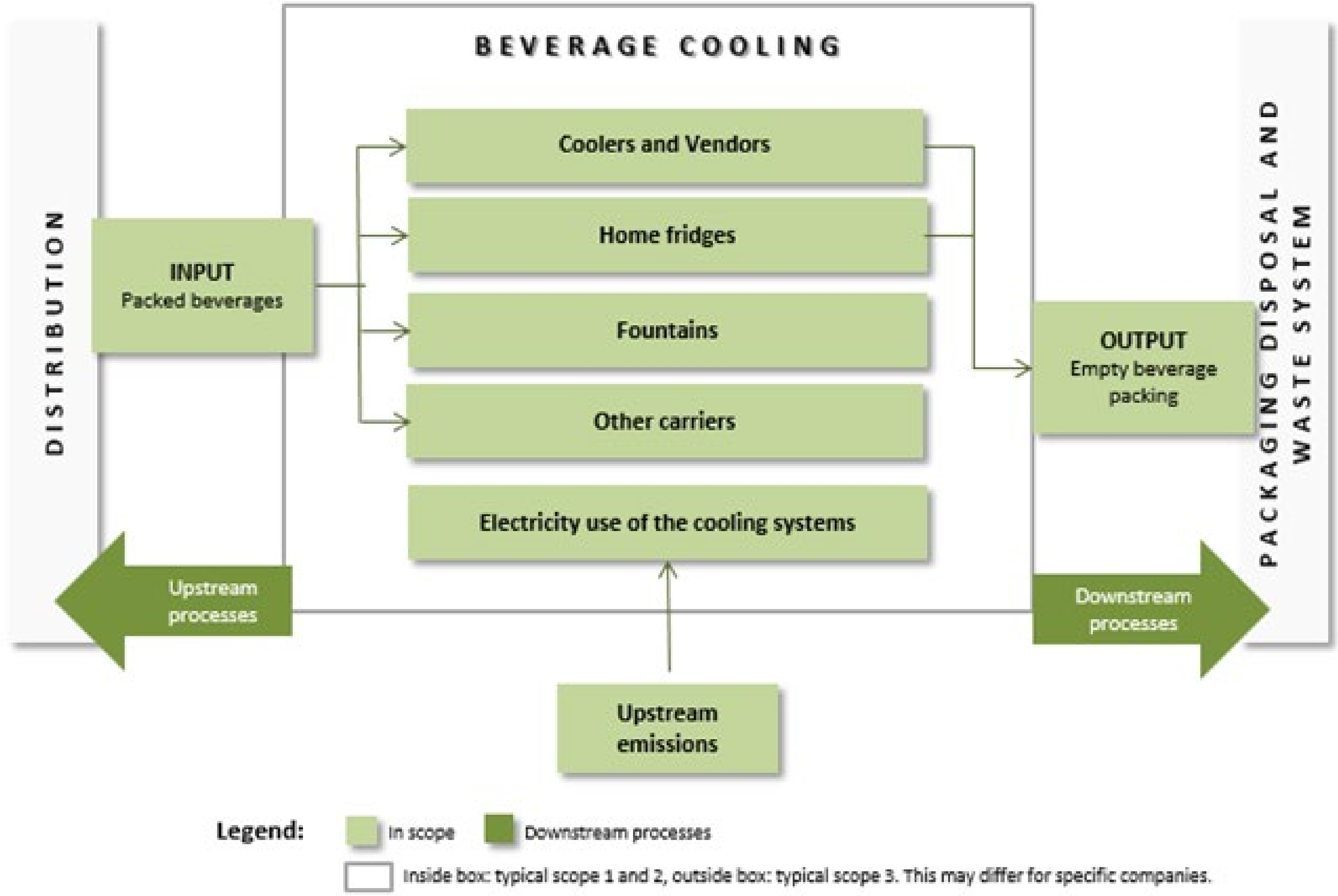
Applicable to all transport of product, ingredients and packaging materials within the value chain, indicated in the overall value chain process map with a **T**.

More information on how to calculate emissions from transportation logistics and distribution, including a fictional calculation example, can be found in *Appendix I*.

Beverage Consumption

Key inputs and outputs for the retail and beverage consumption process regarding spirits are summarized as follows.

Beverage Consumption Process Map - Fig. 32



Processes Included

This scope is applicable to the storage of the product at home users and retailers and other storage carriers and the associated ‘hotel load’. It is the responsibility of the enterprise to determine if these sources are material and should be included within the boundary of their inventory.

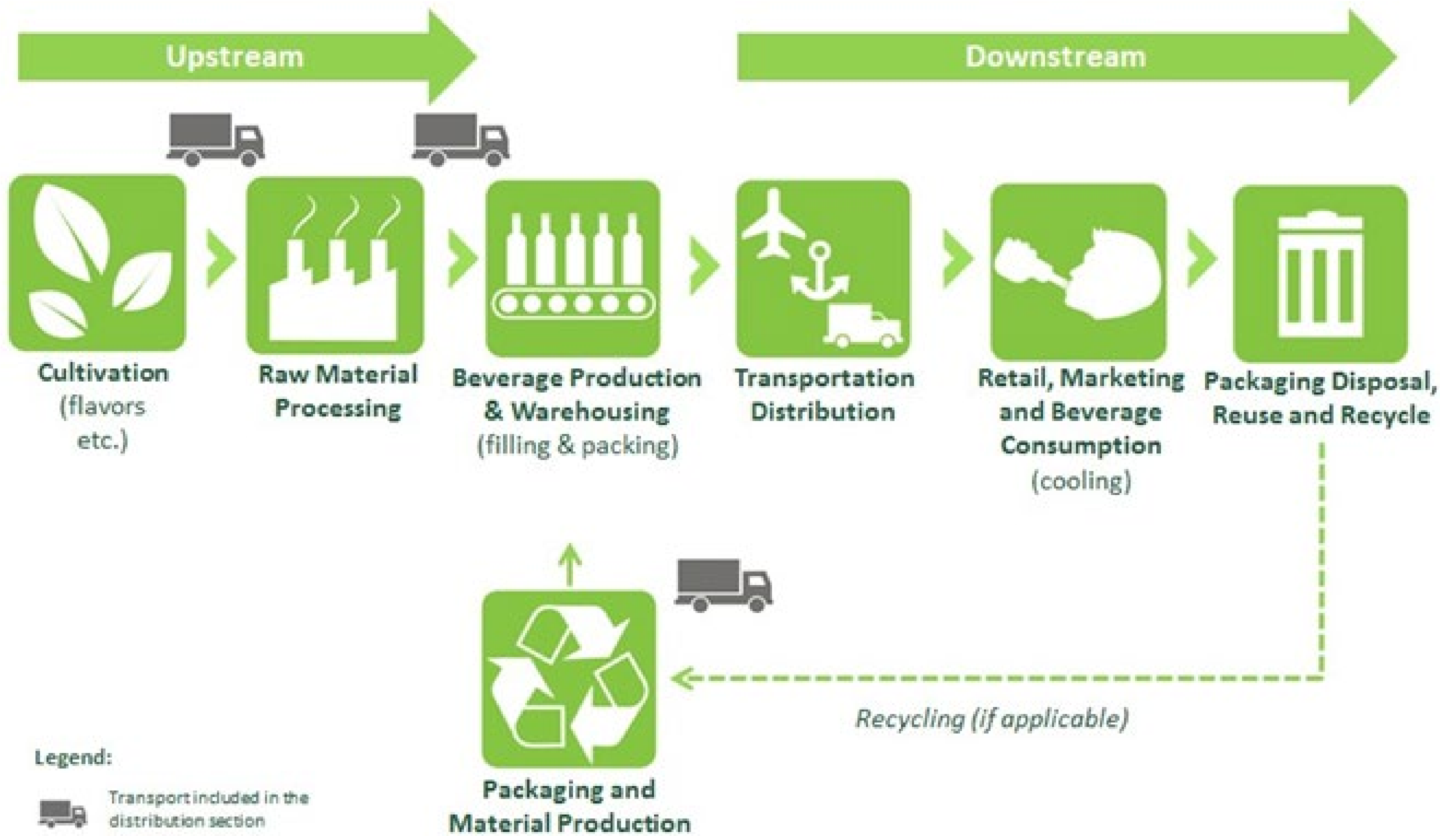
More information on how to calculate cooling emissions in the use phase (beverage consumption), including a fictional calculation example, can be found in *Appendix J*.

Beverage Category Alignment: Bottled Water

Bottled Water Alignment

The overall *Bottled Water Value Chain* is presented in figure 33. This value chain serves as the basis for more detailed description of the different value chain elements further on in this chapter.

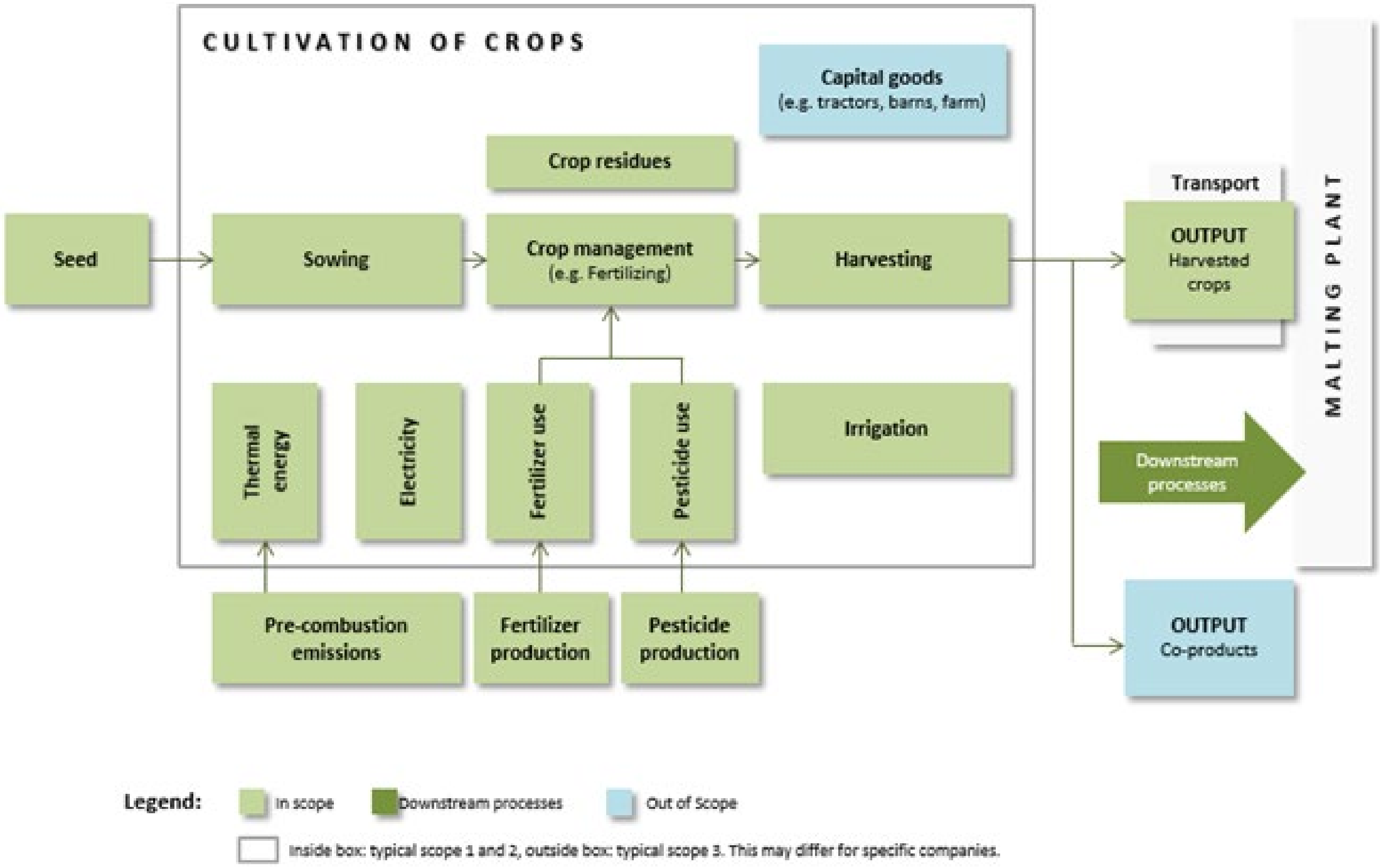
Bottled Water Value Chain - Fig. 33



Cultivation

The figure on the following page shows the cultivation process map for bottled water ingredients of natural based flavored waters. In case these are natural based flavors, the agricultural process starts with seeds and ends with harvested product. The emissions related to transportation of the crops are included in the distribution GHG emissions. The calculation methodology for transportation is described in the distribution reporting guideline.

Cultivation Process Map - Fig. 34



The cultivation of flavors is taken into account. For these crops the GHG emissions from fertilizer and pesticides production and application, land use and change of land use, and the energy use (e.g., sowing and harvesting) are taken into account. Upstream emissions of fuels and electricity shall be taken into account as well.

Processes Included

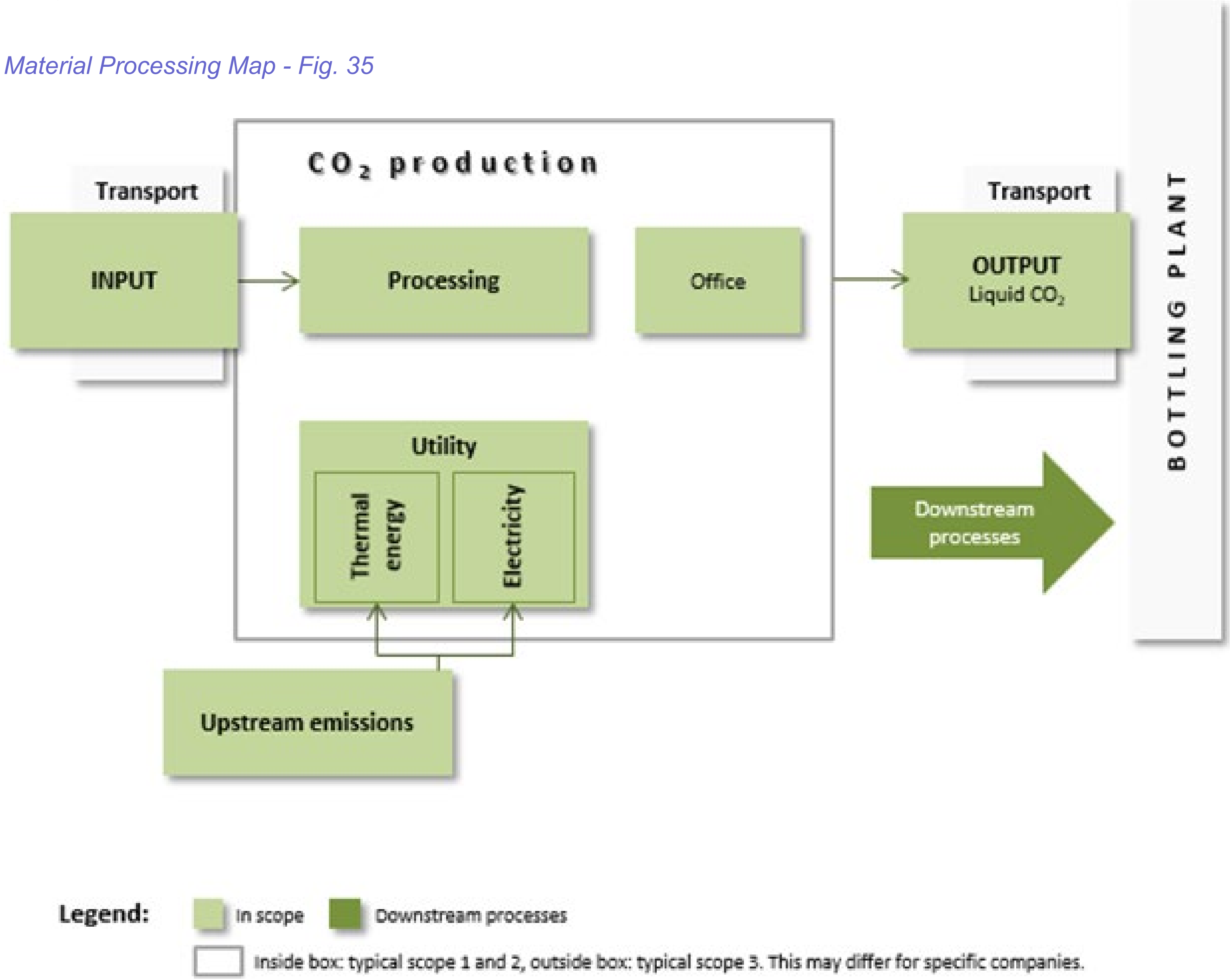
This scope is applicable to all significant ingredients (significant is > 99% of mass of the overall emissions of all ingredients), determined after de-minimus rule is applied.

More information and an example on the calculation of emissions from cultivation can be found in *Appendix F*.

Raw Material Processing

The figure below shows the raw material inputs and outputs for carbonated bottled water. How to deal with (purchased) CO_2 as ingredient is described in *Appendix E*.

Raw Material Processing Map - Fig. 35



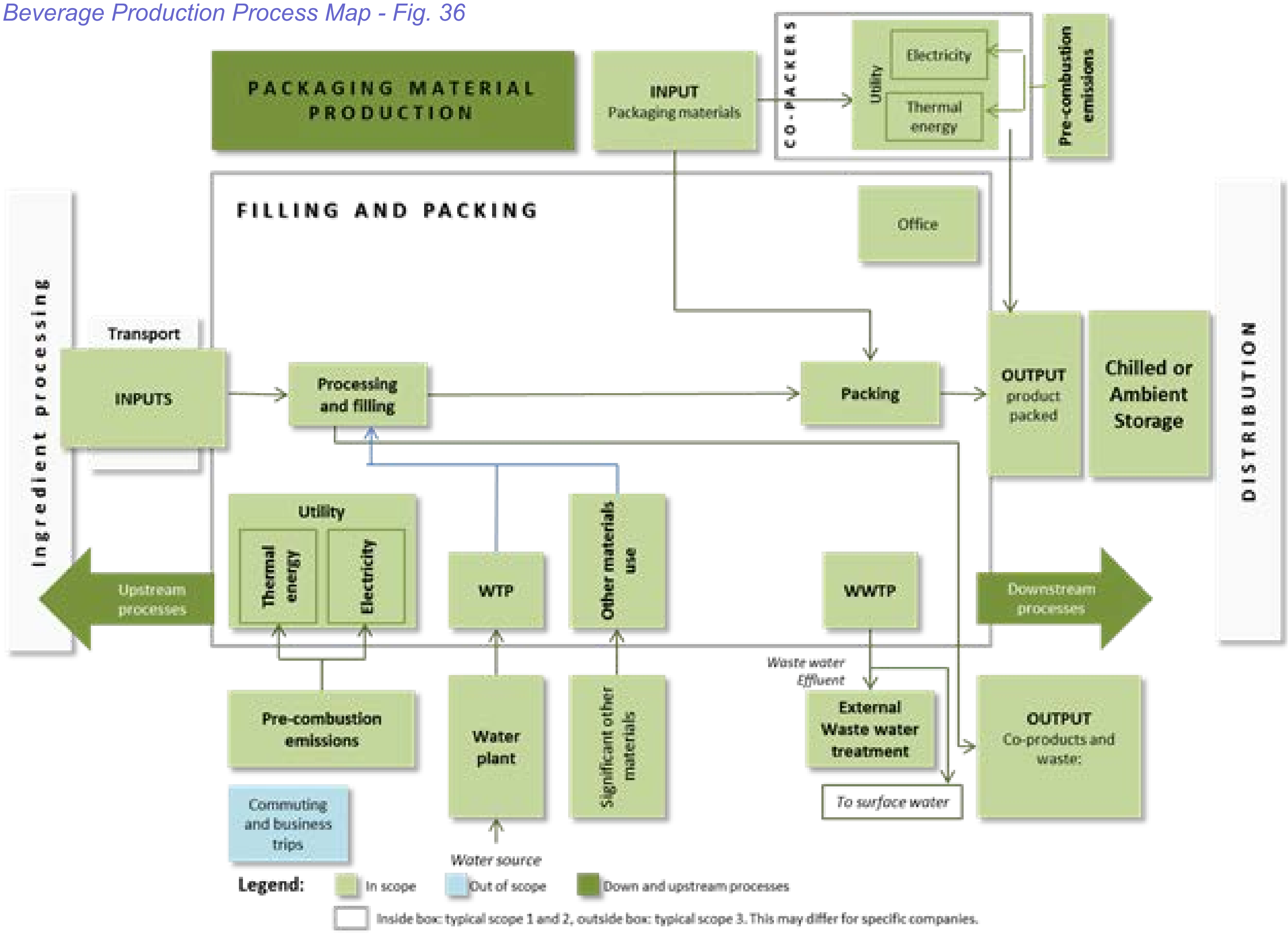
Processes Included

Where applicable this scope applies to all purchased CO_2 (in some cases the CO_2 is natural and directly available on site and thus excluded from the scope of this value chain element).

Beverage Production

The figure below includes primary outputs and inputs into the beverage production process for bottled water.

Beverage Production Process Map - Fig. 36



Processes Included

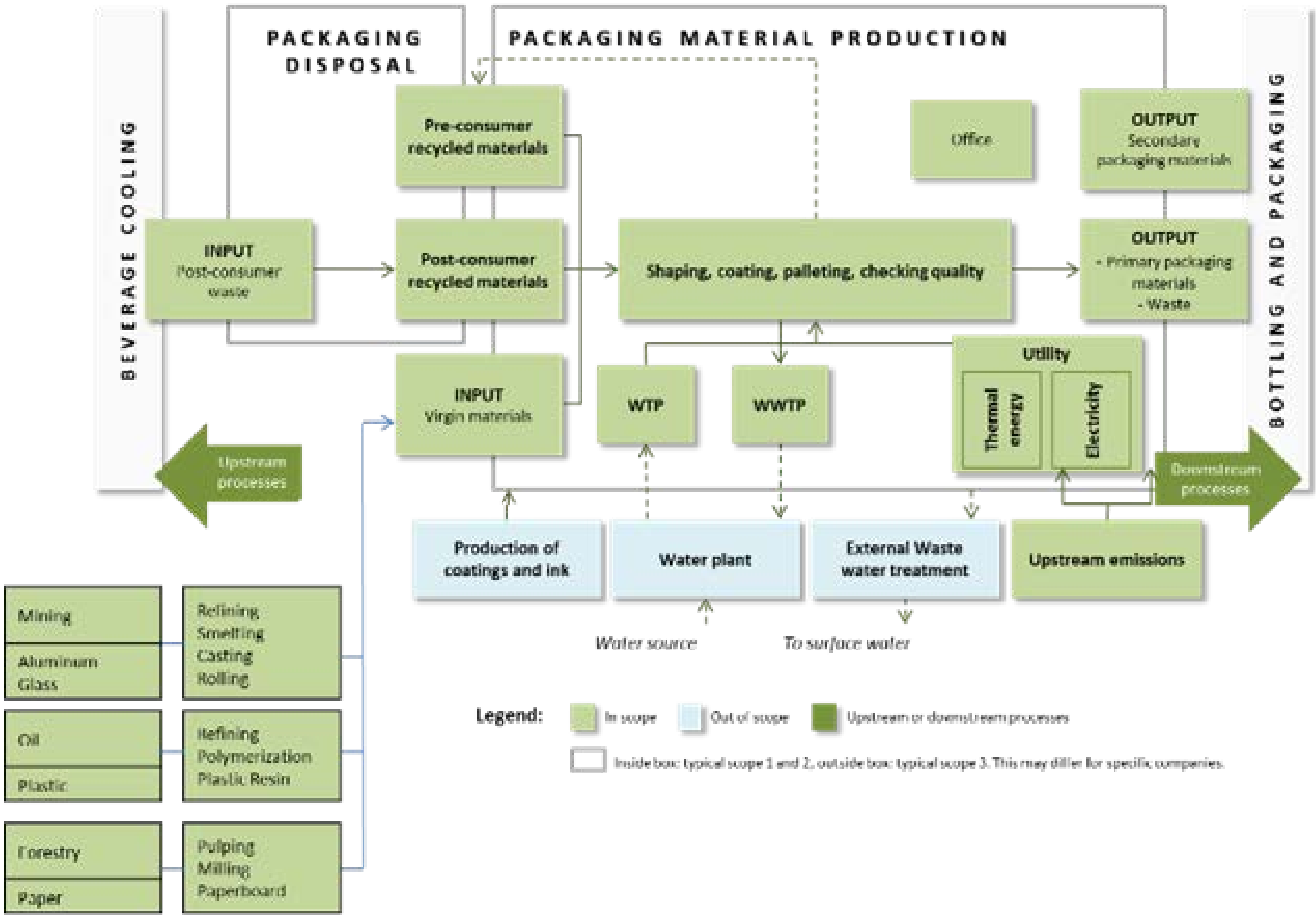
This scope is applicable to all company owned production units, co-packers, franchises and leased units (as defined in GHG inventory scope).

Additionally, processes related to warehousing and internal and external WWTP are included.

Packaging Materials

The figure below summarizes the inputs and outputs for the packaging disposal and packaging material production process.

Packaging Materials Process Map - Fig. 37



Processes Included

This scope is applicable to:

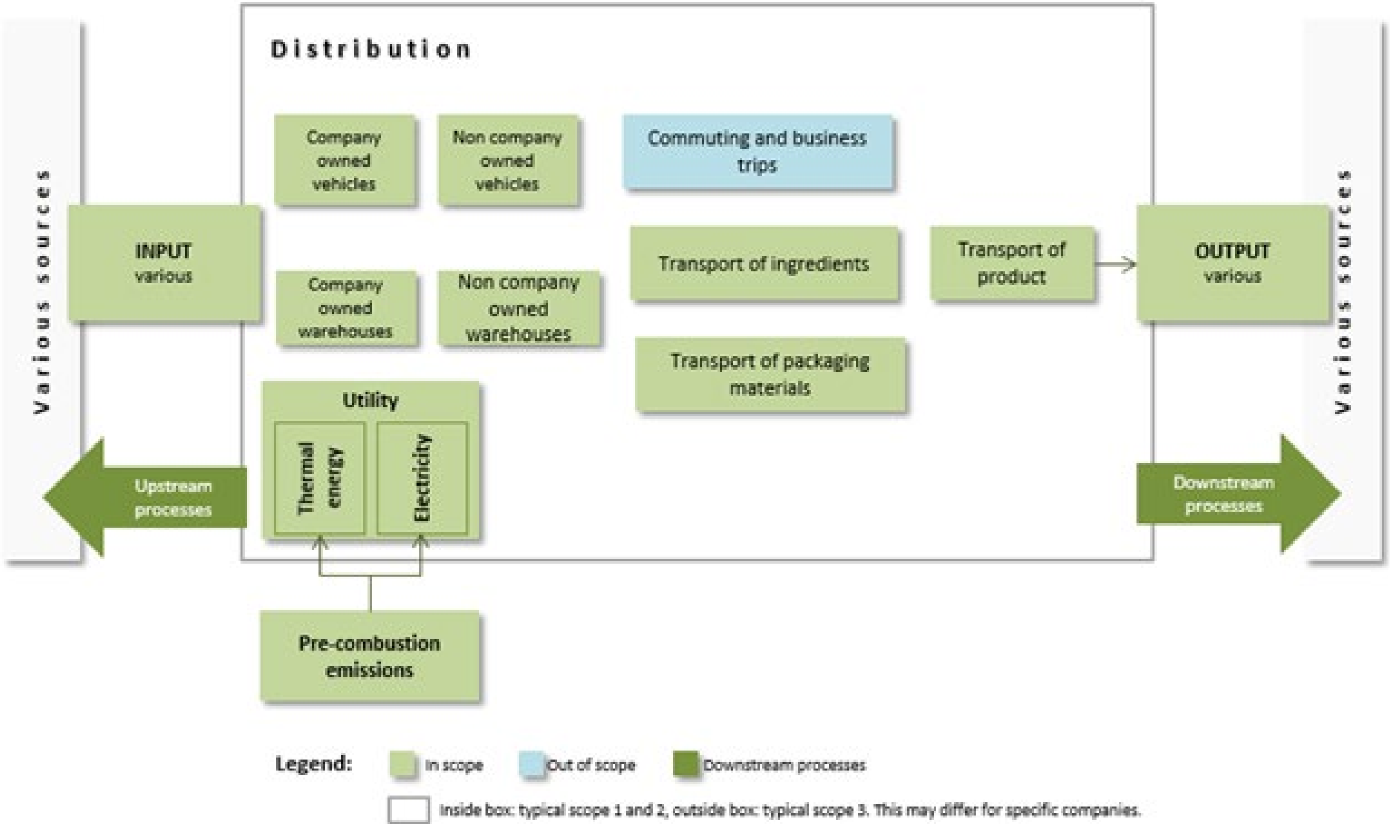
- All primary packaging materials: PET, aluminum, glass, LLPDPE, PE, PP, laminated film.
- All packaging types: bottle, Bag in Box, can, box, pad, can.
- Secondary and tertiary packaging materials, like crates and pallets, after de-minimus rule is applied.

More information on how to calculate emissions from packaging materials (and the recycling allocation), including fictional calculation examples, can be found in *Appendix H*.

Distribution

The figure below summarizes the key inputs and outputs for transportation and distribution of bottled water.

Distribution Process Map - Fig. 38



Processes Included

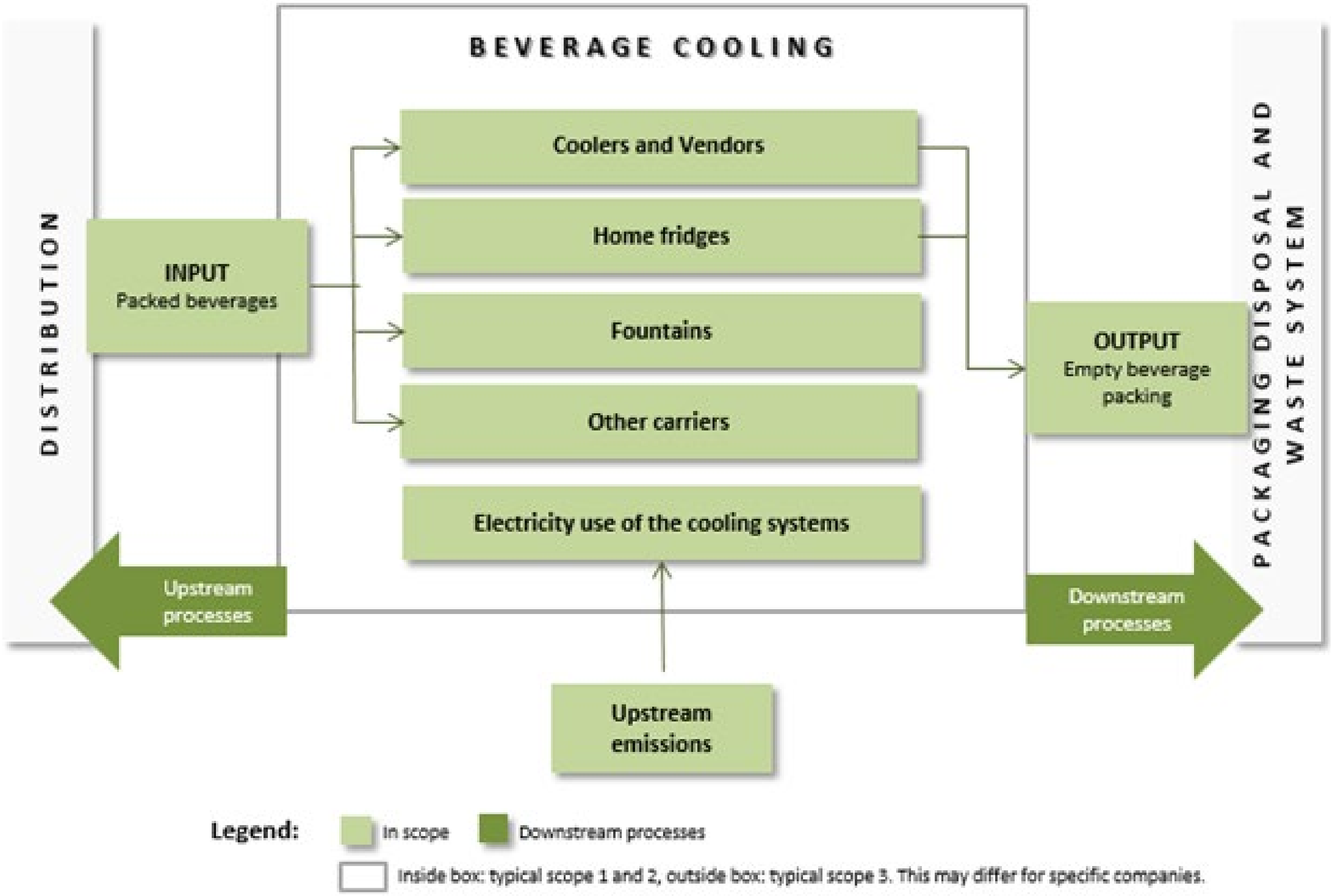
This scope is applicable to all transport of product, ingredients and packaging materials within the value chain, indicated in the overall value chain process map with a **T**.

More information on how to calculate emissions from transportation logistics and distribution, including a fictional calculation example, can be found in *Appendix I*.

Beverage Consumption

Key inputs and outputs for the retail and beverage consumption process regarding bottled water are summarized as follows.

Beverage Consumption Process Map - Fig. 39



Processes Included

The cooling of the produced product at retailer, bars or home users, including the 'hotel load' of the premises. It is the responsibility of the enterprise to determine if these sources are material and should be included within the boundary of their inventory.

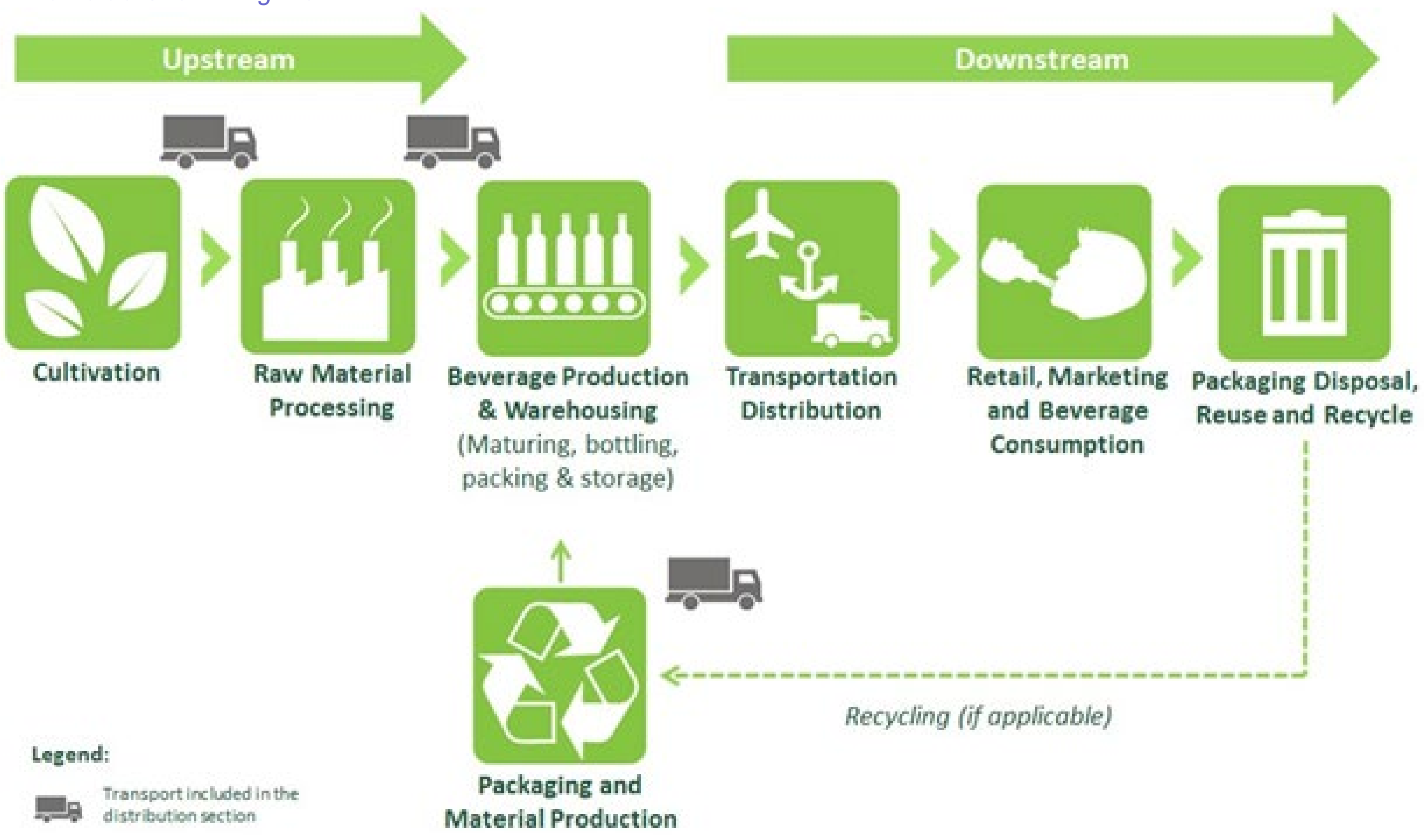
More information on how to calculate cooling emissions in the use phase (beverage consumption), including a fictional calculation example, can be found in *Appendix J*.

Beverage Category Alignment:
Wine

Wine Alignment

The overall *Wine Value Chain* is presented in the figure below. This value chain serves as the basis for more detailed description of the different value chain elements further on in this chapter.

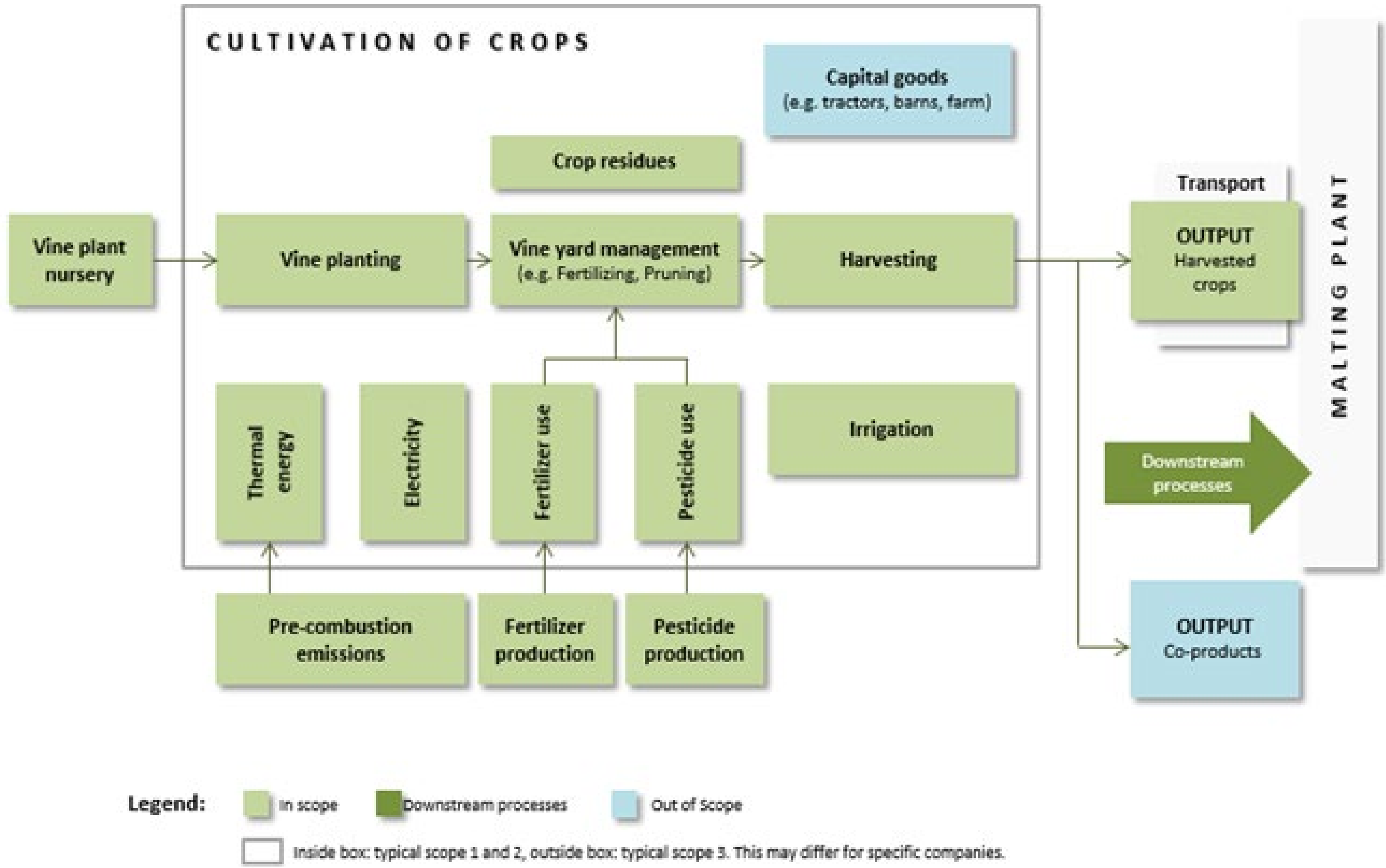
Wine Value Chain - Fig. 40



Cultivation

The figure on the following page shows the cultivation process map for wine production. The agricultural process starts with seeds and ends with harvested product. The emissions related to transportation of the crops are included in the distribution GHG emissions. The calculation methodology for transportation is described in the distribution reporting guideline.

Cultivation Process Map - Fig. 41



The cultivation of all grapes and any other ingredients are taken into account. For these crops the GHG emissions from fertilizer and pesticides production and application, land use and change of land use, and the energy use (e.g., sowing and harvesting) are taken into account. Upstream emissions of fuels and electricity shall be taken into account as well.

Processes Included

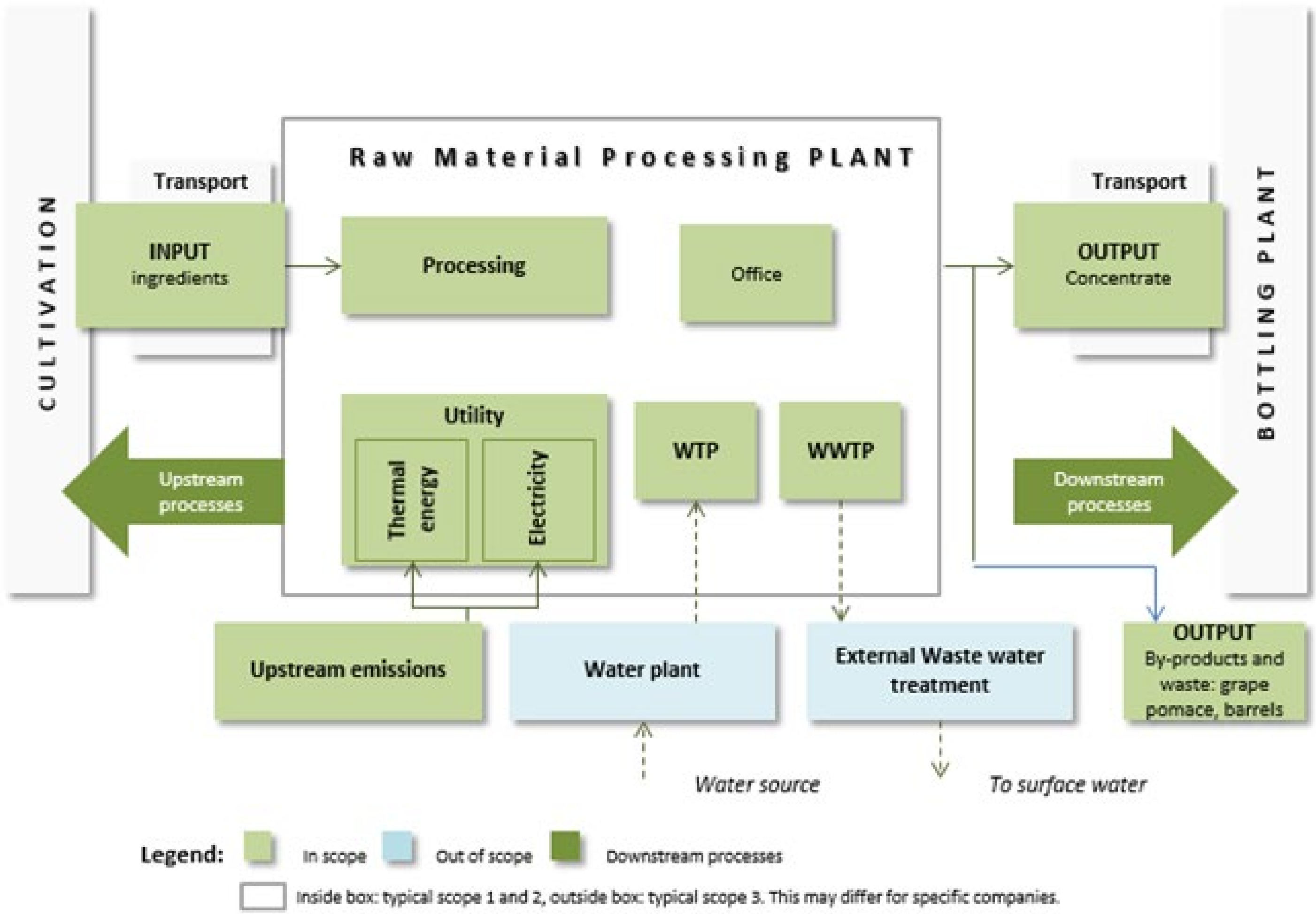
This scope is applicable to all significant ingredients (significant is > 99% of mass of the overall emissions of all ingredients) determined after de-minimus rule is applied.

More information and an example on the calculation of emissions from cultivation can be found in *Appendix F*.

Raw Material Processing

The figure below shows the raw material inputs and outputs for wine. For wine, raw material processing is the pressing of the grapes, resulting in grape pomace and grape must.

Raw Material Processing Map - Fig. 42



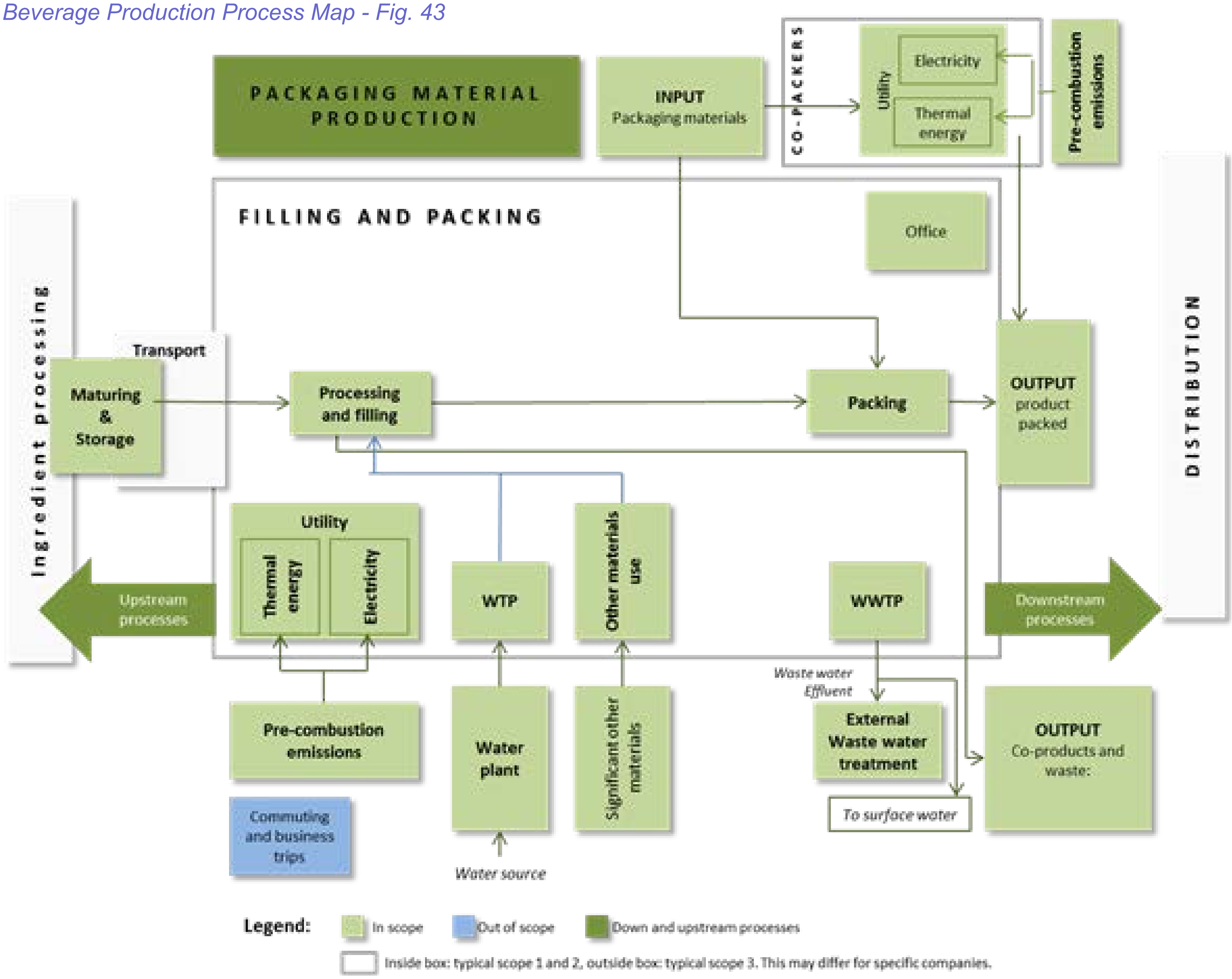
Processes Included

This scope is applicable to all significant fruits and other juice ingredients and the byproducts.

Beverage Production

The figure below includes primary outputs and inputs into the beverage production process for wine (filling and packaging beverage).

Beverage Production Process Map - Fig. 43



Processes Included

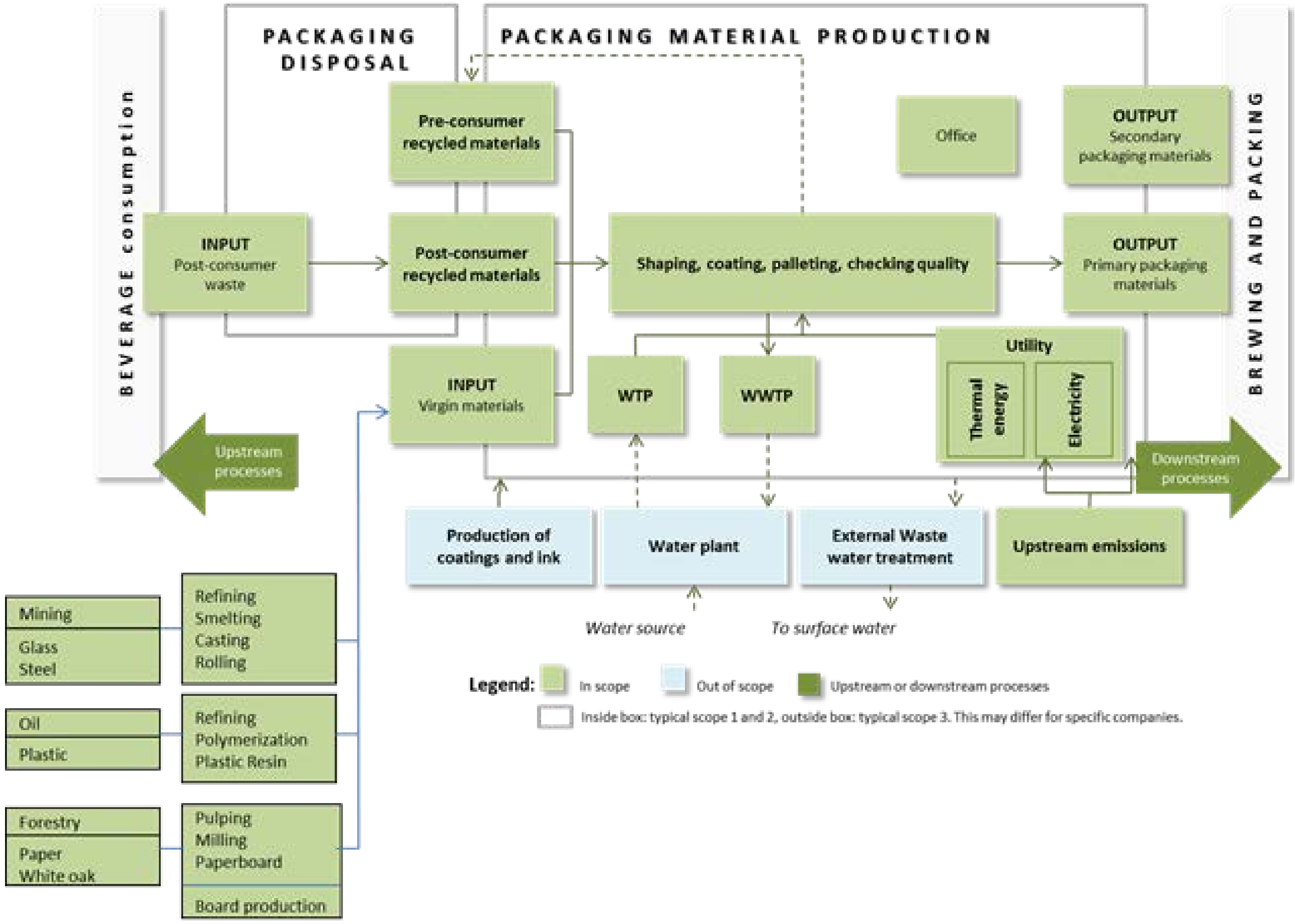
This scope is applicable to all company owned production units, co-packers, franchises and leased units (as defined in GHG inventory scope).

Additionally, processes related to warehousing and internal and external WWTP are included.

Packaging Materials

The Figure below summarizes the inputs and outputs for the packaging disposal and packaging material production process.

Packaging Materials Process Map - Fig. 44



Processes Included

This scope is applicable to:

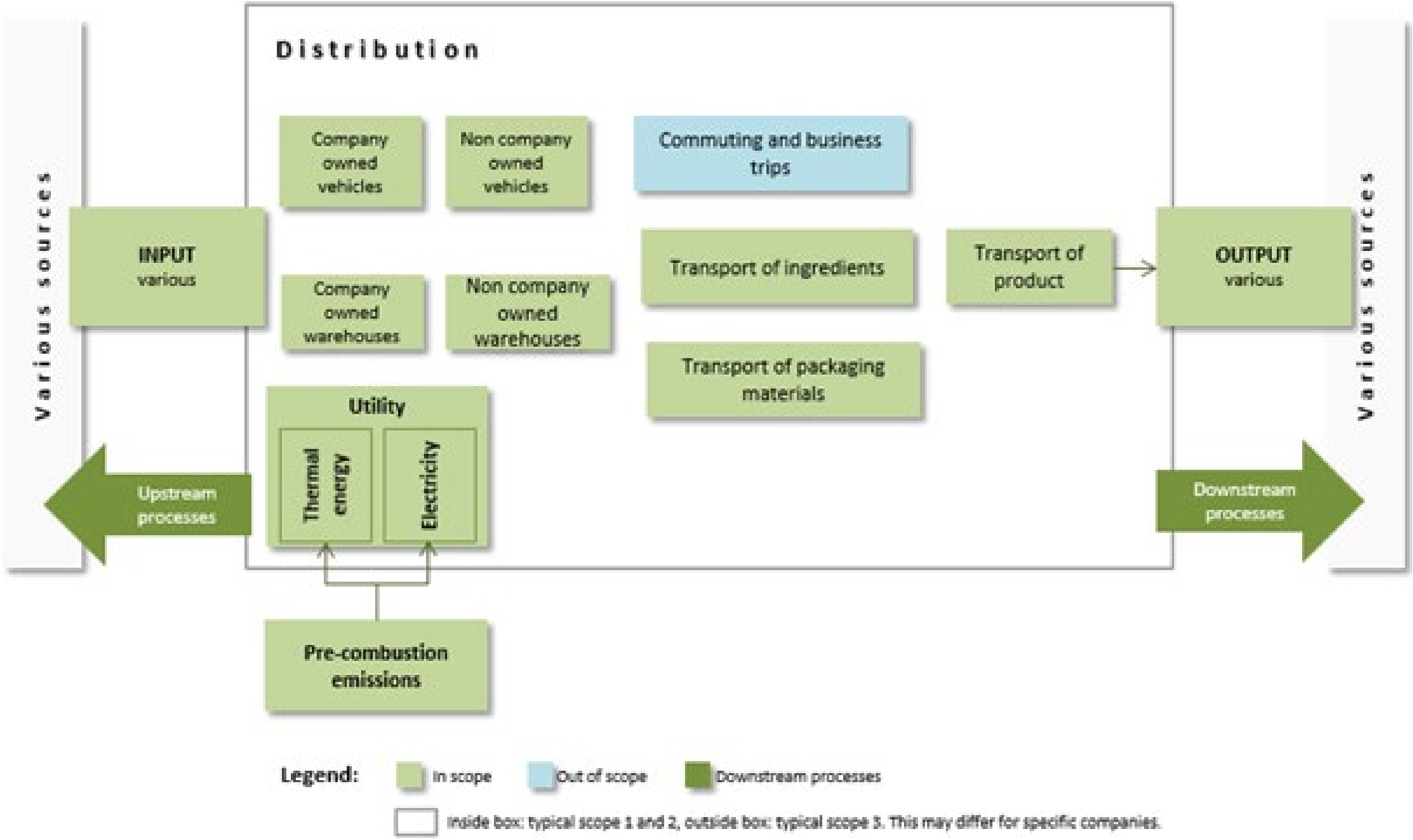
- All primary packaging materials: PET, aluminum, glass, LLPDPE, PE, PP, laminated film.
- All packaging types: bottle, Bag in Box, etc.
- Secondary and tertiary packaging materials, like crates and pallets, after de-minimus rule is applied.

More information on how to calculate emissions from packaging materials (and the recycling allocation), including fictional calculation examples, can be found in *Appendix H*.

Distribution

The figure below summarizes the key inputs and outputs for transportation and distribution of wine.

Distribution Process Map - Fig. 45



Processes Included

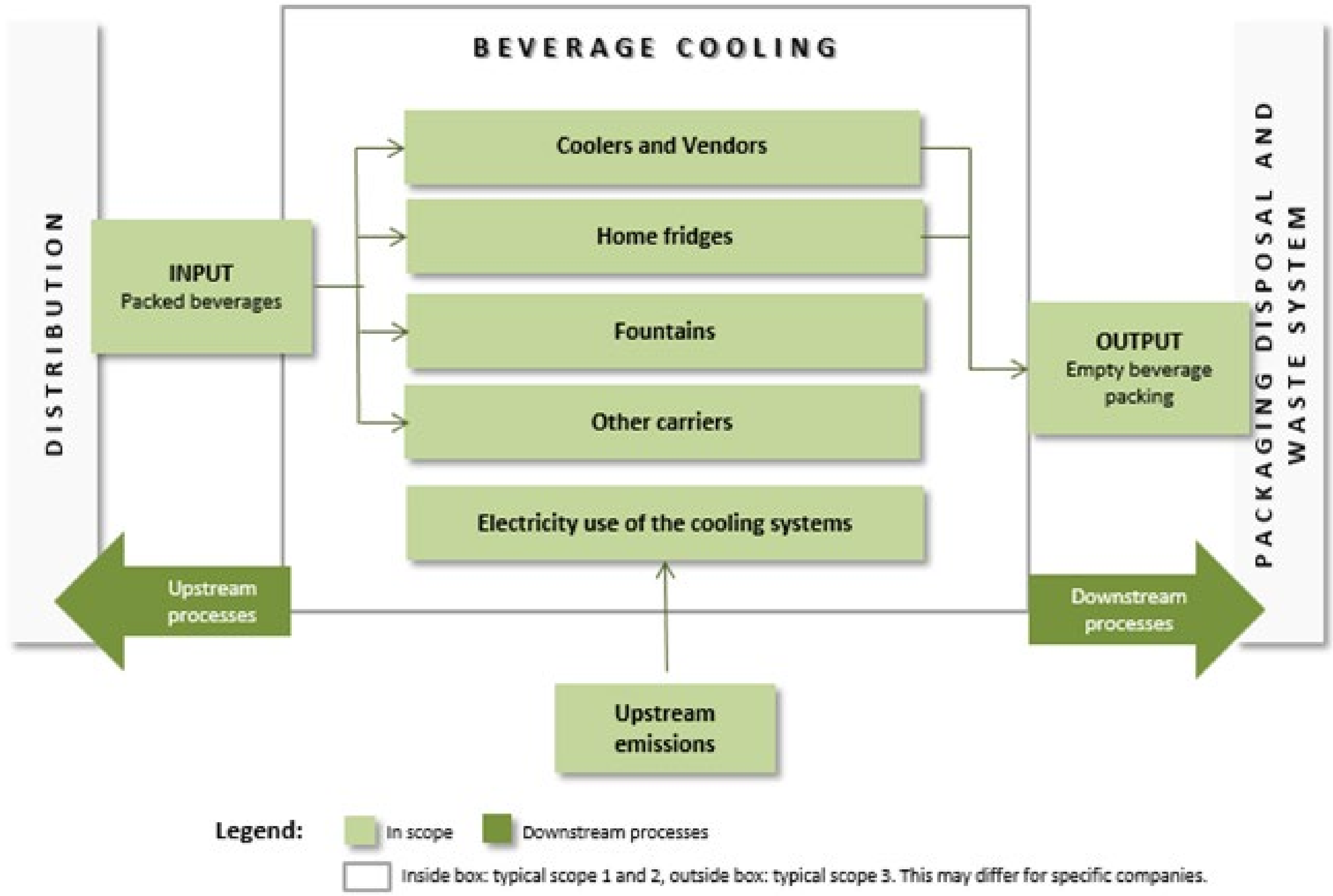
Applicable to all transport of product, ingredients and packaging materials within the value chain, indicated in the overall value chain process map with a **T** and after de-minimus rule is applied.

More information on how to calculate emissions from transportation logistics and distribution, including a fictional calculation example, can be found in *Appendix I*.

Beverage Consumption

Key inputs and outputs for the retail and beverage consumption process regarding wine are summarized as follows (only applicable to wines that are being cooled).

Beverage Consumption Process Map - Fig. 46



Processes Included

This scope and description is applicable to the cooling of the produced beer at retailers, restaurants, bars and home users. In this scope the hotel load of the retail stores should also be included. It is the responsibility of the enterprise to determine if these sources are material and should be included within the boundary of their inventory.

More information on how to calculate cooling emissions in the use phase (beverage consumption), including a fictional calculation example, can be found in *Appendix J*.

Glossary

Enterprise

An enterprise includes all beverage product production-related activities for the reporting company. This will include but not be limited to: all manufacturing operations, offices, research facilities and transportation activities.

Facility/Factory

A facility or factory encompasses a single campus and may include multiple buildings. Facility examples include sales offices and research centers, while factories are typically manufacturing plants. This term applies to all on-site activities on the campus (fleet, equipment maintenance, etc.) unless such activities are expressly excluded and reported separately.

Hotel Load

A plant's non-manufacturing and warehouse portion, including: facility lighting, heating and cooling.

Life Cycle Impacts

The assessment of the environmental impacts of a given product or service throughout its lifespan, including all phases: raw material production, manufacture, distribution, product use and disposal and all intervening transportation steps.

Product

A standard base sales unit not differentiated by volume (both package and product) (e.g., a bottle of soda, can of beer, PET of juice, or box of wine). A product is a subset of the beverage class; for example, carbonated soft drink, fitness drink, juice, beer, wine, distilled spirits or water.

SKU

An SKU (stock keeping unit) is a sales unit as defined by reporting organization - for example, a 12-oz can of carbonated soft drink or a 750 ml bottle of wine. For purposes of the aggregation examples provided in *Appendix D, Aggregation and Apportionment of Emissions*, the same SKU can be assigned to products made at different locations.

Value Chain

The network along which products or services move from suppliers to customers, transporting raw materials and transforming them into a finished project, delivering finished product to end users, and disposal or recycling of residual wastes. A value chain may consist of many different suppliers and customers before the product reaches the end user.

Appendix A:
Data Requirements by Value Chain Element

This section consolidates the minimum data requirements applicable to each value chain element. In some cases a more accurate number could be obtained, although this is not required, only recommended.

Table A1: Cultivation

Minimum Data Requirements	More accurate
Ingredient name	
Country specific yield factor per ingredient	Supplier values by ingedient
(Global / corporate) fixed cultivation value or factor	Cultivation value or factor of country of origin
(Global / corporate) fixed fertilizer value or factor	Fertilizer value or factor of country of origin
Scope 1 and 2 emissions from cultivation (e.g. N_2O and CO_2 emissions from soil, GHG emissions from diesel combustion for crop management)	Activity data by suppliers
Yield/Volume (metrics, tons, output ratio, etc.)	
Land use change factor based on ‘previous land use unknown’	Land use change factor based on ‘previous land use known’

Table A2: Raw Material Processing

Minimum Data Requirements	More Accurate
Location of malting or processing plant	
Amount and type of fuels used plus emission factor	
Amount of electricity from national grid (plus grid factor)	
Amount of electricity from other source (plus grid factor)	
Output / input ratio fixed	Output / input ratio calculated

Additionally for beverage categories Beer and Spirits:

	% dry matter of malt

Table A3: Beverage Production

Minimum Data Requirements
Beverage production, total volume produced/sold (hl/y for beer, spirits or L/y for CSD, packed water, wine)
On-site use of Thermal energy (MJ)
On-site fuel types used (types, LHV)
On-site CO_2 emissions for company owned transport (scope 1)
On-site CO_2eq emissions, from lost refrigerants
On-site electricity consumption (kWh)
Waste water COD
Own treatment or third party

Specific additional data requirements for beverage category Beer:

Water consumption (m^3)
Water source
Kieselguhr, hops and other materials consumed (purchased kg)
Non-recycled Brewers Spent Grains

Specific additional data requirements for beverage categories CSD, Juices, Packed Water and Wine:

CO_2, water and other materials consumed (purchased kg or m^3)

Specific additional data requirements for beverage category Spirits:

Water consumption (m^3)
Water source
Other materials consumed (purchased kg)

Table A4: Packaging

Minimum Data Requirements		
Activity data by packaging supplier and activity data by beverage producer for 3 categories:		
Packaging Mix	• Beverage type • Production unit location • Packaging type (and weight) **Additionally for the beverage categories Beer, Spirits and Wine:** • Tankered volume	• Packed volume • Trip rates of reused packaging • Recycling percentages of packaging and/or recycled content of packaging
One-Way Packaging	• Beverage type • Production unit location • Volume packed • Packaging unit volume	• Purchased packaging units • Weight and packaging material (+ recycling content) of container and can ends/lids • Country and location of packaging supplier
Secondary and Tertiary Packaging Materials	• Beverage type • Material type	• Total weight of packaging • Trip rates of reused packaging

For recycling rates and recycling content percentages, as well as country specific recycling rates (where available), the figures for where product is sold are used.

Table A5: Distribution

Minimum Data Requirements
Scope 1 and 2 emissions of company owned and non-company owned warehouses, distribution centers etc., plus their pre- combustion emissions.
CO_2 emissions of all transport in the value chain.

Table A6: Beverage Consumption

Minimum Data Requirements
Hl (beer/spirits) or Liters (CSD/packed water/wine) per cooling category
Country specific emissions
Specific energy use various cooling methods

Appendix B:
Sources of Primary and Secondary Data

Sources of Primary Data

The preferred sources for primary data elements are listed in Table B1. (Note that primary data can be used for Scope 1, 2, or 3 emissions as well as for any or all data points in a product footprint.)

Table B1: Primary Data

Data Element	Sources of Information
Natural gas use	Invoice, utility usage log
Coal use	Purchase or delivery records, inventory data, invoice, utility usage log
Purchased steam use	Meter reading, invoice, utility usage log
Fuel oil use	Invoice, utility usage log
Propane use	Invoice, utility usage log
Biogas/landfill gas used as fuel	Invoice, utility usage log
Biomass used as fuel	Purchase or delivery records, inventory data, invoice, utility usage log
Electricity used but not generated on site	Meter reading, electrical use invoice, utility usage log
Electricity generated on site	Meter reading
Electricity sold to grid	Meter reading
Other energy sources: (specify: e.g., solar, wind, etc.)	Utility usage log

Sources of Secondary Data

BIER has developed an interim list of data resources that can be used to complete an enterprise inventory or product carbon footprint. We continue developing guidance and alignment to data sources and data quality.

The table on the following page indicates some PEF background datasets for secondary data (login through personal list, registration through user list).

Table B2: Secondary Data

Data Element Dataset	Provider	Contact	Node
Energy and Transport	Thinkstep	martin.baitz@thinkstep.com	http://lcdn.thinkstep.com/Node/
Packaging	Thinkstep	martin.baitz@thinkstep.com	http://lcdn.thinkstep.com/Node/
Agrofood	Pre Quantis	xavier.bengoa@quantis-intl.com	http://lcdn.blonkconsultants.nl
End of Life	Thinkstep	martin.baitz@thinkstep.com	http://lcdn.thinkstep.com/Node/

Appendix C: Aggregation and Apportionment of Emissions

Greenhouse gas (GHG) emissions can be apportioned based on the enterprise, the facility or factory, the product, the SKU or the functional unit such as an 1.5 oz serving size for distilled spirits, or a can of a carbonated soft drink.

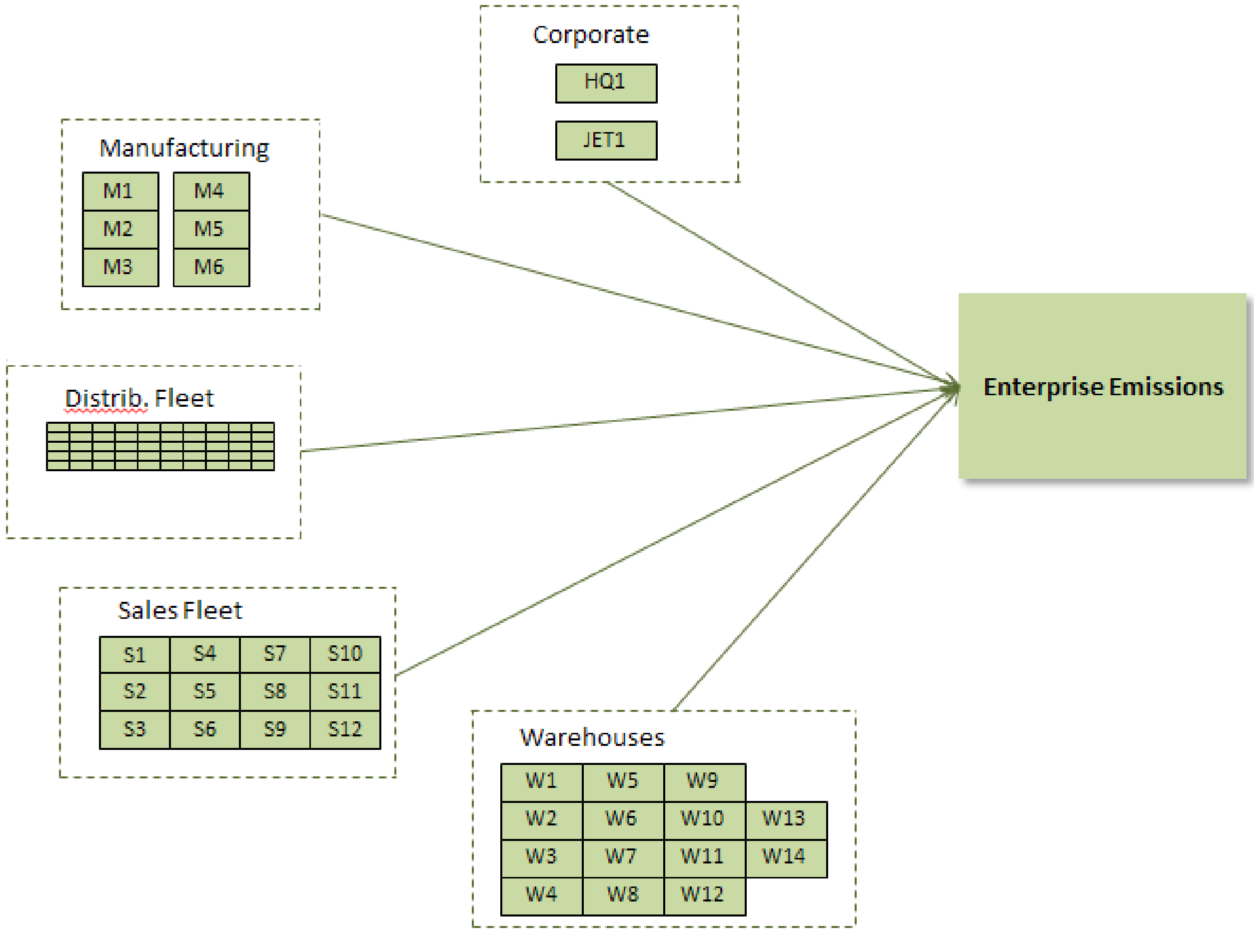
Enterprise Aggregation

Calculate the emissions for an enterprise by summing the emissions for all facilities and factories and transportation of products and goods between sites. An example is provided as Example 1 below.

Example 1: Aggregation of Emissions from Enterprise Components

A beverage company consists of a corporate headquarters, one corporate jet, six manufacturing plants, a fleet of 50 company-owned trucks, a sales fleet of 12 company-leased vehicles, and 14 warehouses. Because all of these assets are controlled by the beverage company, Scope 1 and 2 emissions can be calculated by taking the sum of respective scope emissions across the enterprise.

$$E_{Enterprise} = E_{HQ} + E_{Jet} + \sum E_{Manufacturing\ Plants} + \sum E_{Distribution} + \sum E_{Sales} + \sum E_{Warehouses}$$

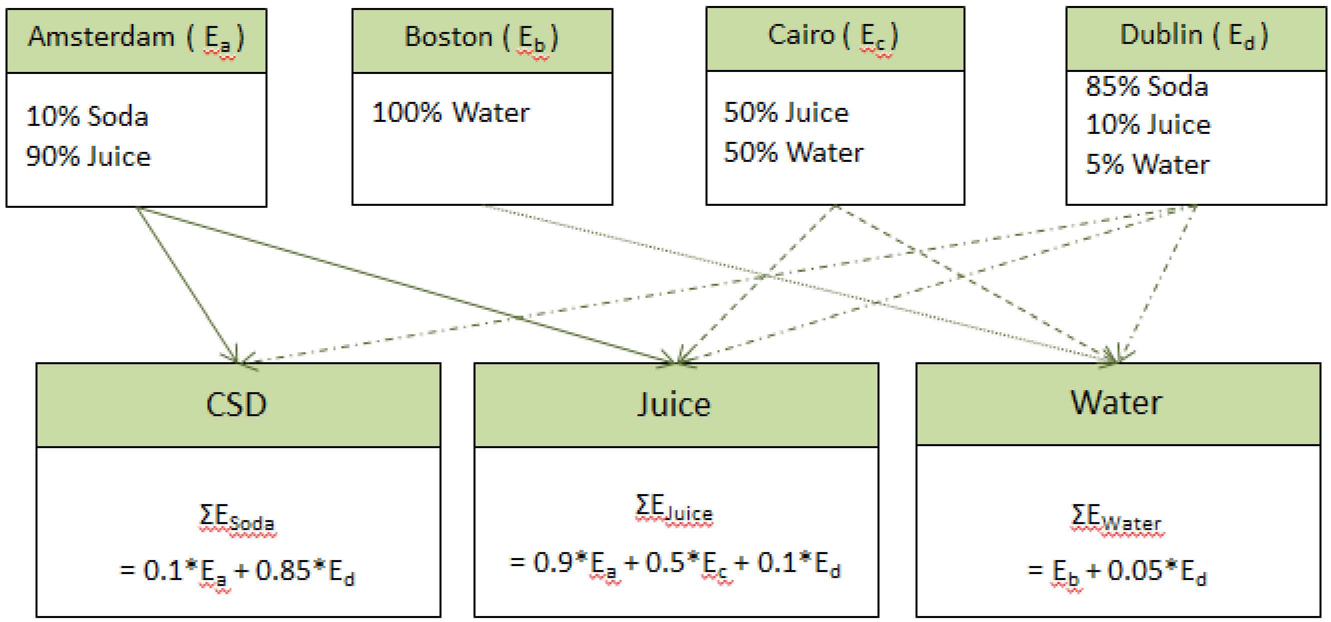


When reporting aggregated emissions, state what entities and Scopes are included in the emissions inventory (i.e. Scope 1 and 2 for beverage manufacturing in South America). When reporting Scope 3 emissions, it is essential that the reporting company state which elements of Scope 3 are included in the inventory. The reporting period must also be stated.

Product Level Emissions from Manufacturing

Calculate the emissions for a product by summing the product-specific emissions over all factories where that product is manufactured. At the factory level, use data from product-specific (i.e., line) meters or records if possible. A fraction of hotel load emissions equal to the volume share of that product made at the facility should be added to the product-specific manufacturing emissions. Alternatively, apportion all emissions from the production facility (including hotel load) to the products according to the amount of their relative output (i.e., by volume).

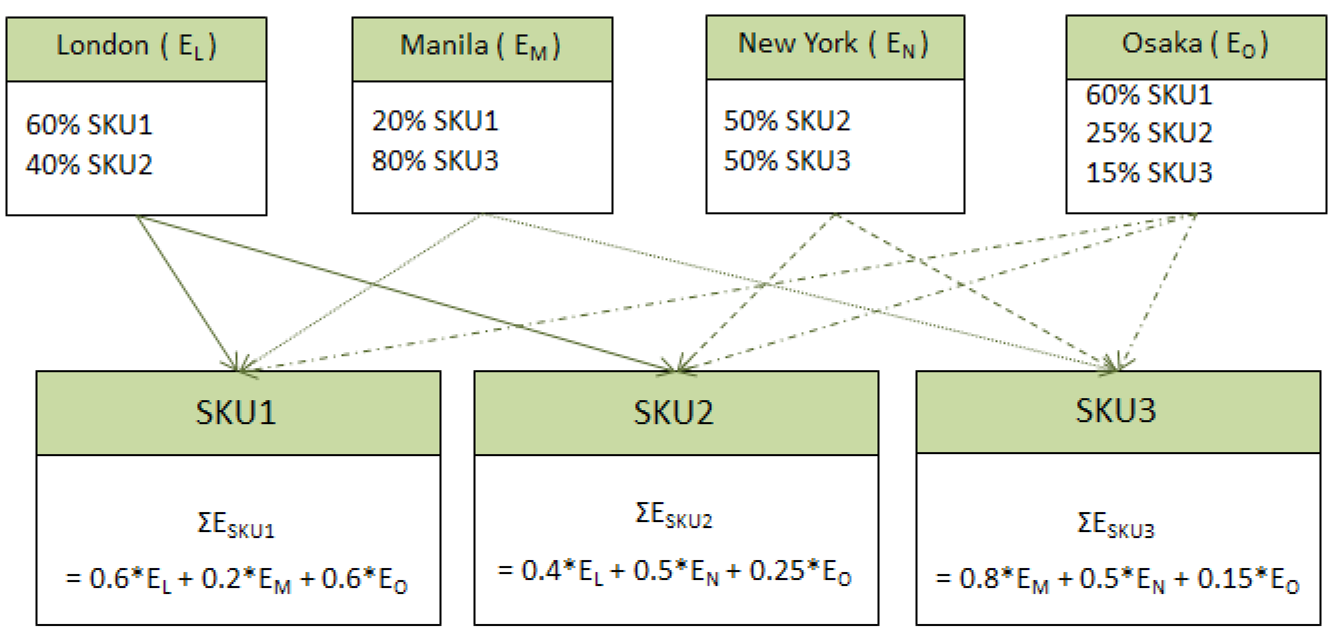
Example 2: Apportioning Emissions to Product Types by production volume at facility



SKU-Level Emissions from Manufacturing

Calculate the emissions for an SKU by apportioning product-specific emissions by the fraction of a product that is packaged as a particular SKU. Where possible and relevant, calculate emissions on a plant-by-plant basis to account for differences in emission factors across different production locations.

Example 3: Apportioning Emissions to SKUs



Appendix D:
Base Year Recalculation Guidance Tool

When deciding whether to recalculate the base year greenhouse gas (GHG) emissions, the user walks a fine line between making the data comparable over the years without recalculating the baseline every year. Many circumstances may have caused the metric to shift from the base year emissions. The tool prompts the user to examine the cause of the change through a series of two questions.

Always document the company's decision whether to recalculate or not and why it was made. This will help set precedence for future decisions and allow easy communication with external stakeholders such as sustainability auditors.

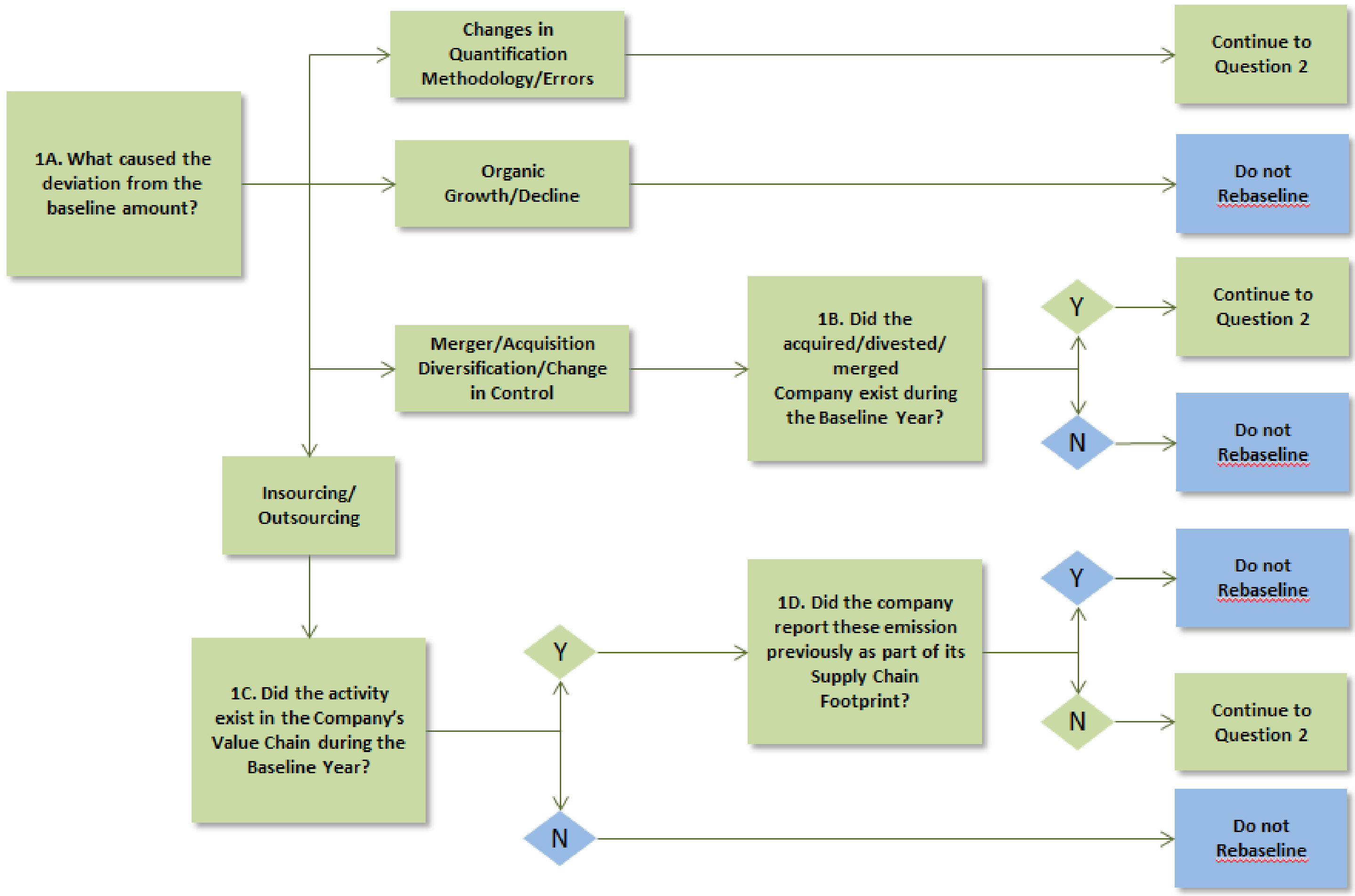
Examples of When Companies May Consider Recalculating Their Baseline:
Structural changes (acquisition, merger, divestiture)
Insourcing / outsourcing
Change in calculation methodology
Discovery of a mistake
Change in product output

Science-Based Targets

This BIER sector guidance can be used both to calculate impact and monitor CO2 emissions, but also to calculate the baseline for Science-Based Targets (SBTs). When recalculating the base year for reasons mentioned in the box above, target recalculation is needed. More criteria and recommendations on this can be found at: http://sciencebasedtargets.org/ and the SBTi criteria document.

More information on Science-Based Targets within the Food and Beverage Processing sector can be found in the BIER Discussion Paper: Science-Based Targets (April 2018). When looking at the Food and Beverage Processing sector, SDA seems to be the most commonly used method. There is no consistent approach in methods used by BIER members, however, as different SBTi methods or own methods have been used.

Question 1: What Caused the Deviation from the Base Year Emissions?



Changes in Quantification Methodology

Calculation methodologies may change as more accurate information becomes available. For example, more precise emissions factors may become available as more tests are conducted. In this case, the user would continue to Question 2.

Discovery of Errors

The user would continue to Question 2 if he/she finds significant errors or a number of cumulative errors that are significant.

Organic Growth/Decline

Organic growth/decline refers to an increase or decrease in production output, change in product mix, or openings or closures of operating units controlled by the company. Changes due to organic growth/decline should not trigger a recalculation of base year emissions. Additionally, if the changes reflect real changes in emissions or emission factors, this is organic growth/decline and the user should not recalculate the baseline emissions. Examples of organic growth are the addition of a new product line and building a new building to keep up with demand. Technology changes may also be organic growth or decline. For instance, installing the most energy efficient boiler, which decreases energy use, is an example of a technological change that falls under organic growth/decline. Process changes are also organic growth/ decline. For instance, using reverse osmosis recovery to decrease water use decreases the number of steps in the water purification process from 5 to 3, which is an example of organic growth/decline.

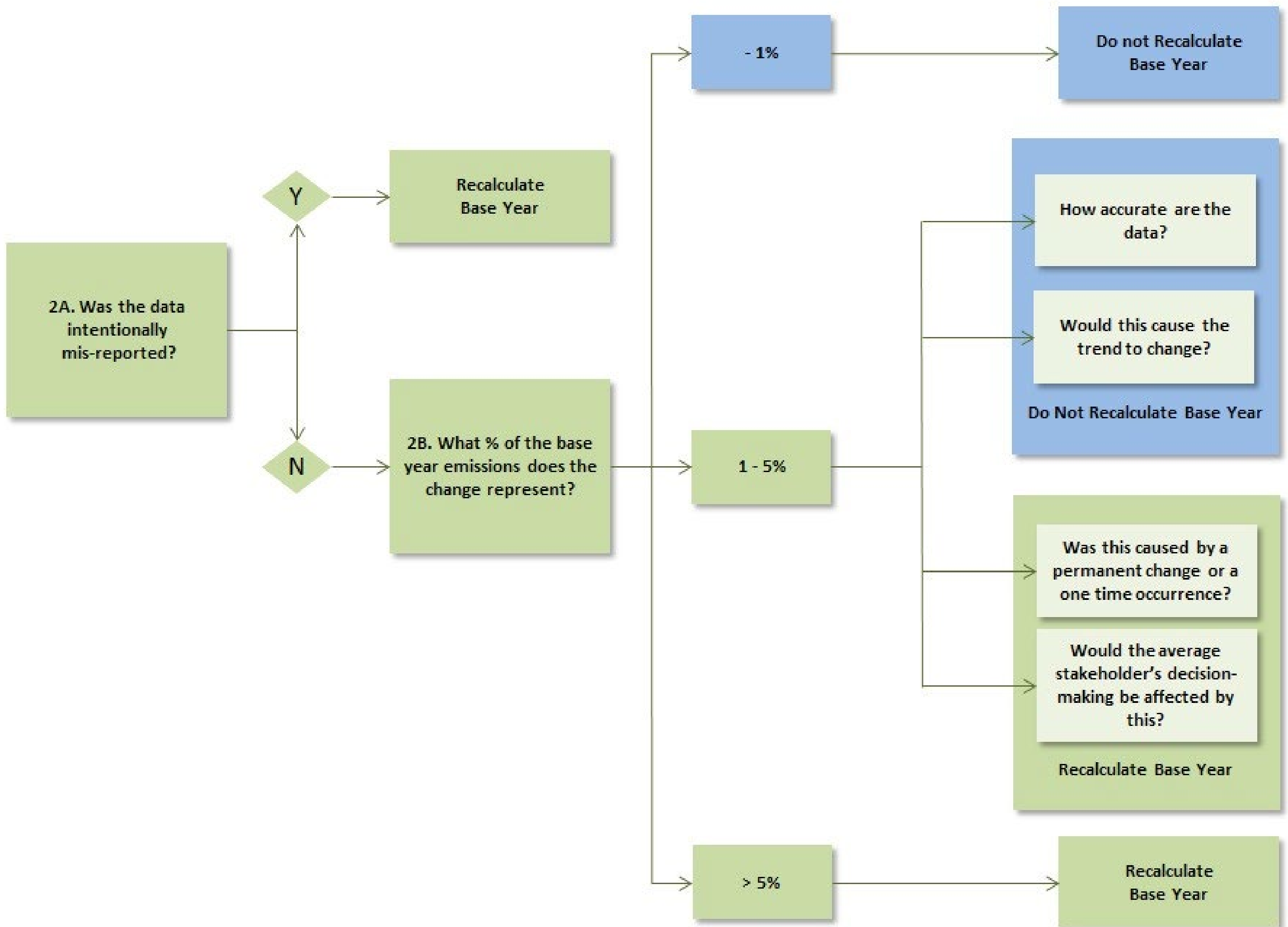
Structural Changes

Structural changes include acquisitions, divestitures, mergers, and changes in control status such as leases. If the entity acquired/divested/merged existed in the baseline year, the user should continue to Question 2. If the entity acquired/divested/merged did not exist in the base year, then it is considered organic growth/decline and the user should not recalculate the company's base year emissions. When a company is using intensity based targets (i.e., Kg CO_2eq/L of product), recalculations for structural changes are not usually needed unless the structural change results in a significant change in the GHG intensity

Insourcing/Outsourcing

This refers to insourcing/outsourcing of activities in the product's value system. Insourcing is defined as conducting activities in-house that were previously contracted. Outsourcing is contracting activities previously conducted internally. If the activity occurred in the company's value system during the base year, the next question is whether the company reported these impacts. Under some GHG reporting protocols, when carrying out a life cycle assessment, the company may have been reporting emissions from its supply chain. If the company has not reported these impacts, then continue to Question 2. In other cases do not recalculate the baseline.

Question 2: Is the Change Material/Significant?



If the user ended Question 1 in a green box, he/she should continue to Question 2 to evaluate the significance of the change. A material or significant change is one that would reasonably affect a stakeholder's decision making. To make this determination, a user must examine how the data will be used by the stakeholder.

Were the data intentionally misreported or did they conceal an unlawful transaction?

The answers to each of the last four questions alone should not determine whether a company should recalculate its baseline. Rather, all four of questions taken as a whole should be considered when the decision is made.

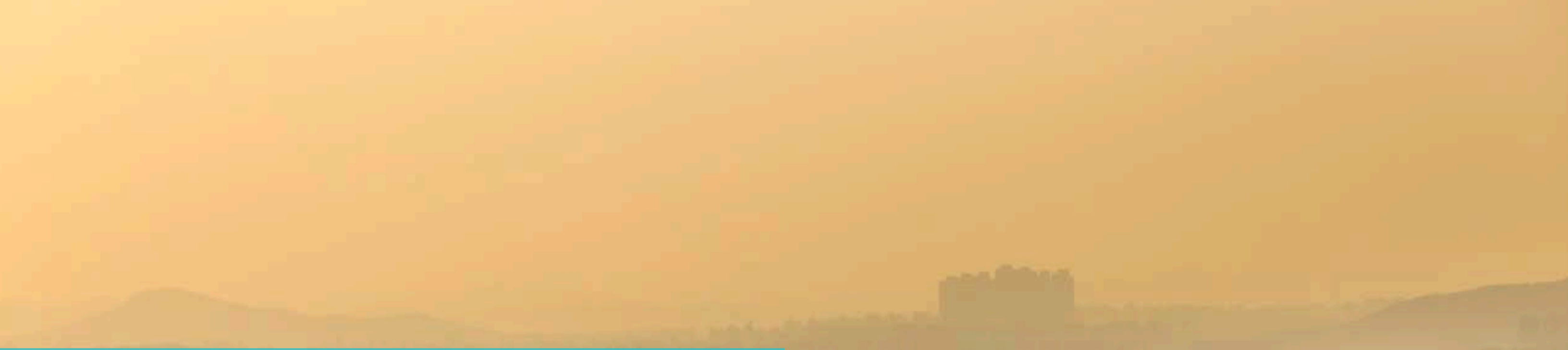
- How accurate are the data?
- Would this cause the trend to change?
- Was this caused by a permanent change or a one-time occurrence?
- Would a reasonable stakeholder's decision making be affected by this?

How to Recalculate the Base Year Emissions

If a company decides to recalculate its baseline, it should collect the environmental metric for the year that the baseline was set and then add this number to the baseline. If this historical information is not available, the user can extrapolate the base year emissions from production data by taking the current ratio of emissions to production and multiplying it by production for the baseline year. If this is not a possibility due to data constraints, the user can take the amount of change in the current year and add it to the baseline emissions. When recalculating base year emissions, the user should account for all of the changes that have occurred since the last time base year emissions were recalculated.

When changes occur mid-year, recalculations should be done for the entire year, rather than just the remainder of the year. This avoids recalculating baseline emissions again in the succeeding year. The company can decide if it would like to report the updated environmental metrics for the years in between the base year and the reporting year.

Reason for Change	Change Category	Action
Divestiture of a company that did not exist in the baseline year	Organic decline	Do not recalculate base year emissions
Building a new plant	Organic growth	Do not recalculate base year emissions
Add a line to an existing plant	Organic growth	Do not recalculate base year emissions
Change in product output (i.e., deliver beverage in a powder form instead of a bottle)	Organic growth	Do not recalculate base year emissions
Purchase own transportation fleet	Insourcing	May recalculate base year emissions
Transport of third-party products (other than company-manufactured) in own transportation fleet	Outsourcing	May recalculate base year emissions
Metered the plant to obtain more accurate energy use estimates	Improvement in accuracy of activity data	May recalculate base year emissions
Discovery of falsified data by an employee responsible for reducing energy use in plants	Error	Recalculate base year emissions



Appendix E:
How to Report Purchased CO_2

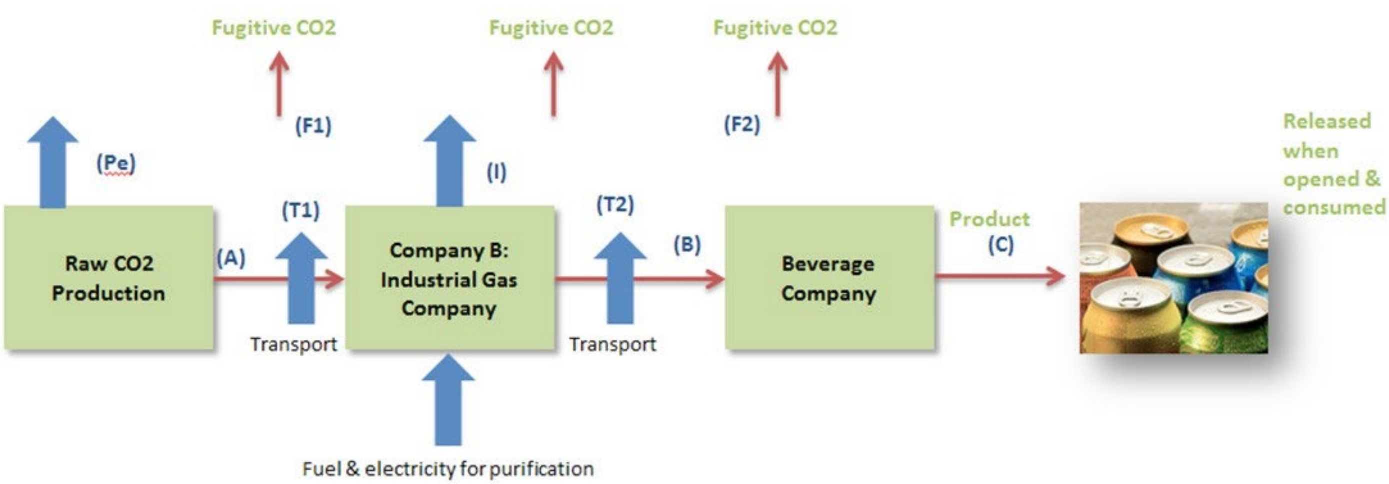
Much confusion exists in the industry regarding the methodology for properly allocating the ingredient 'purchased CO_2' for carbonization of a beverage. Therefore a more detailed explanation on how to properly allocate this ingredient follows.

Accounting for the GHG emissions associated with the purchase of CO_2 ingredient is very particular and requires special attention as it can have a meaningful influence on the carbon footprint. The allocation depends on the raw source of the CO_2 ingredient. Today the following raw CO_2 ingredient sources are available:

1. Biogenic source
2. Fertilizer industries
3. Co-generation from a combined Heat & Power plant
4. Fossil sources, like natural well or burning fossil fuel with the pure purpose of producing raw CO_2.

Depending on the source used in the supply chain there are the following allocations. The basic supply chain is illustrated below:

Figure E1: CO_2 Supply Chain



1. **Biogenic source, which is the easiest allocation:**

   Note: Ingredient CO_2 is not included in value chain carbon footprint (scope 1 or 3).

   Producing company: report the CO_2 separately as BIO-source CO_2 emission.

   Beverage company report Scope 3: only include CO_2e related to transport and processing to food grade,

   Scope 3: Ingredients CO_2 = T1 + T2 + I

2. **Fertilizer industry as source:**

   a. Under the new European Trading Scheme rules, which defines a straightforward allocation that mitigates any double counting.

   Fertilizer Industry: Scope 1: Pe + A (100% allocation of the fuel combustion)

   Industrial gas company: Scope 1 & 2: Energy I

   Beverage company: report Scope 3: Only include CO_2e related to transport and processing to food grade,

   Scope 3: Ingredients CO2 = T1 + T2 + I

   b. Under the old WRI-GHG protocol

   Fertilizer Industry: Scope 1: Pe

   Industrial gas company: Scope 1: Fugitive F1 = A□B

   Scope 1 & 2: Energy I

   Scope 3: T1 +T2+ A k

   Beverage company: **Scope 1: Fugitive F2 = B-C**

   Scope 3: Ingredients CO_2 = T1 + T2 + I +C

3. **Co-generation from a combined Heat & Power plant on site:**

   Note: if the combined heat & power plant isn't under the control of the beverage company then we have the same allocation as in 2a for the beverage company!

   Beverage company: Scope 1: NO Fugitive CO_2- Manufacturing CO_2e from CHP energy already reported Scope 1!

   Scope 1: Fuel = already reported under the CHP production.

   Scope 3: **No scope 3 ingredient CO_2 for beverage producer** everything is reported under Scope 1 & 2.

   Practically this means that for CO2 ingredient you don't have any allocation because it's already reported under other elements.

4. **Fossil source, like natural well or burning fossil fuel with the pure purpose of producing raw CO_2.**

   Raw CO2 Production Company: Scope 1: PE

   Industrial gas company: Scope 1: Fugitive F1 = A□B

   Scope 1 & 2: Energy I

   Scope 3: T1 +T2+ A k

   Beverage company: **Scope 3: Ingredients CO2 = Pe + T1 + T2 + I +C**

   Note: k = physical allocation factor

Appendix F: Cultivation Calculation Example

The following calculation example shows how emissions for the cultivation step can be calculated. The fictional example relates to the beer value chain.

Step 1 - Activity Data, see data requirements

- Ingredient = Barley
- Country of production = Argentina
- Annual yield = 3.6 ton / ha

Step 2 - Calculate Emissions Factor

Barley yield in Argentina is 3.6 ton per ha according to FAO data (5 year average). Based on this yield and the assumed relation between barley yield and inputs, column two states the estimated input use for barley in Argentina. In the following table, an example is given for calculating the total kg CO_2eq per hectare.

Input	Estimated Quantity	Parameter (kg CO_2eq/unit)	Emission (kg CO_2eq/ha)
Diesel (kg/ha)	69	3.5	242
Electricity (kWh/ha)	81	0.5	41
N fertilizer (kg N/ha)	92	12.2	1,122
P_2O_5 fertilizer (kg P_2O_5/ha)	44	1.44	63
K_2O fertilizer (kg K_2O/ha)	0	0.44	0
N in crop residues (kg N/ha)	41	5.74	235
Land use change (m^2/ha)[5]	364	48.3	17,570
Total GHG Emission of barley cultivation in Argentina			**19,274**

5 Data for this calculation example was sourced from http://www.agri-footprint.com. In case no deforestation has happened in the past 20 years, the land use change emissions are zero. There are different datasets / tools to calculate land use change. Some are open-source (e.g. datasets are included in the PEF database) and some are available against a fee.

Step 3 - Emissions per Ton

To calculate the emissionsper ton of barley:

1. As an industry typical example, 77% of the emissions from barley cultivation are economically allocated to the barley, 23% are allocated to the co-products (e.g. straw);
2. The total barley emission per hectare are divided by the yield (3.6 ton/ha).

Emission per ton Barley	=	Total emissions/ha	x	allocation	/	yield
(kg CO_2eq/ton)		kg CO_2eq		(%)		(Ton/ha)

EF = Total * allocation / yield = 4,123 kg CO_2eq per ton.

Appendix G:

Calculation Examples for Emissions from Spirits Production

The following calculation example shows how emissions for the spirits production can be calculated.

Example: Product Maturation

To determine the GHG emissions per unit of product, the emissions for each stage of manufacture must be calculated while taking into account the material lost during the maturation process.

The most recent accounting year (e.g., calendar year, fiscal year, rolling consecutive 12-month period) GHG Scope 1 and Scope 2 emissions are as follows:

Distillation:	100 tons CO_2eq emitted (100 wine liters of distilled whisky produced) ED = 1 ton/L
Aging (Warehouse):	10 tons CO_2eq emitted (per year) EW = 10 ton/yr Aging loss (AL) = 10 wine liters of whisky per year in storage Warehouse space that each year's inventory occupies (W) = 25%
Bottling:	60 tons CO_2eq emitted (60 wine liters of whisky bottled) EB = 1 ton/L

The life cycle calculation starts with the finished product produced during the selected accounting year. This will be used to determine how much material was distilled at the beginning of the product's life cycle. For this example, our final volume of product bottled is 60 wine liters, so product distilled four years ago is determined as follows:

Term	Units
AL = Aging loss	L/yr
VolD = amount of product distilled	L
N = Number of years in storage	Yr
ED = emissions from distillation	Tons CO_2eq/l
EW = emissions from warehousing	Tons CO_2eq/yr
EB = emissions from bottling	Tons CO_2eq/l
W = % space in warehousing	%

Amount of Product Distilled (VolD)[6] = Bottling + (AL)*N

VolD = 60 + (10)*4 = 100 wine liters

So the GHG emissions associated with the distillation of this year's finished product are:

Distillation GHG = VolD * ED

Distillation GHG = 100L * 1 ton/L = 100 tons CO_2eq

The next step is to calculate the GHG emissions contribution for the product each year the product was in the warehouse[7]:

Warehouse GHG = warehouse GHG emissions * % of space in warehouse * number of years in storage

Warehouse GHG = EW * W * N

Warehouse GHG = 10 * 25% * 4 = 10 tons CO_2eq

The final step is to add the GHG emissions from distillation and warehousing to the emissions from bottling to generate the total GHG emissions within the spirits manufacturer[8].

Spirits GHG = Distillation GHG + Warehouse GHG + Bottling GHG[9]

Spirits GHG = 100 tons CO_2eq + 10 tons CO_2eq + 100 tons CO_2eq = 210 tons CO_2eq

Spirits GHG	Warehousing GHG	Distilling GHG	Bottling GHG
(tons CO_2eq)	(tons CO_2eq)	(tons CO_2eq)	(tons CO_2eq)
	Vol+AN*N*EW	VolD*ED	W*N*EW

The total GHG emissions are then divided by the final volume of product bottled to calculate the manufacturing portion of the product life cycle:

210 tons CO_2eq / 60 wine liters product = 3.5 tons CO_2eq /L

The manufacturing emissions are then added to the emissions from the other segments (raw materials, transportation, distribution, retail/sales/marketing, consumer and end-of-life) to determine the final GHG per unit of product.

6 The volume distilled should also be used to determine the volume of raw materials required; this information will then be used to calculate the appropriate supply chain GHG emissions as described in this document.

7 Most producers that handle matured products have a means to calculate their product losses during maturation. Company loss factors may vary; in this example, the loss factor is a simple constant (10 wine liters/year) for that warehouse. Other common methods include: an annual %loss (this assumes a first-order loss curve); or an estimated initial %loss (e.g., from evaporation, spillage, product soaking into the barrel) plus an annual %loss (again, a first order loss curve from, e.g., evaporation, leakage). Producers have flexibility to use the loss factor or loss equation that they believe provides the best estimate for losses. The method used should be consistent with other internal accounting practices and the producer should provide an explanation of how the losses were estimated and any assumptions made.

8 This equation assumes that all portions of the operation are completed in the same location and no transportation by a mobile source is required (e.g. pipeline transport only). However, transportation emissions must be included if product is transported between production locations by a mobile source.

9 Bottling emissions must include any operations used to transfer the product from one container to another, any filtration or proof gauging operations (including the production and addition of treated water or other ingredients), sanitation of production equipment, and any bottling, palletizing, and warehousing associated with the final product.

Example: Blended Product - Different Suppliers

Blended product composition: 20% Product 1; 15% Product 2; 15% Product 3; 50% Product 4

GHG for Blended Product = (0.2)*(E1) + (0.15)*(E2) + (0.15)*(E3) + (0.5)*(E4) + EBlend

E1 is the total relevant GHG emissions for Product 1[10]

EBlend is the Scope 1 and Scope 2 GHG emissions during the blending and bottling process of the final product.

For complex blends (products with more than 10 components), an industry average GHG contribution per unit of product may be used in lieu of producer specific data. This approach is recommended for blend ingredients that make up less than 5% of the total volume of the final product.

10 The products supplied by third parties should use the methods described in this guidance to calculate the GHG emissions from production. Information on the relevant GHG emissions for these products may not be available. In this instance, the producer will need to use secondary data or if the suppliers' operations are similar to that of the producer, the site-specific emission factors and aging loss factors can be used to estimate the relevant GHG emissions for these products. The methods used and assumptions should be clearly described by the producer.

Appendix H:
Guidance for Calculation of Packaging Material Emissions

Our packaging materials have environmental impact in their production phase and in “End of Life”. Packaging materials can be recycled after use to make new packaging (closed loop) or other applications (open loop).

Packaging becomes more sustainable if it:

- contains a larger proportion of recycled/secondary materials, which is the “**Recycled Content**”; and
- is collected and recovered for new (packaging or other) products, referred to as the “**Post Consumer Recycling Rate**”.

Both Recycled Content and Post Consumer Recycling Rate need to be taken into account for packaging material emissions through a balanced “allocation factor”, which divides burdens and benefits of recycled materials from a supplier and user perspective. The allocation split depends on the type of packaging material (glass, aluminum, steel, PET, etc.). Based on the EU PEFCR guidance[11], allocation factors are 50/50 for PET and 20/80 for glass, aluminum and paper packaging material.

For materials with the 20/80 allocation factor, this means that when you use recycled material as input material for your packaging, you get 20% of the burdens and benefits of avoided emissions through recycling (“the supply efficiency”). The other 80% go to the supplier of this secondary material. After use, (part of) your bottle will be recycled and used as input material by others. You can account for 80% of the burdens and credits of these avoided emissions (“the end-of-life efficiency”).

The EU developed a “Circular Footprint Formula” that became mandatory for PEF pilots (beer, wine, packed water). It is arranged in a modular way:

1. Cradle to gate production burdens (including “burdens and benefits” related to secondary materials input (**Recycled Content**).
2. Additional information from the End of Life stage where there are “burdens and benefits” related to secondary materials output (**Post Consumer Recycling Rate**). For materials not recycled, there are some benefits via energy recovery (when plastics are burned with waste for example) or when materials are disposed.

11 European Commission, PEFCR Guidance document, - Guidance for the development of Product Environmental Footprint Category Rules (PEFCRs), version 6.3, December 14 2017.

The Circular Footprint Formula

1. Cradle to gate emissions

Production burdens from virgin material:

$$(1 - R_1)\ E_v$$

Burdens and benefits related to secondary materials input (i.e. recycled content):

$$R_1 * (A * E_{recycled} + (1 - A)\ E_v * (Q_{s,in}/Q_p))$$

2. End of Life

Burdens and benefits related to secondary materials output (i.e. post-consumer recycling):

$$(1 - A)\ R_2 * (E_{recyclingEoL} - E_{*v} * (Q_{s,out}/Q_p))$$

Energy recovery:

$$(1 - B)R_3 * (E_{ER} - LHV * X_{ER,heat} * E_{SE,heat} - LHV * X_{ER,elec} * E_{SE,elec})$$

Disposal:

$$(1 - R_2 - R_3)*E_D$$

R_1: proportion of recycled material in the product

E_v: emissions due to use virgin material

A: allocation factor of burdens and credits between supplier and user of recycled materials

$E_{recycled}$: emissions due to recycling process input material

$Q_{s,in}/Q_p$: quality of ingoing recycled material compared to virgin material

R_2: proportion of the material that will be recycled

$E_{recyclingEoL}$: emissions due to recycling process at EoL

E_{*v}: emissions avoided due to avoided use virgin materials

$Q_{s,out}/Q_p$: quality of outgoing recyclable material compared to virgin material

B: allocation factor energy recovery = 0

R_3: proportion of the material that will be used for energy recovery

E_{ER}: emissions due to energy recovery

LHV : Lower Heating Value of the material

$X_{ER,heat}$: efficiency of the energy recovery process for heat

$E_{SR,heat}$: emissions avoided due to heat production

$X_{ER,elec}$: efficiency of the energy recovery process for electricity

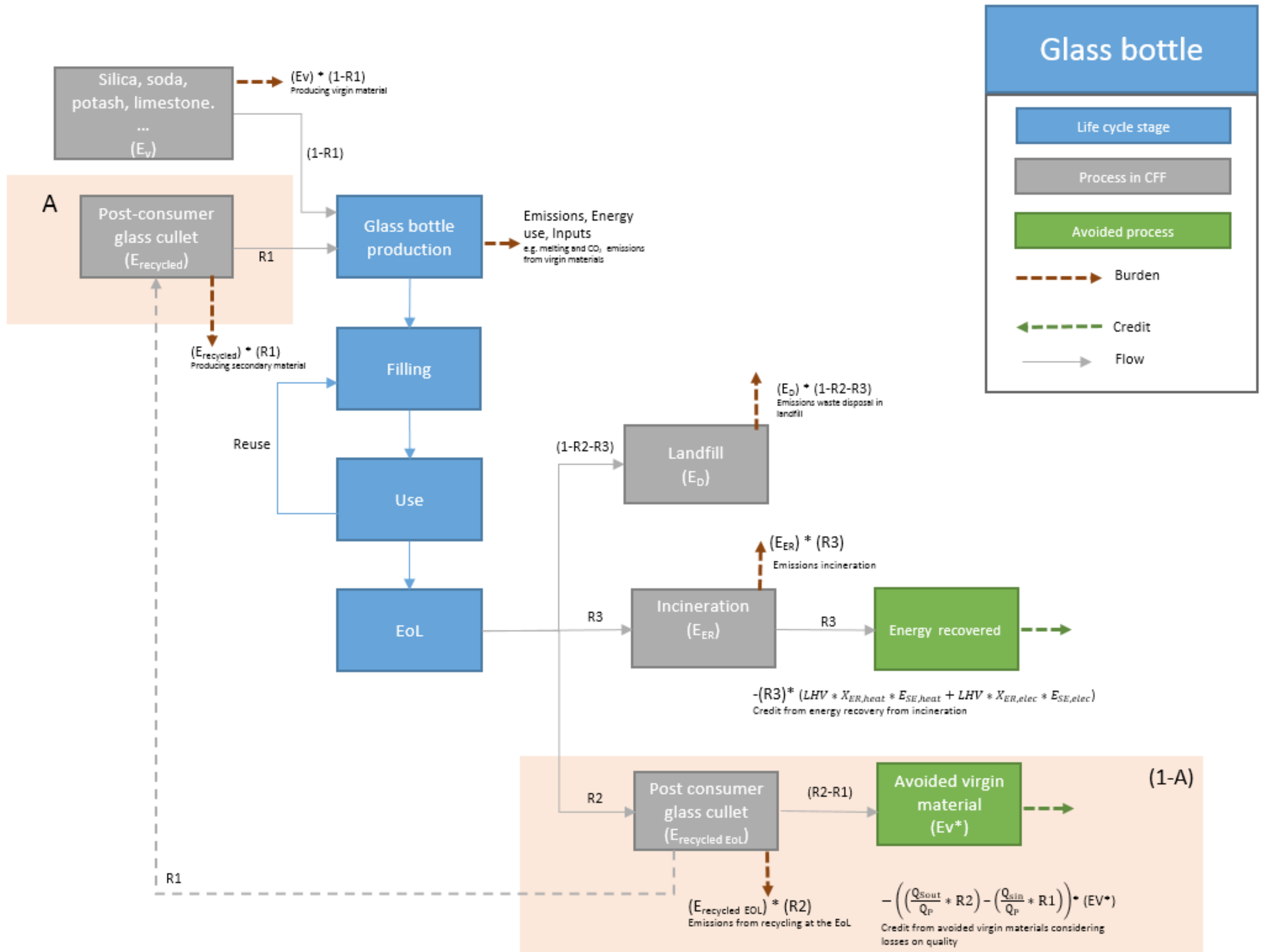
$E_{SE,elec}$: emissions avoided due to electricity production

E_D: emissions due to disposal

The Circular Footprint Formula (CFF) can be used for all packaging types and can also be used when primary data from suppliers is available. BIER has developed a tool for members to utilize for calculating the packaging carbon footprint using the CFF with primary (main tool focus) and/or secondary supplier data. Given the tool comprehensively covers primary data calculations, the following provides examples for packaging calculations (PET, glass and aluminum) where only secondary data is available.

Calculation Example 1: Glass Bottle (based on secondary data)

The fictional example below shows how the carbon emissions related to a glass bottle are built up. The activity data (e.g. emission factors) for this example is taken from background packaging matrices.



Step 1.1: Production burdens from virgin material

We look at a bottle that is made of 52% recycled glass (R_1).

The emissions for virgin material are 1.07 kg CO_2eq per kg glass (E_v).

Emissions from virgin input material = (1 - 0.52) * 1.07 = 0.51 kg CO_2eq / kg glass bottle

Step 1.2: Burdens and benefits related to secondary materials input

The allocation factor for using recycled glass (A) is 0.20 (i.e. the 20 from the 20/80 split).

The emissions from recycling process for input material are 0.616 kg CO_2eq per kg glass ($E_{recycled}$).

The quality of recycled glass is the same as of virgin glass ($Q_{s,in}/Q_p = 1$).

Emissions from recycled input material with benefits = 0.20 * 0.616 = 0.123 kg CO_2eq / kg

Emissions from recycled input material without benefits = (1 - 0.20) * 1.07 * 1 = 0.856 kg CO_2eq / kg

Total emissions recycled material = 0.52 * (0.123 + 0.856) = 0.51 kg CO_2eq / kg glass bottle

Step 2.1: Burdens and benefits related to secondary materials output

The allocation factor is 0.80 (1 – A), i.e. the 80 from the 20/80 split.

66% of our bottle will be recycled at EoL (R_2).

The emissions due to recycling process at EoL are 0.616 kg CO_2eq per kg glass ($E_{recyclingEoL}$).*

The quality of recycled glass is the same as of virgin glass ($Q_{s,out}/Q_p = 1$).

Emissions from recycling material EoL = (1 - 0.20) * 0.66 * (0.616 – 1.07 * 1) = - 0.240 kg CO_2eq / kg glass bottle

**In this example, $E_{recycled}$ and $E_{recyclingEoL}$ are the same (based on secondary data). They can however differ, since the recycling can take place in different systems.*

The total carbon footprint from the material of the glass bottle then becomes 0.78 kg CO_2eq / kg glass bottle.

Step 2.2: Energy recovery

In this example we look at the Netherlands where 97% of the non-recycled waste is incinerated. For this example where 66% of the material is recycled, this means 0.97 * (1 – 0.66) = 32.98% of material is incinerated (R_3).

The emission factor for glass (emissions from energy recovery (E_{ER}) – avoided emissions from generated heat energy (LHV * $X_{ER,heat}$ * $E_{SE,heat}$) – avoided emissions from generated electric energy (LHV * $X_{ER,elec}$ * $E_{SE,elec}$)) is 0, because glass is an inert material.

Emissions from energy = (1 – 0) * 0.3298 * 0 = 0 kg CO_2eq / kg glass bottle

Step 2.3: Disposal

The emissions from disposal for glass are 0.0274 kg CO2eq / kg glass (ED).

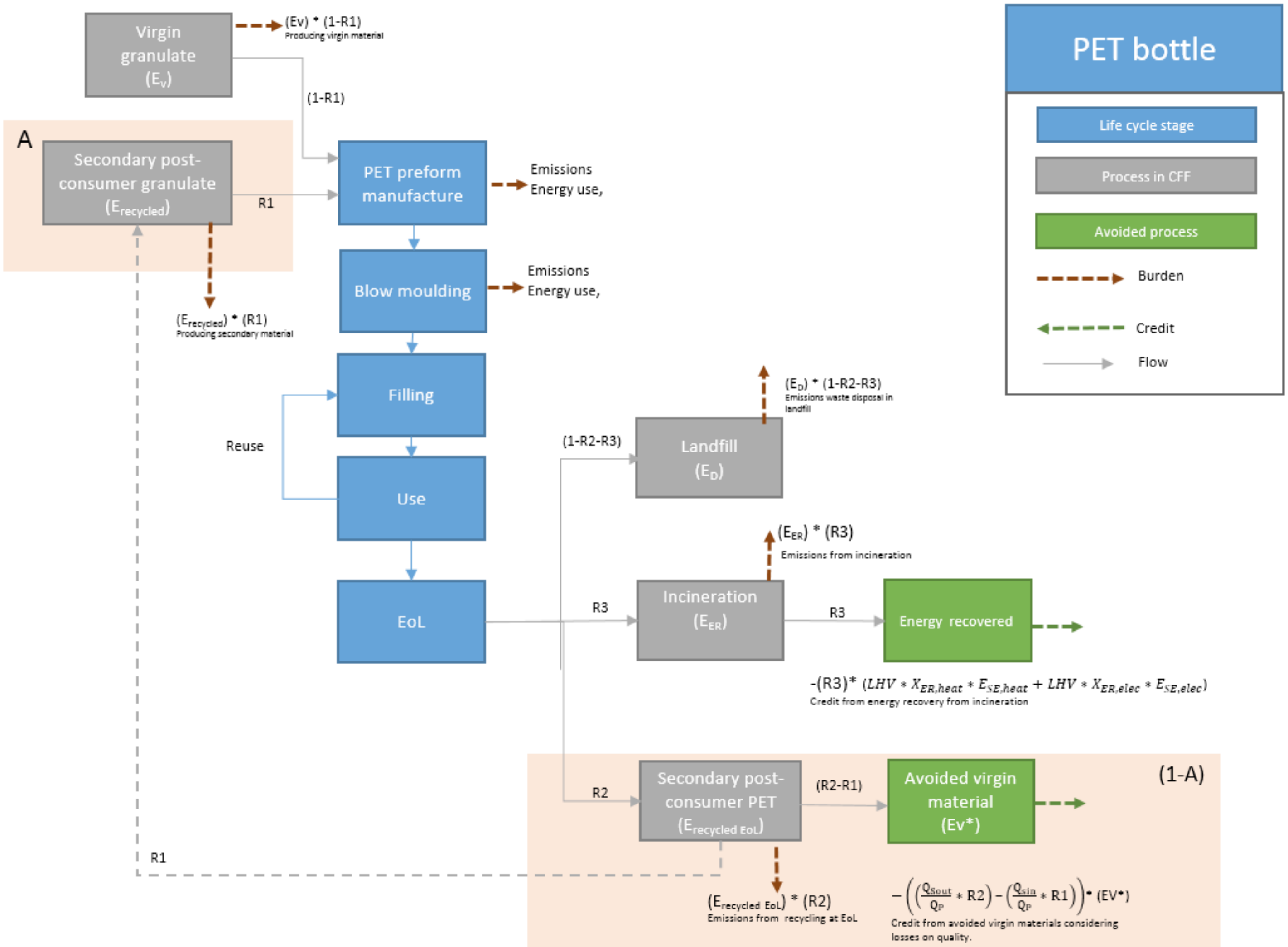
Emissions from disposal of our glass bottle = (1 – 0.66 – 0.3298) * 0.0274 = 0.0003 kg CO_2eq / kg glass bottle

CFF glass bottle = 0.78 + 0 + 0.0003 = 0.78 kg CO_2eq / kg glass bottle

For a glass bottle with a volume of 30 cl and a glass weight of 220 g, the carbon footprint amounts to 57.20 kg CO_2/hl.

Calculation Example 2: Plastic Bottle (based on secondary data)

The fictional example on the following page shows how the carbon emissions related to a plastic bottle are built up. The activity data (e.g. emission factors) for this example is taken from background packaging matrices.



Step 1.1: Production burdens from virgin material

We look at a bottle that is made of 100% recycled PET (R_1).

The emissions for virgin material are 2.21 kg CO_2eq per kg PET (Ev).

Emissions from virgin input material = (1 - 1.00) * 2.21 = 0 kg CO_2eq / kg PET bottle

Step 1.2: Burdens and benefits related to secondary materials input

The allocation factor (A) for using recycled plastic is 0.50 (from the 50/50 split).

The emissions from recycling are 0.73 kg CO_2eq per kg PET ($E_{recycled}$).

The quality ratio of source-separated recycled PET is the same as of virgin PET ($Q_{s,in}/Q_p$ = 1).

Emissions from recycled input material with benefits = 0.50 * 0.73 = 0.366 kg CO_2eq / kg

Emissions from recycled input material without benefits = (1 - 0.50) * 2.21 * 1 = 1.10 kg CO_2eq / kg

Total emissions recycled material = 1.00 * (0.366 + 1.10) = 1.47 kg CO_2eq / kg PET bottle

Step 2.1: Burdens and benefits related to secondary materials output

The allocation factor (1 – A) is 0.50 (from the 50/50 split).

42% of our bottle will be recycled at EoL (R_2).

The emissions due to recycling process at EoL are 0.73 kg CO2eq per kg glass ($E_{recyclingEoL}$).*

The quality of recycled PET is the same as of virgin PET ($Q_{s,out}/Q_p$ = 1).

Emissions from recycling material EoL = (1 - 0.50) * 0.42 * (0.73 – 2.21 * 1) = - 0.31kg CO_2eq / kg PET bottle

**In this example, $E_{recycled}$ and $E_{recyclingEoL}$ are the same (based on secondary data). They can however differ, since the recycling can take place in different systems.*

The total carbon footprint from the material of the PET bottle then becomes 1.16 kg CO_2eq / kg PET bottle.

Step 2.2: Energy recovery

In this example we look at the Netherlands where 97% of the non-recycled waste is incinerated. For this example where 42% of the material is recycled, this means 0.97 * (1 – 0.42) = 56.26% of material is incinerated (R_3).

The emission factor for PET in the EU (emissions from energy recovery (E_{ER}) – avoided emissions from generated heat energy (LHV * $X_{ER,heat}$ * $E_{SE,heat}$) – avoided emissions from generated electric energy (LHV * $X_{ER,elec}$ * $E_{SE,elec}$)) is 1.39 kg CO_2eg/kg PET.

Emissions from energy = (1 – 0) * 0.5626 * 1.39 = 0.78 kg CO_2eq / kg PET bottle

Step 2.3: Disposal

The emissions from disposal for PET are 0.034 kg CO_2eq / kg PET (E_D).

Emissions from disposal of our PET bottle = (1 – 0.42 – 0.5626) * 0.034 = 0.0006 kg CO_2eq / kg PET bottle

CFF PET bottle = 1.16 + 0.78 + 0.0006 = 1.94 kg CO_2eq / kg PET bottle

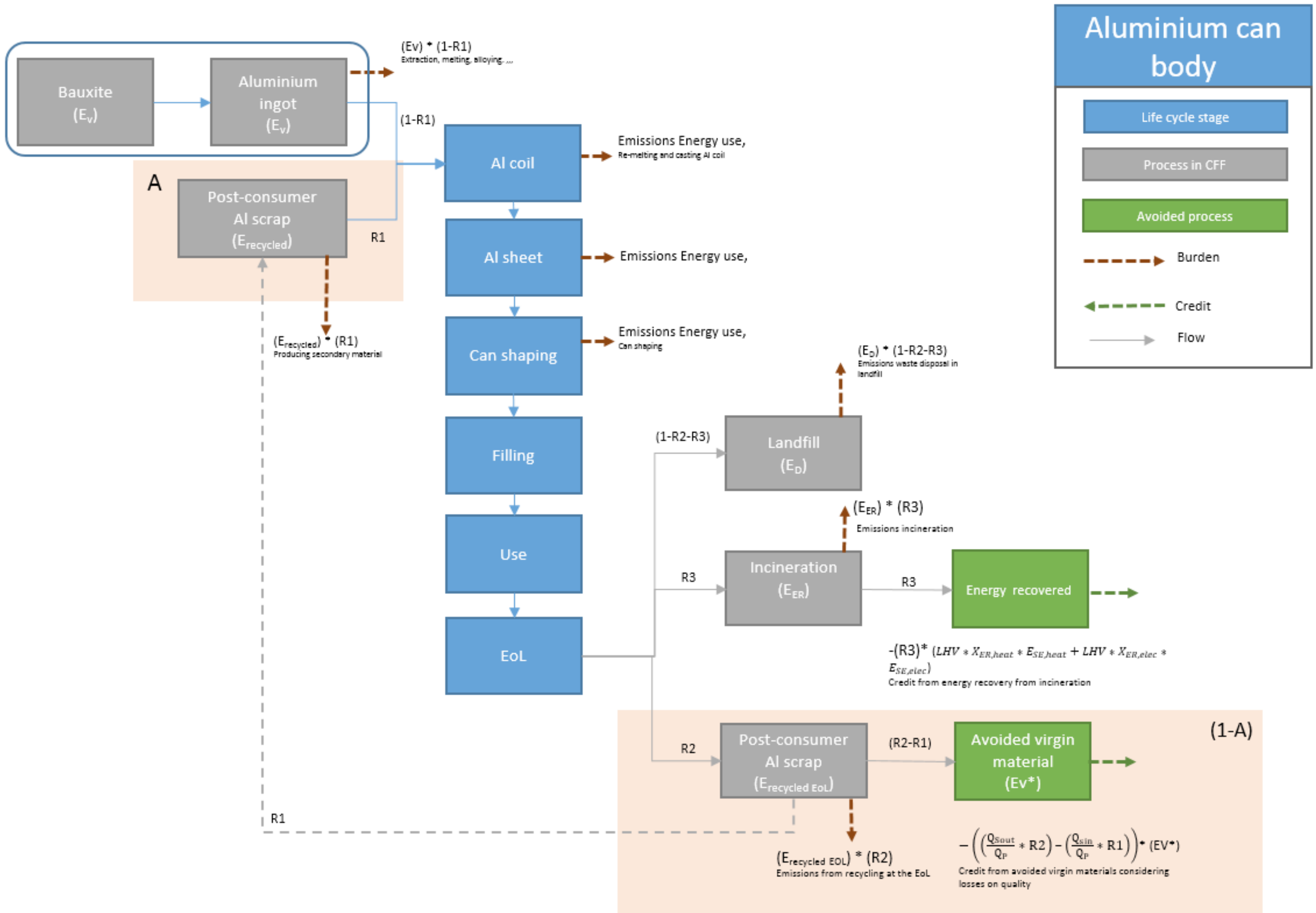
For a PET bottle with a volume of 50 cl and a PET weight of 10 g, the carbon footprint amounts to 3.88 kg CO_2/hl.

Calculation Example 3: Aluminum Can (based on secondary data)

A calculation example for aluminum cans is not currently available as data from European PEFCR initiative was not finalized prior to publication of this guidance document. A calculation example will be incorporated into future versions as accepted data and calculation methods are made available.

Calculation Example 3: Aluminum Can (based on secondary data)

A calculation example for aluminum cans is not currently available as data from European PEFCR initiative was not finalized prior to publication of this guidance document. A calculation example will be incorporated into future versions as accepted data and calculation methods are made available.



Appendix I: Transportation Logistics and Product Distribution

Introduction

Transportation logistics covers all activities required to deliver raw materials and supplies to the company and between company units. Product distribution covers all the activities to deliver product to the final consumer, from the time the product is moved off the site where primary packaging occurs until it is delivered to the point of consumption.

For most companies, most if not all of these activities are Scope 3 (i.e., they are performed by third parties outside the control of the company and hence the company may have limited access to the information needed to accurately calculate carbon emissions).

The majority of the emissions from transportation logistics are likely to come from different forms of transport and this guidance appendix will aim to assist companies in identifying and quantifying these emissions. This guidance document is based on the WRI/WBCSD *Greenhouse Gas (GHG) Protocol – Guide to Calculating* CO_2 *Emissions* from Mobile sources[12].

Due to the level of detail in the above document, this guidance does not seek to replicate it completely but rather to use it as a reference to provide a pragmatic approach for company usage when assessing the impact of logistics within the beverage industry.

Details on the specifics of The GHG Protocol guidance are available on The GHG Protocol website.[13] There is frequent reference throughout this document to *The GHG Protocol – Guide to Calculating* CO_2 *Emissions* from Mobile sources, which will be referred to henceforth as the *"GHG protocol mobile guide"*.

Operational Boundaries

Each company will need to define the scope of its corporate GHG inventory and its operational boundaries in accordance with Section 3 of this Sector Guidance document. Any significant emissions from transportation, including raw material procurement and product distribution, that are directly attributable to the company (Scope level 1) should be included in the company's carbon inventory. Companies are encouraged where possible to include the entire distribution chain (i.e., delivery up to point of consumption).

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12 WRI &WBCSD, Greenhouse Gas (GHG) Protocol – Guide to Calculating CO2 Emissions (Mobile guide 03/21/05 v1.3). Retrieved from Mobile sources.
13 The Greenhouse Gas Protocol – All Tools. Retrieved 24 September 2009 at http://www.ghgprotocol.org/calculation-tools/all-tools

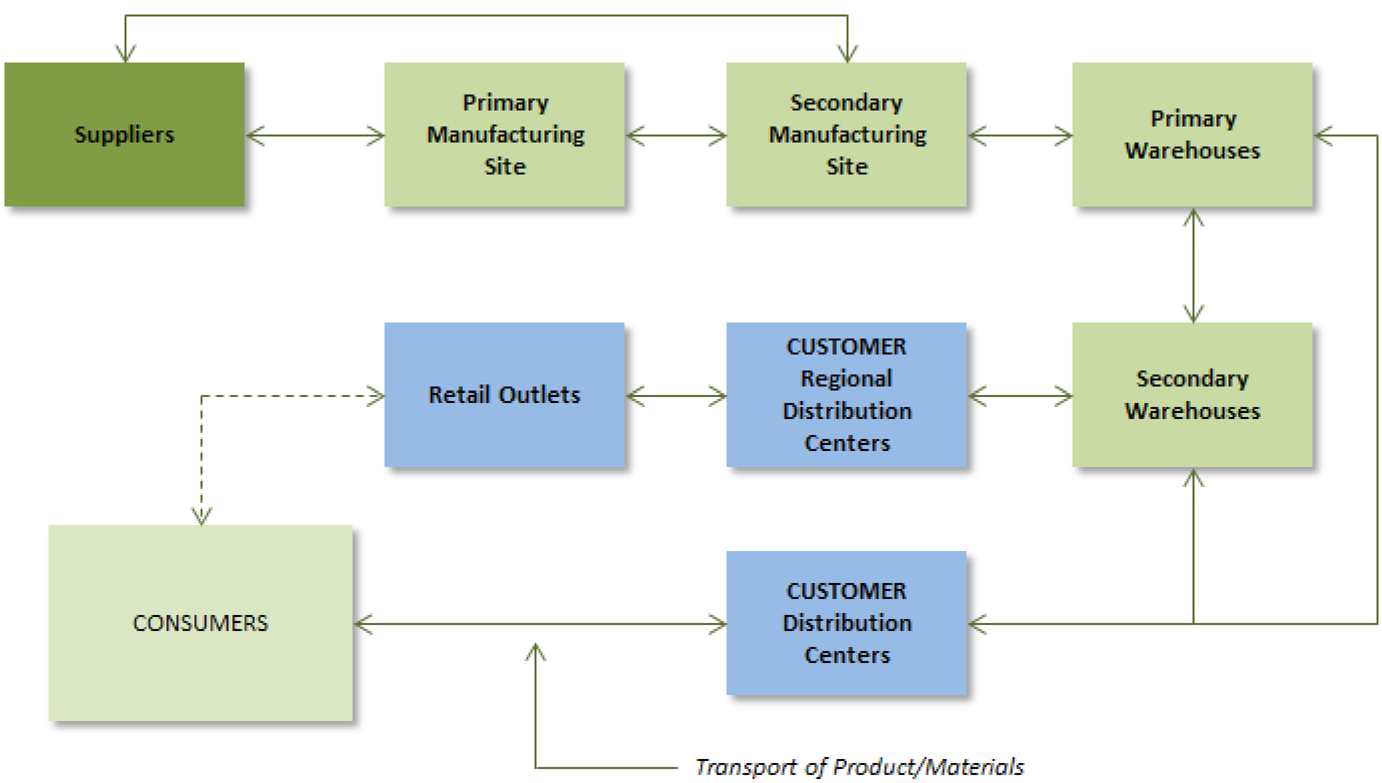
Description of Logistics Activities

The process of delivering raw materials and supplies to a manufacturing site and then distributing the finished products to their point of consumption requires energy and, typically, GHG emissions. The types of activities requiring power or fuel consumption may include:

- Transport by a vehicle or vessel (e.g., truck, train, ship, air carrier);
- Off-loading or on-loading from or to a vehicle or vessel;
- Temporary storage in a warehouse, distribution center or transfer facility;
- Re-packing of product cases or parcels using automated equipment (e.g., for product display such as from closed to open cases of product);
- Delivery by truck to a retail establishment; and
- Storage of the product at the retail establishment until purchased.

The product may be consumed at the point-of-sale or carried home by the consumer for future consumption. For purposes of this guidance, activities such as the act of consumption, storage of the product at the consumer's home and any preparation are not included.

Figure I1: Beverage Industry Value Chain



Suppliers

Activities that occur at the suppliers are likely to be Scope 3 activities for most companies.

Primary and Secondary Manufacturing Sites

Activities at the Primary and Secondary manufacturing sites will be a Scope 1 or Scope 3 activity, dependent on the amount of control over them exercised by the company.

Warehousing and Distribution Centers

Activities at warehousing and distribution centers may be Scope 1 or 3, dependent on the amount of control over them exercised by the company and will include activities such as space heating, lighting, conveying and fork lift truck (FLT) use. Activities associated with logistics, such as any off loading and storage as well as re-packaging, should be included in the emissions of the warehouse.

Also consider emissions associated with fuel and/or power consumption by cargo transfer equipment (e.g., cranes, fork lift trucks, conveyors), as well as fuel and/or power consumption for temporary storage of product between off-loading from inbound transport vehicle or vessel and on-loading to outbound transport vehicle or vessel.

Transportation

Transportation between modal points is likely to be Scope 3 for many companies and would include activities such as the use of trucks, trains, ships or air carriers to move the product or raw material.

Transfers

Transfer of product from one transport vehicle or vessel to another ordinarily occur when there is a change in transport mode (e.g., from rail to truck), but may also occur at government control points. Many transfers would occur at a manufacturing site or warehouse and hence would be included in the emissions from that site; however, some transfers take place during the transportation phase (e.g., loading or off-loading sea vessels or air carriers).

Also consider emissions associated with fuel and/or power consumption by cargo transfer equipment (e.g., cranes, fork lift trucks, conveyors), as well as fuel and/or power consumption for temporary storage of product between off-loading from inbound transport vehicle or vessel and on-loading to outbound transport vehicle or vessel.

Repacking

Product cargo handling involving a change in the shipment packaging (e.g., re-packing into a different type of case or parcel, breaking large shipment units down into smaller shipment units) shall be included. Ordinarily this will be done at a warehouse and should be included in the emissions for that site.

Consider emissions associated with fuel and/or power consumption by automated equipment used for re-packing, and fuel and/or power consumption for facility during the re-packing activity.

Example: Product Distribution

As a simple example, consider a product that is canned or bottled in its primary packaging at the manufacturing site, placed in secondary packaging (e.g., cases), stacked on pallets, and then stabilized with stretch wrap. The pallets are stored temporarily in a holding area, and then loaded onto a freight trailer. The energy for these activities would be covered under the manufacturing site's energy and GHG inventory (Scope 1 and Scope 2). The product distribution portion of the value chain begins when the truck leaves the manufacturing site and begins its journey.

The product may then be shipped over road by a large freight truck to a central distribution center. Product deliveries are managed from this site. The product will be off-loaded from the freight truck and moved to a location in the distribution center for temporary storage. Some of the product may require re-packing to meet the requirements of retail outlets (i.e., the retail customers). The re-packing may be done with automated equipment at the distribution center, or moved to another facility where it is re-packed before being shipped forward. This activity may take place at a regional distribution center closer to the retail outlet. Product is then shipped from the distribution center (or the re-pack facility) onward to market. To reach its destination in the most cost-effective manner, several means of transport may be required (e.g., large freight trucks, rail, ship, air cargo carrier, light delivery trucks). Each point where the product changes shipping mode is a transfer station where product shipping units (e.g., pallets or containers) are moved from the inbound vehicle or vessel (off-loaded) to a storage location, held temporarily until outbound vehicle of vessel for the next freight movement is available, and then transferred onto to that vehicle of vessel (on-loaded).

Product will typically be delivered to a regional distribution center where it will be off-loaded and placed in temporary storage. The distribution center may be owned and operated by the company or by a third-party who distributes product to regional customers for sale to the public. Alternatively, it may be owned by a large retail customer that then distributes the product to one or more of its retail outlets. As previously mentioned, there may be re-packing activities performed at the regional distribution center - for example, large shipping pallets or containers may be broken down into smaller shipments units for delivery to smaller retail outlets.

From these distribution centers, it will be on-loaded to delivery trucks (typically smaller and lighter than long-distance freight trucks) that move the product to the retail outlet where the product is sold for consumption by the consumer.

Product distribution can be quite complex and there are many variations of the example given. Some steps may be skipped while in other cases there may be additional steps (e.g., movement from one large regional distribution center to a second tier of local distribution centers).

Choice of Greenhouse Gases to Consider

The degree of difficulty in calculating transportation emissions depends largely on which gases are included in the analysis. Since N_2O and CH_4 emissions comprise a relatively small proportion of overall transportation emissions, only CO_2 emissions should be included (*GHG protocol mobile guide*). Companies that have primary data relating to other GHGs are free to include them and should include a statement to explain the decision made.

Scope 3 Data

As already mentioned, many activities involving a company's value chain are conducted by a third party and hence Scope 3 data is likely to be required. Scope 3 activities are challenging as there are a limited number of service providers that have sophisticated data management systems and are willing to share their data with customers. In most instances, the company will need to rely on secondary data and simplifying assumptions. The BIER secondary data document contains default data that can be used if specific data is not available.

When reviewing what data are required, the following key variables should be considered:

- The types of vehicles being employed;
- Transport conditions (road, track, sea, air conditions);
- Condition of vehicles and vessels;
- How the vehicles and vessels are operated (e.g., speed);
- How fully loaded the vessels and vehicles are during transport; and
- The routes taken to arrive at the destination.

Compiling a Scope 3 carbon emissions inventory will usually be completed in one of three ways:

1. The company compiling the inventory relies on primary data and information from its shipping companies, wholesalers, retailers and other service providers. The company will need to obtain the carbon emissions associated with each step in the product distribution chain as well as the appropriate share of those emissions that should be attributed to the company's products. The company may rely on the service provider to perform this calculation, but should understand how those calculations are done and ensure that the methodology is generally consistent with the company's protocols.
2. The company obtains basic data from the service provider and performs the necessary calculations. In order to do this, the company will need to obtain the apportionment factor (the amount of product carried or stored by the service provider that is owned by the company) and the basis for this factor. Second, the company needs to obtain data sufficient to make a reasonable estimate of carbon emissions.
3. The company obtains basic data from its own records (i.e., amount of packaging purchased or amount of finished product distributed) and performs the necessary calculations. In order to do this, the company may need to make a number of simplifying assumptions about apportionment factors, distances traveled, etc.. Where sufficient primary data is not available, then default conversion factors may be used in order to make a reasonable estimate of carbon emissions.

Additional factors that need to be taken into account include:

1. Apportionment of the carbon emissions among shared cargo

Many shipments involve vehicles or vessels that haul a range of different products to market. Similarly, distribution centers hold a range of products. The total carbon emitted by any given activity will often need to be allocated to the different products. The allocation method will need to rely on an appropriate unit of measure (e.g., weight, volume) and the company will need to use this measure to estimate an allocation. The measure used and the estimation method and assumptions should be clearly stated. Where primary data is not available, then annual averages may be used and the assumptions made documented.

2. Return trips

This point is in regard to vehicles and vessels that, having delivered the product shipment, then return for the next shipment. The return trip will require energy and carbon emissions and need to be properly accounted. If the vessel or vehicle carries a cargo on the return trip, the company may omit the carbon emissions from its inventory, attributing those emissions to inbound cargo. If the vehicle or vessel is known to be empty, however, then it is generally appropriate to include the carbon emissions from this inbound trip as part of the company's product distribution. Where specific details are not known, then the BIER assumptions guide should be followed.

3. De minimus contributions

Finally, the product distribution network will often include small entities or activities that have a de minimus contribution to the overall carbon inventory. The entity compiling the carbon inventory will need to decide how to address these small contributors (e.g., whether to create a simplifying assumption to provide a gross estimate to cover all small activities in a given category or simply to omit the activity). See *Section 4* of the Sector Guidance document for further information about establishing de minimus contributions. The entity will need to establish some criteria that constitute a "de minimus activity," the basis for that determination and clearly state how and when this de minimus threshold was applied.

Calculation Methodology for Transportation

For logistics emission sources, either a fuel-based or distance-based methodology to calculate CO_2 emissions can be used. Because the data on fuel is generally more reliable, the fuel-based method is the preferred approach for the companies to use. The distance-based method should be used if sufficiently accurate primary data on fuel is unavailable. As the majority of logistics activities are likely to be Scope 3 for most companies, it is unlikely that accurate fuel data will be available and hence the distance-based method is more likely to be used.

A basic description of the fuel and distance methodologies is given below. For more detail companies should refer to the *GHG protocol mobile guide*.

Fuel-based Approach

In the fuel-based approach, fuel consumption is multiplied by the CO_2 emission factor for each fuel type. To use the fuel-based approach, the following forms of data should be available: transportation-specific fuel purchase records, direct measurement of vehicle fuel gauges, or financial records that summarize expenses on fuel.

Step 1 - Gather fuel consumption data by fuel type.

Fuel Use = Distance x Fuel Economy Factor

Note: the units for the fuel economy factor will depend on the type of distance traveled activity data known (e.g., gallons per ton-mile if ton-miles given).

Step 2 - Convert fuel estimate to CO_2 emissions by multiplying results from step 1 by fuel-specific factors.

CO_2 Emissions = Fuel Used x Emission factor

Distance-based Approach

In the distance-based method, emissions can be calculated by using distance-based emission factors to calculate emissions. To use the distance-based approach, the following data should be available: distance activity data by vehicle type, fuel economy factors by vehicle type, and distance based emission factors.

Because there are so many discreet steps involved in bringing product from the manufacturing site to the consumer, and typically so many different entities, the company will often need to employ a number of calculation methods, rely on a variety of data sources and make numerous simplifying assumptions.

Calculating emissions requires two main steps:

Step 1: Collect data on distance travelled by vehicle type and fuel type.

Distance travelled data can basically come in three forms: distance (e.g., kilometres), passenger-distance (e.g., passenger-kms), or freight distance (e.g., ton-miles).

Step 2: Convert distance estimate to CO_2 emissions by multiplying results from step 1 by distance based emission factors.

Appendix B gives default factors for different types of mobile sources and activity data.

CO_2 Emissions = Distance Traveled x Emission factor

Emissions Factors

Appendix B, Directory of Data Resources shows default CO_2 emission factors, depending on fuel type. In the case of road transportation, companies have the option to override these defaults if they have appropriate data on the type of fuel used (i.e., the type and proportion of fuel additives) based on fuel characteristics for geographical regions. To do so, companies should specify the location where fuel is purchased and use default emission factors for that geographic region. Companies may base customized emission factors on company-specific heat rates and/or carbon content coefficients for each fuel combusted. These data may be available from fuel purchase records.

In most cases, default emission factors will be used, based on generic fuel type categories (e.g., unleaded gasoline, diesel, etc.). These emission factors, however, may be customized by using company-specific information on fuel characteristics, based on either: a) company-specific heat rate and/or carbon content coefficient information, or b) the location of gasoline purchases.

BIER Assumptions

The following assumptions can be made if more detailed Primary data is not available. All assumptions made should be clearly documented by the company.

Use the following table and the map above to reference transportation logistics.

Operation	Key Assumptions	Comments
Overall	Scope - Retailer's Supply Chain and consumption excluded from this guidance.	
	BIER secondary data document contains default data for each transport mode.	
	Deliveries where the customer picks up the product part of the way through the logistics supply chain (i.e., from a port (customer pick-ups)) are included.	
	Deliveries where the supplier takes responsibility for the delivery of raw materials to a manufacturing site are included.	
	Delivery of agency brands (i.e., brands being distributed for another company as part of a contractual agreement) is excluded and should be included in the carbon footprint of the agency company.	
Sea A to B	Distance travelled = straight line from port to port unless specific data available	Factor = 1
	Include the other freight modes used and distance travelled to deliver to and collect from vessel	
	Assume one vessel size used on all routes	See BIER Secondary data
	Vessel utilization (%)	See BIER Secondary data
	Assume port operations covered within CIF	
Truck B to C	Distance travelled is straight line from load to discharge point. If specific data is not available, then use center of population density for the state or country.	
	Add 25% to nominal distances to account for pre- and post- delivery routing of truck.	Factor = 1.25
	Assume a full truck (13.6m / 40 tes gross) trailer used.	See BIER Secondary data
	Ignore the age of equipment used or the impact of fuel efficiency.	
	Assume full vehicle equipment utilization.	See BIER Secondary data
Truck E to F	Use regional CIF for international journeys. If the journey is within one country, then use specific country data if available. Assume that CIF accounts for local driving conditions.	See BIER Secondary data
Rail	Source of motive power determines CIF (i.e., electric, diesel). Use regional CIF for all journeys.	Factor = 1 See BIER Secondary data
	Include all other freight modes used and distance travelled to deliver to and collect from railhead for multi modal journeys.	
	Distance travelled = straight line from load to discharge point.	
Air	Use a Single CIF for long haul and short haul.	Factor = 1 See BIER Secondary data
Warehousing	No automated picking / material handling equipment unless specified.	
	No space heating and / or refrigeration unless specified.	See BIER Secondary data
	Use one CIF for warehousing operations unless otherwise advised.	See BIER Secondary data
	CO2 creation related to repack activities to be counted as 'manufacturing'.	

Fictional Calculation Example

The calculation on the following page shows how the carbon emission from transportation of malted barley is built up. For our fictional example, two transportation steps apply. The first is of the cultivated barley in the United States and its transportation to the processing facility also located in the United States. The second step is transportation of malted barley from the United States to France.

Step 1 - Activity Data

For our fictional example, the following activity data is taken from background transportation matrices.

Transportation of barley to the maltery: 500 km by heavy truck. The amount is 1.25 tonne transported barley for 1 tonne of malt, which is the default conversion factor for malteries.

Transportation of malted barley to the production unit: 6000 km by ocean and 500 km by truck within France.

Step 2 - Emission Factors

The emission factors depend on the transportation type (e.g. EURO5 truck), capacity (e.g. 32t truck), load factor (e.g. 80%) and empty return trip. The relevant emission factors in this example are:

Emission factor heavy truck USA	0.0754	kg CO_2eq/ton*km
Emission factor heavy truck France	0.0743	kg CO_2eq/ton*km
Emission factor ocean (ship)	0.0225	kg CO_2eq/ton*km

Step 3 - Calculating GHG Emissions

The total carbon emission from the transportation of malted barley can then be calculated as:

- Barley from field to malting site, transport by truck: 0.0754 * 1.25 * 500 = 47.1 kg CO_2eq.
- Malted barley transport from malting plant in ship to overseas harbor, transport by ocean: 0.0225 * 1.00 * 6000 = 135 kg CO_2eq.
- Malted barley transport by truck from harbour to brewery: 0.0743 * 1.00 * 500 = 37.2 kg CO_2eq.

The total carbon footprint from transportation then becomes 219.3 kg CO_2eq/tonne malted barley.

Transport Type	Emission Factor	km	Amount	Emissions
	(kg CO2eq/ton*km) *	(km) *	(Tons) =	(kg CO_2eq)
truck transport crop products	0.0754	500	1.25	47.1
truck transport malted barley	0.0754	500	1	37.2
sea transport malted barley	0.0225	6000	1	135.0
Total Emissions				219.3

Emissions = (kg CO_2eq/ton*km) * (km) * (Tons) = (kg CO_2eq)

= emission factor * km * weight

Inventory Quality Assurance/Quality Control

Companies should ensure they follow the guidelines of the BIER GHG sector guidance document for data validation.

Reporting and Documentation

In order to ensure that estimates are independently verifiable, quantitative input data used to develop emission estimates should be clearly documented. For more detail companies should refer to the *GHG protocol mobile guide*.

Conclusion

In calculating transportation related emissions, it is likely that the company will need to make a number of simplifying assumptions so the exercise is manageable while providing a reasonable level of precision. The estimations will rely on:

- Primary data;
- Secondary data;
- Reporting by third-parties (e.g., shipping companies, distribution center operators)

While flexibility is often needed to complete the exercise, it is important to be transparent in the approach taken. The company should clearly identify how the data (Primary and Secondary) and information were obtained, what assumptions were made, and what calculation techniques were employed. Wherever appropriate, the reasons for relying on the data, making the assumptions and using the calculation methods should be explained.

Appendix J:
Guidance for Calculation of Cooling Emissions

Introduction

Life cycle analyses show the importance of cooling emissions for the total life cycle of beverages. Cooling installations (refrigerators, premix, postmix, fountains, vending machines, and draught beer systems) have a significant environmental impact. This impact can roughly be divided into three phases:

- **Production phase:** The production of the cooling unit requires materials (e.g. steel, glass, refrigerants), and energy.
- **Use phase:** Emissions released while cooling system in in operation (energy and refrigerants to run the units). Additionally, emissions can be associated with maintenance activities.
- **End-of-life phase:** the removal and disposal of the cooling system can result in GHG emissions.

Within the beverage industry, material emissions from cooling are generated by the electric consumption to operate refrigeration units during the use phase. The production, maintenance, and the end-of-life of a refrigeration unit are not included in the inventory boundary because of insufficient data and a minor contribution to the total GHG emissions of cooling[14]. If these sources ever become material they should be included within the boundary of your inventory.

Enterprise Inventory Approach (Scope 1)

The cooling emissions in scope 1 are considered zero, as purchased electricity does not generate emissions during use. Some enterprises may choose to include refrigeration from company owned vehicles or refrigerants released from company owned refrigerators but is considered immaterial and not required.

Enterprise Inventory Approach (Scope 2)

The cooling emissions in scope 2 consist of the emissions from the generation of purchased electricity used for cooling. The cooling emissions cover the electricity use of all cooling installations running within the organizational boundaries of the enterprise.

Product Cardon Footprint Approach

The cooling emissions associated with the production, storage, retail, and use of the product shall be included in this approach. There are three differences between the *enterprise inventory approach (scope 1 and 2)* and the *carbon footprint approach (all scopes)*:

14 Often the share of the production + end-of-life phases will be below the cut-off criteria of 1% of the total cooling GHG emissions as stated in the GHG protocols.

1. The Carbon Footprint Approach is normalized to one unit of beverage (e.g., CO_2e/1 hl) rather than total CO_2e.
2. Cooling elements outside the organizational boundaries that are used to cool the beverages (e.g., cooling installations at retail/bar/home refrigerators, vending machines, fountains, ice consumption, etc.) should be considered even if they are not controlled by the reporting company.
3. Upstream emissions (e.g., the production and transportation of fuels) for the electricity sources should be taken into account.

Cooling Sources Considered Immaterial

Every beverage type requires different degrees of cooling for production as well as consumption of the product. For consistency purposes, as well as best in class approach throughout the entire value chain of a beverage, the electricity needed for refrigeration is the only source of emissions which are material. All other sources including the production, maintenance, and the end-of-life of a refrigeration unit, heating and cooling at the retail/bar/home, refrigerants used for chilled transport and refrigerators, as well as the consumption of ice are a minor contribution to the total GHG emissions of cooling[15] and therefore considered immaterial. It is the responsibility of the enterprise to determine if these sources are material and should be included within the boundary of their inventory.

Calculating Emissions from Cooling

Beverages which are not consumed cold or with ice have zero cooling emissions. Home cooling is the most efficient way of cooling and has low emissions compared to fridges in retail as requirements for refrigeration units in retail are different (capacity to cool fast) and they often have a glass or an open front door which is less energy efficient. The average electricity consumption of cooling installations as used for the enterprise inventory approach can be used in combination with the amount of beverage sold through the fridges. The GHG emissions due to electricity consumption for cooling at the enterprise level can be calculated as follows:

Formula 1 - Calculating Emissions from Purchased Electricity Used for Refrigeration at the Enterprise Level

Cooling emissions (kg CO_2e/year) = Number of cooling installations * average electricity use per cooling installations (kWh/cooler/year) * (Total amount of coolers) * country specific electricity emission factor (kg CO_2e/kWh)

- Country specific emission factors are available from the International Energy Agency (IEA)
- Beverage companies are responsible for determining the average energy consumption of the vendors and coolers (under realistic user conditions) in which they sell their products. The energy consumption values from lab tests (kWh/day) typically refer to consumption under lab stead conditions and do not fully account for product load (e.g. initial cooling from ambient to target temperature) or service load (e.g. air infiltration from door openings). Coolers and vendors should be tested using either a recognized international standard (e.g. American Society of Heating, Refrigeration and Air- Conditioning Engineers (ASHRAE)) or established company protocol to determine average energy consumption.
- Formula 1 can be applied repeatedly for different cooling installations if an average electricity use is known for different cooling installations (e.g., draught beer installations have an average energy use of "x" and open front fridges an average energy use of "y"). The total emissions per group of cooling installations have to be aggregated to get the total scope 2 cooling emissions.

15 Often the share of the production + end-of-life phases will be below the cut-off criteria of 1% of the total cooling GHG emissions as stated in the GHG protocols.

The GHG emissions due to electricity consumption for cooling at the product level can be calculated as follows:

Formula 2 - Calculating Emissions from Purchased Electricity Used for Refrigeration at the Product Level

Cooling emissions (kg CO_2e/hl) = average electricity use per cooling installations (kWh/cooler/hl/day) * (Amount of coolers) * (hl being refrigerated) * (days beverage refrigerated) * (country specific electricity emission factor + upstream emissions (kg CO_2e/kWh))

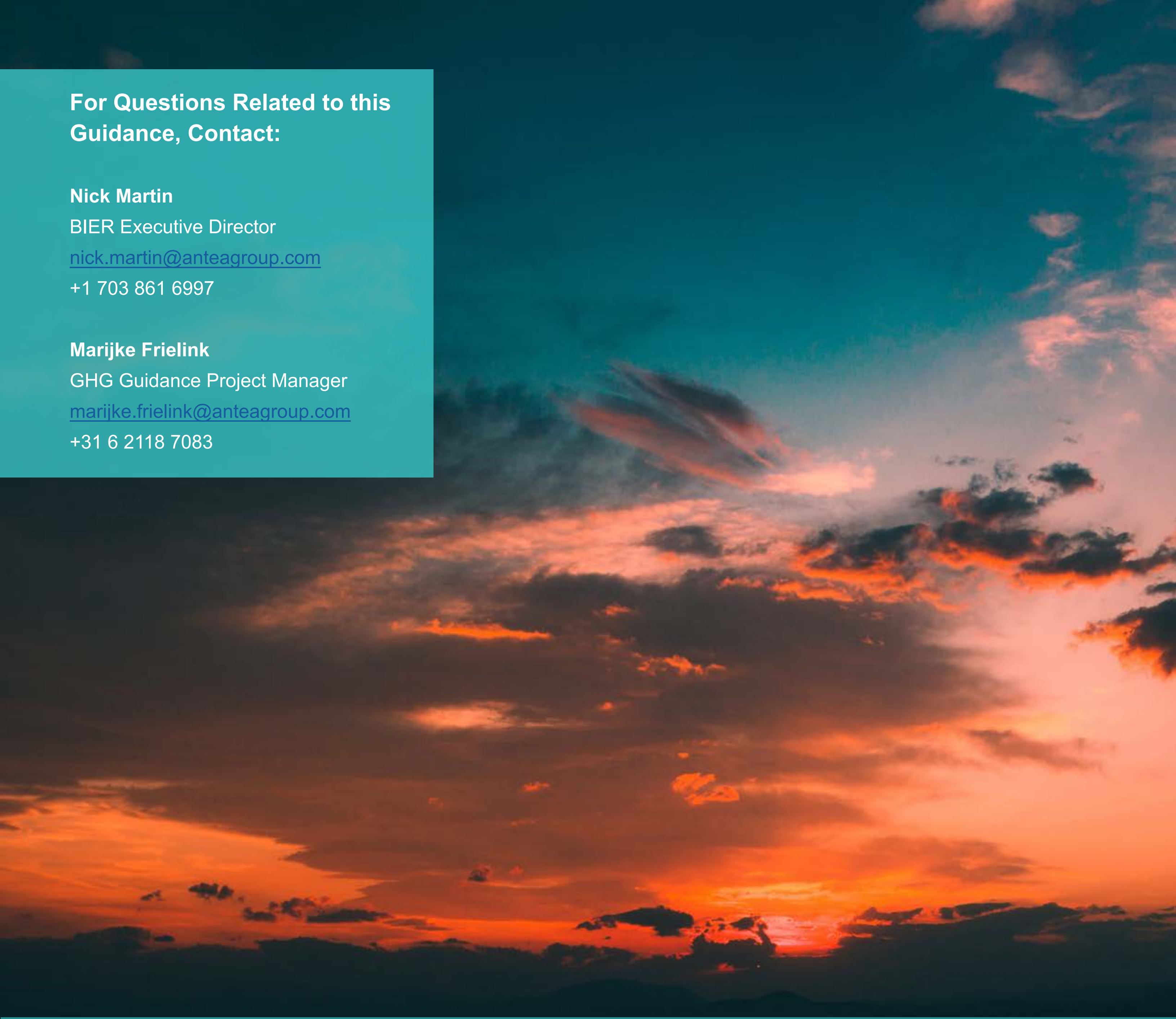
- Country specific emission factors are available from the IEA
- Upstream emissions have to be calculated based on the energy mix used to generate electricity.
- Beverage companies are responsible for determining the average energy consumption of the vendors and coolers in which they send their projects. Coolers and vendors should be tested using either a recognized international standard (e.g. ASHRAE) or established company protocol to determine average energy content.
- Formula 2 can be repeated for different cooling installations if an average electricity use is known for different cooling installations (e.g., draught beer installations have an average energy use of x and open front fridges an average energy use of y). This results in different cooling emissions for one hl of home cooled beverage, than an hl of beverage cooled in a glass door fridge.
- Refer to applicable PEFCR beverage category guidance for average energy consumption (kWh/hl) for different cooling installations.
- This calculation only applies to beverages which are cooled for consumption.

The GHG emissions for ice consumption at the product level can be calculated as follows:

Formula 3 - Calculating Emissions from Ice Consumption

Ice Consumption emissions (kg CO_2e/Ice Cube) = average electricity use per ice cube (kWh/ice cube/hl) * (Amount of ice cubes) * (hl being consumed on ice) * (country specific electricity emission factor + upstream emissions (kg CO_2e/kWh))

- Country specific emission factors are available from the IEA.
- Upstream emissions have to be calculated based on the energy mix used to generate electricity.
- Beverage companies are responsible for determining the average energy consumption to create ice.
- Formula 3 can be repeated for different sized ice cubes if an average electricity use is known for different ice (e.g., Ice Machines installations have an average energy use of x and Ice made in a home freezer use an average energy use of y). This results in different cooling emissions for one hl of beverages consumed using ice from an ice machine, than an hl of beverage consumed at home using ice from the freezer.
- This calculation only applies to beverages which are consumed with ice.



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About the Beverage Industry Environmental Roundtable (BIER)

The core mission of Beverage Industry Environmental Roundtable (BIER) is to advance the sector's environmental sustainability by developing industry-specific methods and data. In other words, we seek to create tools and methodologies that accelerate sustainability and its journey from analysis to action.

BIER is a technical coalition of leading global beverage companies working together to advance environmental sustainability within the beverage sector. Formed in 2006, BIER aims to accelerate sector change and create meaningful impact on environmental sustainability matters. Through development and sharing of industry-specific analytical methods, best practice sharing, and direct stakeholder engagement, BIER accelerates the process of analysis to sustainable solution development.

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