

Good Practice Guidance for Calculation of Primary Aluminium and Precursor Product Carbon Footprints

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Abstract

This guidance addresses the life cycle environmental impact category “climate change”. It specifies the principles, requirements and methodologies for quantifying and communicating greenhouse gas (GHG) emissions from primary aluminium production processes and the associated cradle-to-gate partial carbon footprints of their products and pre-cursors (e.g. bauxite, alumina). This guidance is aligned with international (ISO) standards for environmental management and greenhouse gas emissions calculation and the communication of carbon footprint information but represents a specified approach to the aluminium sector and its products. Employment of this best practice guidance enables bauxite and/or other ores, alumina and aluminium producers (their customers and other stakeholders) to calculate and communicate harmonized and comparable carbon footprints of a product or set of products. While there is significant cross-over with corporate accounting principles (greenhouse gas inventories of an entity, company or set of companies) – including default data, calculation methodologies and relevant processes – the scope of emissions accounting can differ between CORPORATE and PRODUCT carbon footprint metrics (even within given companies). This guidance is applicable to the development of product carbon footprints – for guidance on corporate accounting, alternative sources should be used.

Keywords: Carbon footprint, Bauxite, Alumina, Anode, Primary Aluminium.

1. Introduction

This guidance addresses the life cycle environmental impact category “climate change”. It specifies the principles, requirements and methodologies for quantifying and communicating greenhouse gas (GHG) emissions from primary aluminium production processes and the associated cradle-to-gate partial carbon footprints of their products and pre-cursors (e.g. bauxite, alumina).

This guidance is aligned with international (ISO) standards [1,2,3,4,5]. for environmental management and greenhouse gas emissions calculation and the communication of carbon footprint information, but represents a specified approach to the aluminium sector and its products. This guidance is applicable to the development of product carbon footprints – for guidance on corporate accounting, alternative sources should be used.

2. Goal and Scope

2.1 General

The climate change impact of a product, expressed as carbon dioxide equivalents (CO₂e), is the summation of all GHG emissions and removals over the partial (cradle-to-gate) life cycle of the product (or process). This guidance does not address avoided emissions or actions taken to

mitigate released emissions. This guidance is also not designed to be used for quantifying GHG reductions from offsets or claims of carbon neutrality.

2.2 Product Category

The goal of this guidance is to provide practitioners with a standardised approach to the calculation of climate change impact of a given mass of primary aluminium and precursor products, including:

- Dry bauxite and/or other ores
- Aluminium hydroxide (Al(OH)₃, commonly known as “hydrate”)
- Aluminium oxide (Al₂O₃, commonly known as “alumina”)
- Primary aluminium tapped from electrolytic cells or pots during the electrolytic reduction of metallurgical alumina, excluding alloying additives and recycled aluminium.
- Alloyed and unalloyed primary aluminium in different forms produced in the cast-house of aluminium smelters from liquid primary aluminium

2.3 System Boundary

The system boundary can be illustrated by the following flow-chart. The yellow boxes refer to the core processes which are under the responsibility of the aluminium industry.

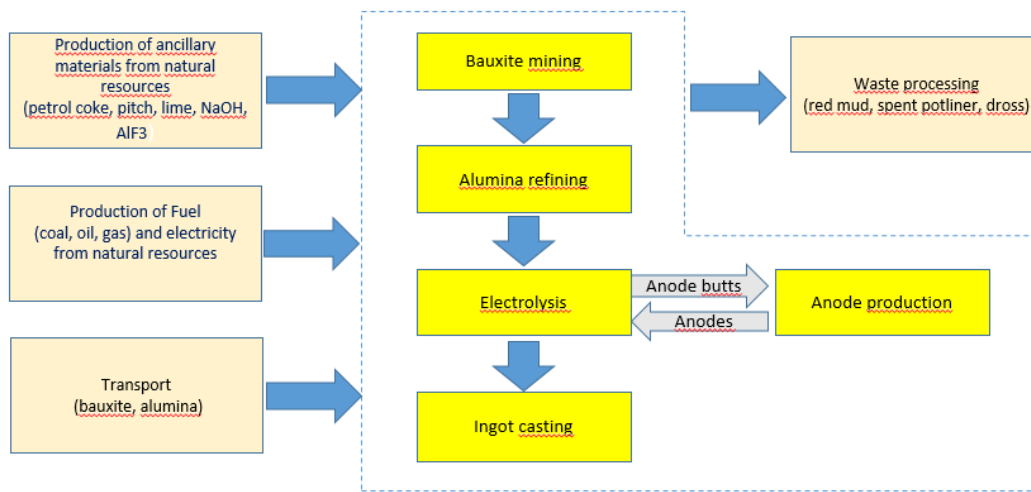


Figure 1. System boundary of primary aluminium production.

For primary aluminium this includes the unit processes bauxite and/or other ores mining, alumina production (hydrate production & calcination), anode production, electrolysis, ingot casting, raw materials transport, electricity generation, and waste processing. It also includes the production of ancillary materials and fuels required for primary aluminium production. It does not include the stages of “production of semi-finished products from raw material”, “use” and “end-of-life”.

3. Life Cycle Impact Assessment

This carbon footprint study uses only one impact category: climate change. The different substances which have been considered as GHG emissions and the selected characterization factors shall be reported.

3.1 Climate Change Impact Category Characterisation Factor

The Intergovernmental Panel on Climate Change (IPCC) published value of a 100-year global warming potential (GWP) for different greenhouse gases [21]. GWP used in the national inventory reporting, is recommended to be used to convert life cycle inventory results to an indicator of climate change impact (CO₂e).

The potential climate change impact of each GHG emitted and removed by the system under study shall be calculated by multiplying the mass of GHG released or removed by the 100-year GWP given by the IPCC in units of kg CO₂e per kg emission. The (partial) carbon footprint of the system under study is the sum of these calculated impacts.

When comparing impacts across time, the characterisation factors applied to emissions inventories should be the same for all periods under study.

3.2 Applicable Time Series

Carbon footprints should be updated whenever a significant change occurs in the emissions intensity of the product(s) under study [(+/- 10 %)], or every 5 years, whichever is shorter.

The following situations, as stipulated in the GHG Protocol [7], shall trigger a significant change:

1. Structural changes in operation, including significant process change in operation, technology advancement, raw material or energy changes.
2. Changes in calculation methodology or improvements in the accuracy of emission factors or activity data or inclusion of new types of sources that result in a significant impact on the emissions data.
3. Discovery of significant errors, or a number of cumulative errors that are collectively significant.

Frequency of inventory data collection should be informed by the frequency of significant change in emissions intensity of the process(es) under study. These may be different for different emission sources.

All inventory data shall refer to a one-year period, prior to application of the characterisation factor (GWP).

4. Emissions Inventory Calculations: Direct Emissions from Process

Guidance for direct emissions calculation for significant aluminium production processes are included below. Emissions from fuel combustion, waste (including wastewater) treatment and disposal, emission control and ancillary processes should be included in the inventory.

Across all processes, fuel combustion in stationary or mobile equipment (such as haul trucks, molten metal transfer crucibles or support vehicles) should be calculated following the GHG Protocol calculation tools “GHG Emissions from Stationary Combustion (2005)” [12] and “GHG Emissions from Transport or Mobile Sources (2015)” [14].

4.1 Bauxite and/or Other Ores Mining

Mining direct emissions are evolved in the combustion of fossil fuels for stationary and mobile equipment, with calculation following the GHG Protocol calculation tools “GHG Emissions from Stationary Combustion (2005)” [12] and “GHG Emissions from Transport or Mobile Sources (2015)” [14].

4.2 Alumina Production

Alumina production can be further categorised as 2 sub-unit processes by product:

1. aluminium hydroxide production from bauxite and/or other ores
2. calcination of aluminium hydroxide to produce aluminium oxide

The majority of direct emissions from both processes is from the combustion of fossil fuels for heat and steam, with calculation following the GHG Protocol calculation tool “GHG Emissions from Stationary Combustion (2005)” [12].

- a. Stationary combustion to sustain the requested condition in a digester
- b. Stationary combustion in kilns for the production of calcined alumina (calciners);
- c. Stationary combustion in kilns/ovens for the production of dried specialty alumina (dryers);
- d. Stationary combustion in auxiliary, emergency or pollution control equipment (boilers, heaters, diesel generators, incinerators, thermal oxidizers, thermal engines).
- e. Mobile combustion in transportation equipment (ships, trucks, trains, cars, conveyors) for raw material, products, wastes residues and employees, with calculation following the GHG Protocol calculation tools “GHG Emissions from Stationary Combustion (2005)” [12] and “GHG Emissions from Transport or Mobile Sources (2015)” [14].

Other possible direct process emissions, such as flue gas desulphurization, acid cleaning of process equipment, organic carbon in bauxite and/or in other ores, liquor burning, are not a main source of GHG emissions (<1 %), therefore, currently considered to be negligible by following “2019 IPCC Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3: Industrial Processes and Product Use, Chapter 4: Metal Industry Emissions, Section 4.4 Primary Aluminium” [6].

4.3 Anode Production

Direct emissions from operation of an anode or paste production facility and/or anode baking plant.

4.3.1 Paste Production / Green Anode Production

Most direct emissions are from the combustion of fossil fuels for heat and steam, with calculation following the GHG Protocol calculation tool “GHG Emissions from Stationary Combustion (2005)” [12].

Where coke calcination is present as an ancillary process, direct emissions calculation should follow the “Aluminium Sector Greenhouse Gas Protocol (2006) - 1.6.1 Coke Calcination” [10].

4.3.2 Anode Baking

Direct emissions are from three sources: bake furnace fuel combustion, combustion of volatiles evolved from the anode during baking and combustion of baking furnace packing material.

The first of these should be calculated following the GHG Protocol calculation tool “GHG Emissions from Stationary Combustion (2005)” [12].

For the others, calculation follows “The Aluminium Sector Greenhouse Gas Protocol (2006) 1.3.2 Baking furnace carbon dioxide emissions” [10]

4.4 Electrolysis

Calculation of emissions from the electrolysis process is according to the following sections of “The Aluminium Sector Greenhouse Gas Protocol (2006)” [10]:

- 1.3 calculation of carbon dioxide emissions from prebake processes
- 1.4 calculation of carbon dioxide emissions from Söderberg processes

Calculation of perfluorocarbon emissions follows, instead, International Aluminium Institute (2020) Good Practice Guidance: Measuring Perfluorocarbon [17], being consistent with the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories [6], which covers both high voltage (HV) and low voltage (LV) PFC emissions.

4.5 Gas Treatment Centres

Direct CO₂ emissions may be evolved where sodium carbonate (soda ash) is used as a reagent in SO₂ scrubbing facilities. Calculation follows “The Aluminium Sector Greenhouse Gas Protocol (2006) 1.6.2 Soda Ash Use” [10]

4.6 Aluminium Casting

Calculation of CO_{2e} emissions from fuels used in the cast-house follows the calculation tool “GHG Emissions from Stationary Combustion (2005)” [12].

5. Emissions inventory calculations: Emissions from the production of energy, consumed by unit processes

Emissions related to the production of fuels and electricity and consumed in unit processes, including production, waste/wastewater treatment and disposal, emission control and ancillary processes, should be included in the inventory.

Table 1. Activities included in Emissions from the production of energy.

Activity	Description	Broadly equivalent corporate accounting “scope”
A. Upstream emissions of fuels	Extraction, production, and transportation of fuels consumed by the reporting product	3 (Category 3)
B. Upstream emissions of electricity, steam and heat	For both conventional and renewable energy: <ul style="list-style-type: none"> • Raw Materials Extraction • Construction Materials Manufacture • Power Plant Construction 	3 (Category 3)
C. Generation of electricity, steam and heat	The emissions from the combustion of fuels to generate electricity, steam, heating, and cooling that is consumed by the reporting product; also emissions from operations and maintenance at the power plant	1 or 2
D. Transmission and distribution (T&D) losses	Generated (upstream activities and combustion) electricity, steam, heating, and cooling that is consumed (i.e., lost) in a T&D system – reported by end user	3 (Category 3)

Calculation of emissions from the activities A/B/D follows [Category 3: Fuel- and Energy-Related Activities Not Included in Scope 1 or Scope 2] in “Greenhouse Gas Protocol Technical Guidance for Calculation Scope 3 Emissions (2013)” [9]

Calculation of emissions from the activity B is based on the emission factor methodology, which estimates CO₂ emissions by multiplying a level of activity data (e.g., MWh of electricity consumed) by a combustion emission factor (e.g., kilograms of CO₂ per MWh).

Activity data x Combustion Emission Factor = CO₂ emissions

The activity data that should be collected is the quantity of consumed energy. Emissions factors may vary with season, time of the day and supplier. For practical reasons, this guidance recommends the use of average rates over a full year and over a relevant selection of sources. If the life cycle emission factor is known to the consumed electricity,
 life cycle emission factor = upstream emission factor + combustion emissions factor + T&D losses

Combined Emissions from Activities B, C, D can be simply calculated as:

Activity data × Life Cycle Emission Factor = CO₂ emissions

5.1 Selection of Emission Factors

Several options for selecting emission factors are provided below in order of preference. It is important to express emission factors in the same measurement units as the activity data. It is also important to document and justify the choice of emission factors used in the inventory. Contractual purchase agreements are the best piece of justification.

- a) Site-specific emission factors provided by the supplier. In this case, the emission factors should be based on the actual fuel fired and/or the technology employed by the supplier and provided to the customer on a frequent basis.
- b) Site-specific estimate custom emission factors. If the supplier is not able or willing to provide emission factors of dedicated production units, then a method based on the assumed fuel fired and derived from the efficiency method for can be used to estimate custom emission factors. It is described here after in paragraph 5.2.
- c) Regional emission factors. If site-specific emission factors are not available or appropriate (no dedicated source), generic regional or power pool emissions factors that have been publicly published can be used.
- d) National average emission factors. If regional or power pool emission factors are not available, an appropriate generic national average factor for the entire country’s grid can be used. If the type of fuel fired by the supplier is known, International Energy Agency (IEA) and UN Environment Programme (UNEP) provide emission factors for different fuels.

5.2 Custom Emission Factors Estimate

5.2.1 Energy Supply from Conventional Boilers

It is only necessary to know the type of fuel combusted and to determine the assumed thermal efficiency of the energy production unit. The CO₂ emission factor of the supplied energy is calculated from the CO₂ emission factor of the combusted fuel, both related to the same energy unit (eg. MWh), by dividing the latter by the actual or assumed thermal efficiency:

$$EF_H = F_{c,h} \cdot F_{ox} \cdot (44/12) / e_H \quad (1)$$

where:

EF_H	CO ₂ emission factor of supplied energy in kg CO ₂ per energy unit (e.g. MWh)
$F_{c,h}$	Carbon content of fuel on a heating value basis in kg C per energy unit (e.g. MWh)
F_{ox}	Oxidation factor to account for fraction of carbon in fuel that remains as soot or ash
(44/12)	The ratio of the molecular weight of CO ₂ to that of carbon
e_H	Assumed efficiency of energy production (fraction)

Care should be taken to ensure consistency between the thermal efficiency value and the basis of underlying fuel heating value (GCV or NCV).

5.2.2 Energy Supply from Combined Heat and Power (CHP) Units

For CHP units, the estimation method is based on the "efficiency method" described in section 7.2.2. However, in the case of CHP units out of control of the reporting company, some data such as actual fuel fired may not be available and a surrogate method is then needed.

To apply the surrogate efficiency method, it is only necessary to know the type of fuel combusted, the energy balance of the unit in standard operating conditions (fuel input, steam output, electricity output, all expressed in the same energy or power unit, e.g. MW) and assumed thermal efficiencies of reference units producing steam and electricity separately.

The following equations can be applied to calculate two conventional factors which have the dimension of energy efficiencies and can then be used to estimate the CO₂ emission factors of supplied steam and electricity from the CO₂ emission factor of the type of fuel combusted, exactly as in the previous paragraph, with E_H or E_P replacing e_H .

$$E_H = (e_H / A_f) \cdot (H / e_H + P / e_P) \quad (2)$$

$$E_P = (e_P / A_f) \cdot (H / e_H + P / e_P) \quad (3)$$

where:

E_H	Conventional efficiency factor for steam produced from the CHP unit
E_P	Conventional efficiency factor for electricity produced from the CHP unit
e_H	Assumed efficiency of steam production from a conventional unit (fraction)
e_P	Assumed efficiency of electricity production from a conventional unit (fraction)
H	Standard steam output of the CHP plant in energy or power unit (e.g., MW)
P	Standard electricity output of the CHP plant in energy or power unit (e.g., MW)
A_f	Standard fuel energy input of the CHP plant in energy or power unit (e.g., MW)

Care should be taken to ensure consistency between the assumed efficiency values and the basis of underlying fuel heating value (gross calorific value (GCV) or net calorific value (NCV)).

E_H and E_P are purely conventional values. They may be higher than 100 % for steam since they reflect the far better global efficiency of CHP compared with traditional power plants and the low efficiency of electricity production compared with steam production.

5.3 Purchased Energy

The operator shall obtain the relevant emission factor for purchased electricity and heat from the supplier based on section 5 considerations. If the operator has a contract with a supplier with a defined energy generation facility, the emissions factor for the contractual amount of energy from the specific generation facility, and the energy mix and emissions factor for the residual purchased power shall be calculated separately, with a principle of transparency and avoidance of double counting. If relevant data are not available from the supplier, the operator shall select emission factors by following 5.1.

A record shall be maintained of the reference factors and their source in the supporting evidence. If contract used for physical supply of power from a particular power generation plant via grid, the renewable energy certificates/guarantees of origin can be used to confirm the origin of received power.

5.4 Self-Generated Energy

Consumers of energy which are also generators of such energy carriers, shall possess the relevant emission factor for self-generated energy considering upstream emissions of fuel production as described in Section 5.

The operator should allocate to the product emissions inventory the consuming aluminium (or precursor) process(es), including ancillary processes, share of total energy transformation emissions, calculated according to the calculation tool “GHG Emissions from Stationary Combustion (2005)” [12].

6. Emissions Inventory Calculations: Other Emissions

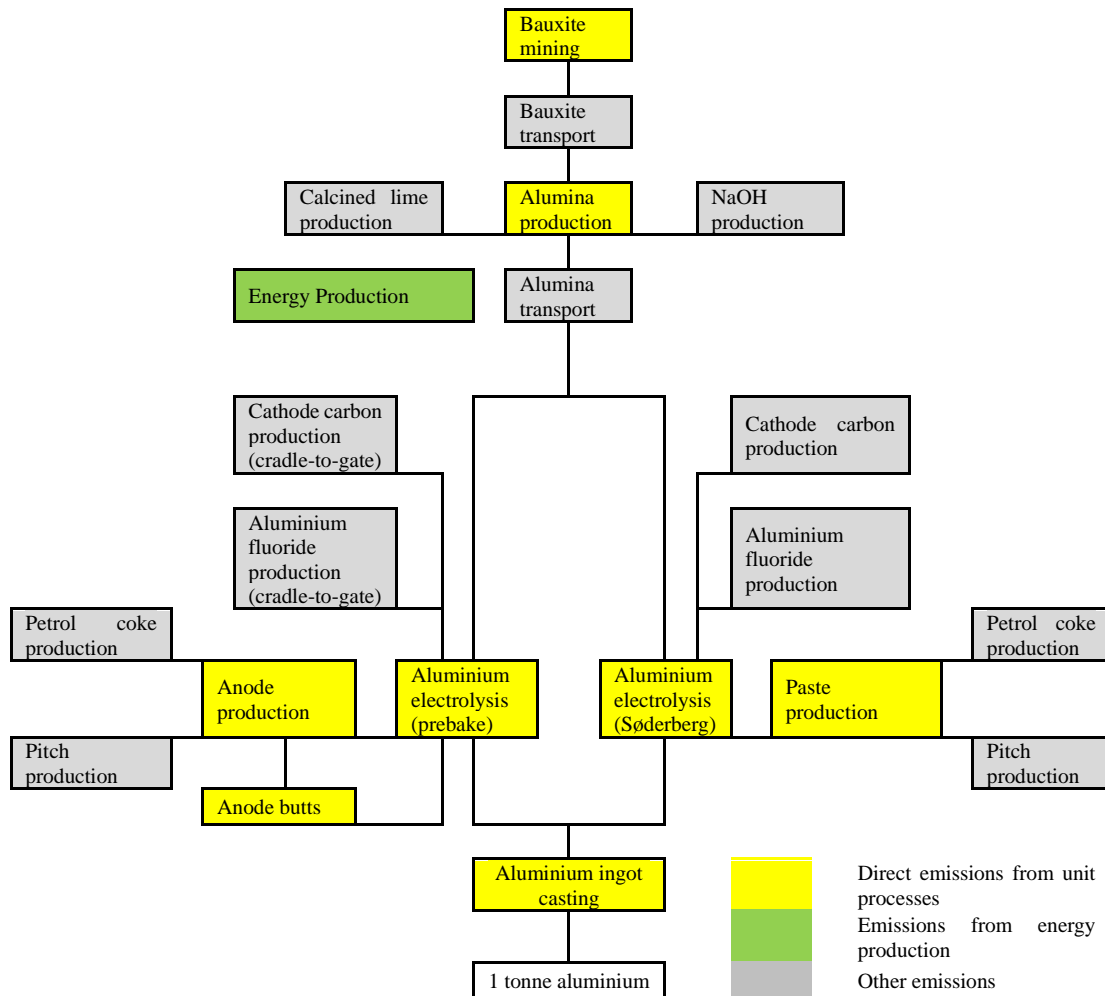
All GHG emissions over the partial (cradle-to-gate) life cycle of the product (or process), excluding those aforementioned in section 4 and 5, are under this category.

The Greenhouse Gas Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard (2013) [8] offers an internationally accepted method to enable GHG management of companies’ value chains. The 8 categories of emissions from upstream activities are the most relevant to the emissions under this category. Based on recent International Aluminium Institute (IAI) study on industrial reporting of scope 3 emissions, the following categories are considered material for the primary aluminium value chain:

- Category 1: Purchased goods and services
- Category 3: Fuel and energy related activities (not included in Scope 1 and 2)
- Category 4: Upstream transportation and distribution,

Figure 2. listed the typical goods and services purchased in the production of primary aluminium. Calculation for category 3 is covered in Section 5.

The “Greenhouse Gas Protocol Technical Guidance for Calculation Scope 3 Emissions (2013)” [9] serves as a companion to the aforementioned GHG Protocol Scope 3 Standard to offer companies practical guidance on calculating their scope 3 emissions. It provides information not contained in the Scope 3 Standard, such as methods for calculating GHG emissions for each category, data sources, and worked examples. Following this guidance, the IAI is developing a sector specific Scope 3 calculation tool.



7. Modelling Parameters and Assumptions, Allocation Issues

7.1 General

Inputs and outputs shall be allocated to different products according to a clearly stated and justified allocation procedure.

The sum of allocated inputs and outputs of a unit process shall be equal to the inputs and outputs of the unit process before allocation. Whenever several alternative allocation procedures seem applicable, a sensitivity analysis shall be conducted to illustrate the consequences of the departure from the selected approach.

7.2 Allocation Procedure

7.2.1 Alumina Production

An allocation issue occurs for alumina refineries which sell both calcined metallurgical alumina to aluminium smelters and non-calcined hydrate, as co-products, to other users. It is proposed to solve this allocation issue as follows:

1. The refinery shall report the mass P_1 of calcined metallurgical alumina produced in a given time period and the mass P_2 of non-calcined hydrate over the same period as separate figures
2. The refinery shall report the GHG emissions E_c of the calcination and the GHG emissions E_r of all the other operations in the refinery as separate figures
3. The mass $P_{1.0}$ of metallurgical alumina before calcination shall be determined by using the relevant stoichiometric formulas
4. Allocation by mass is applied to the GHG emissions E_r of all the other operations in the refinery according to the ratio of the mass $P_{1.0}$ of metallurgical alumina before calcination and the mass P_2 of the annually produced non-calcined hydrate.

7.2.2 Allocation of CO₂ Emissions from a CHP (Co-generation) Plant

When a CHP plant (or cogeneration unit) is owned by the reporting company and operated in an alumina refinery site, the most likely situation is that a significant fraction of the produced electricity output is sold to other users or power companies (steam in excess may also be sold, e.g., for district heating). In this case, the sold energy should be deducted from the internal energy consumption and corresponding CO₂ emissions should be reported separately. This is done by determining emission factors for the electricity and steam outputs and multiplying those emission factors by the energy outputs sold.

The most common method to allocate emissions from a CHP plant is the efficiency method whereby CO₂ emissions are allocated based on the fuel energy inputs needed to produce the separate steam and electricity products from the same type of fuel. The efficiency method is the preferred method of this guidance document. It assumes that converting fuel energy to steam energy is more efficient than converting fuel to electricity, which optimizes the CO₂ emissions savings for the steam consumers, i.e. the alumina refineries. Actual efficiencies of steam and electricity production will not be precisely characterized, necessitating the use of assumed values. If national fuel or emissions allocation procedure applies, the allocation shall be in accordance with the national procedure.

The efficiency method is referred from ‘Allocation of GHG Emissions from a Combined Heat and Power (CHP) Plant’[11].

7.2.3 Primary Cast-House Products

7.2.3.1. Allocation of Cast-House Emissions to Unalloyed Primary Aluminium from Liquid Metal

The following example shows how the partial carbon footprint of a DC-cast unalloyed primary aluminium ingot from liquid metal is calculated if the plant uses liquid aluminium and purchased scrap. For alloyed ingots, the carbon footprint of the relevant alloying elements must be added.

Typically, the cast-house of a smelter transforms liquid primary aluminium from the pot-room and run-around scrap from the sawing of ingots into the different forms of primary aluminium ingots. In this case, the primary aluminium ingot carries all the GHG emissions of the cast-house. Here liquid metal of about 900 °C is filled into the holding furnace and the run-around scrap is used to cool down the melt to the casting temperature of 700 °C. Therefore, run-around scrap does not need additional fuel for remelting.

If the cast-house of a smelter remelts additional quantities of purchased solid metal, as described additional fuel is needed to melt this solid metal. All the other processes, e.g., casting, ingot

handling, ingot sawing and infrastructure will be identical and have the same GHG emissions per tonne.

GHG emissions tied to the remelting of the scrap (excluding internal scrap) can be obtained by determining the fuel demand and the resulting GHG emissions related to the remelting of a furnace batch consisting of 100 % scrap metal. If such data are not available, default data from European Aluminium and Aluminum Association should be used. The same method should be applied for alloying elements and remelt ingots.

In order to obtain the GHG emissions of unalloyed primary aluminium from liquid metal, excluding purchased solid metal, the total GHG emissions tied to all cast-house operations has to be reduced by the emissions tied to the remelting of the purchased solid metal.

7.2.3.2. Transparency Requirement if Input Material Includes Scrap

The IAI seeks industry consensus on how to calculate partial carbon footprint, cradle-to-gate, of aluminium products containing recycled aluminium.

Post-consumer scrap is assigned burden-free in cradle-to-gate carbon footprint calculations but it needs to be noted that in cradle-to-grave approach post-consumer scrap is typically not burden-free. For pre-consumer scrap no consensus has been reached.

ISO 14044 [1] and ISO 14067 [4] are the reference international standards regarding life cycle assessment and carbon footprint of products. Neither provides explicit requirements regarding how to perform a cradle-to-gate Life Cycle Assessment (LCA) for a product regarding how to deal with pre-consumer scrap. The IAI has developed a dedicated document “Reference document on how to treat pre-consumer scrap flows in carbon footprint calculations for aluminium products”, exploring the different results due to various interpretation of ISO standards. In general, pre-consumer scrap can either be seen as a co-product of a manufacturing process or be seen as a secondary material flow crossing the boundary between two life cycles.

Ten approaches for cradle-to-gate partial carbon footprint of recycled aluminium have been identified, which can be put together into three main groups:

- Co-product approach (pre-consumer scrap is treated as a co-product);
- Cut-off-approach (pre-consumer scrap is treated as a waste);
- Substitution approach (pre-consumer scrap is treated as a secondary material).

Those three approaches can be used for calculating a full life cycle carbon footprint, including loads and benefits beyond the system boundaries (referred to as Module D in ISO 21930 [25]). The calculation of Module D differs depending on the chosen approach.

All these approaches respect the general principles of ISO 14044[1], and none will cause leakage or double counting for cradle-to-gate (metal, semis, final product) and cradle-to-grave (full life cycle of a product) carbon footprint calculations if they are applied consistently by scrap generator and scrap receiver.

As a complement to the carbon footprint of the cast-house product, operators should communicate:

- The method of calculation of the carbon footprint, particularly in relation to any pre-consumer scrap component.
- Calculated (or estimated) typical % of aluminium input from post-consumer scrap.

- Calculated (or estimated) typical % of aluminium input from all other scrap types (excluding internal/run-around scrap) including input from dross (metal content) and other aluminium containing wastes.

It is advised to use professional Life Cycle Analysis software as well as expert advice to develop appropriate and consistent models and for detailed documentation, explanation, and reporting of all processes.

7.2.3.3. Full Carbon Footprint (CFP) Study

The reporter of the cradle-to-gate partial carbon footprint should advise the customer to add the partial carbon footprint of this information module to the carbon footprint of the remaining information modules, i.e., fabrication, use and end-of-life recycling, to obtain the carbon footprint of the product system under study.

8. Communication of Carbon Footprint Result

8.1 General

Guidance on how to communicate carbon footprint of products is given in ISO 14026 [5]. Chapter 11 of the “Greenhouse Gas Protocol Product Life Cycle Accounting and Reporting Standard (2011)” [7] also provide general communication guidelines.

In general, the carbon footprint is communicated cradle-to-gate by the producer of the product. According to ISO 14067 [4] cradle-to-gate carbon footprints cannot be considered as product carbon footprints (CFPs), because CFPs include the whole life cycle of the product.

8.2 Data Quality

Primary data are defined as quantified values of a process or an activity obtained from a direct measurement or a calculation based on direct measurements. Data from databases or other sources which fulfil the criteria of primary data are also primary data. Secondary data are defined as data from sources other than primary data.

Table 2 summarises the components, as well as required data quality when calculating a carbon footprint by following the approach articulated in this guidance.

Table 2. Required quality data.

Category	Required Data	Note
Direct emissions	Primary	Unit processes to be included in calculation are listed in Figure 2;
Emissions from energy production	Primary or secondary	
Other emissions	Primary or secondary	Data sources must be specified at communication.

Preference should be given to site-specific data from suppliers. If such data are not available, regional averages from the IAI’s latest life cycle inventory dataset should be used.

8.3 Additional Information

At the communication stage, along with the carbon footprint result, the following information should be provided:

- 1) Specified product to which the calculated cradle-to-gate carbon footprint relates and declared unit, e.g. 1 tonne
- 2) The percentage of climate change impact that is derived from secondary data, if any
- 3) Source of global warming potential (GWP) values used
- 4) If input materials include scrap, elements contained in section 7.2.3.2 are recommended to be disclosed

The product in question covered by this guidance is listed under section 2.2.

9. References

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10. Greenhouse Gas Protocol Calculation tools:
The Aluminium Sector Greenhouse Gas Protocol (2006)
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 - Worksheet: http://www.ghgprotocol.org/sites/default/files/ghgp/Stationary_combustion_tool_%28Version4-1%29.xlsx
13. GHG Emissions from Purchased Electricity (2015)
 - Worksheet: http://www.ghgprotocol.org/sites/default/files/ghgp/Purchased_Electricity_Tool_Version-4_8_0.xlsx
14. GHG Emissions from Transport or Mobile Sources (2015)

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