ASI Entity-Level GHG Pathways Method

A method for determining 1.5°C-aligned Greenhouse Gas Emissions Reduction Pathways for ASI Entities, in conformance with ASI Performance Standard V3, Criterion 5.3 (GHG Emissions Reduction Plans)

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This document outlines the Aluminium Stewardship Initiative (ASI) developed and endorsed GHG Pathways Method for use in meeting the conformance requirements of the ASI Performance Standard (2022)[i], including:

- the history of its development,
- an outline of sectoral decarbonisation approaches (SDA),
- key aspects of the method, sectoral reference slopes, representative slopes, and
- guidance for ASI Entities and ASI Auditors on choice of baseline year, conformance criteria and applicability.

Guidance on the use of an associated Microsoft Excel based calculation tool is also included.

Background

Since 2018 ASI has been committed to driving the aluminium sector towards a 1.5 degree aligned future, achievement of which is only possible through a shift in primary aluminium smelter power, among other pathways, to zero emitting technologies over the next three decades.

On the back of ASI's decision for 1.5 degree alignment, and in a move that turns ambition into (proof of) action, Version 3 of the ASI Performance Standard[i], published in 2022, calls for certifying ASI Entities (no matter where they sit on the aluminium value chain) to "establish a GHG Emissions Reduction Plan and ensure a GHG Emissions Reduction Pathway consistent with a 1.5 degree warming scenario, using an ASI-endorsed method, when available".

ASI has since been working on developing such a method and the result of this work is articulated in this document.

Performance Standard v3.1 Criterion 5.3 - GHG Emissions Reduction Plans

The Entity shall:

a. *Establish a GHG Emissions Reduction Plan and ensure a GHG Emissions Reduction Pathway consistent with a 1.5°C warming scenario, using an ASI endorsed methodology when available.*

b. *Ensure that the GHG Emissions Reduction Pathway includes an Intermediate Target covering a period no greater than five years, which:*

- *i.* *Addresses all Direct and Indirect GHG emissions.*
- *ii.* *Is developed using a Science-Based Approach endorsed by ASI, if available.*
- *iii.* *Is publicly disclosed.*

c. *Review the GHG Emissions Reduction Plan annually.*

d. *Review the GHG Emissions Pathway on any changes to the Business that alter baselines or targets.*

e. *Publicly disclose:*

- *i.* *The latest version of the GHG Emissions Reduction Pathway.*
- *ii.* *The latest version of the GHG Emissions Reduction Plan.*
- *iii.* *Progress against the GHG Emissions Reduction Plan on an annual basis.*

The purpose of the method is to enable ASI Entities to articulate quantifiable aluminium-related GHG Emissions Reduction Pathways, specific to Entities/companies/assets under study, against which performance can be regularly measured and disclosed.

Ultimately, if each Entity-level Pathway is followed, the outcome should be that the sector's carbon emissions budget (currently around 15 Gt CO_2e[ii]) is not exceeded. With the aluminium industry currently emitting over 1 Gt CO_2e every year[iii], this is a huge undertaking that requires action at speed and scale, even as demand for aluminium is increasing.

ASI-endorsed Method Timeline	
May 2022 – ASI Publishes Version 3 of the ASI Performance Standard with a requirement for 1.5°C-aligned GHG Emission Reduction Pathways from all Certifying Entities	☑
2021-2023 – ASI explores opportunities to leverage existing or developing methods (e.g. SBTi, Center for Climate Aligned Finance) but none is able to meet its specific requirements	☑
January 2023 – ASI Climate Change Working Group and Standards Committee begin work in earnest to deliver an ASI-developed method	☑
September 2023 – ASI Standards Committee agrees to recommend the method to ASI Board	☑
November 2023 – ASI Board endorses the recommended method	☑
February 2024 – Publication of the method and associated calculation tool, development of training materials, to allow Entities and Auditors to prepare for implementation/audits	☑
May 2024 – Incorporation of method into Performance Standard Guidance (all ASI Performance Standard Audits from this point must seek evidence that the method has been used by the Certifying Entity)	☐
2024 - Further research and development by the ASI Secretariat regarding bauxite and alumina specific methods and the impact of land use change emissions.	☐

The Method – from Sectoral Ambition to Corporate Action

A 1.5 degree sector-wide pathway to 2050 was developed by the International Aluminium Institute (IAI) in 2021[iv], broadly aligned with the International Energy Agency (IEA) Net Zero Emissions (NZE) Scenario[v], but there has been a need to develop a science-based method that defines individual aluminium company/Entity/asset action for some time.

In particular, ASI's Performance Standard[i] requires a method that is consistent with the sectoral scenario, but which is also applicable to the different types of Entities that ASI certifies all along the value chain.

Some key expectations of the ASI-endorsed method are that it should:

- Be applicable to all ASI certifying Entities (not just those involved in primary aluminium production);
- Be science-based;
- Be broadly aligned with existing sectoral 1.5 degree scenarios;
- Address all direct and indirect GHG emissions;
- Be simple to implement and audit against.

While the bulk of aluminium industry emissions (and emissions reduction potential) lies in decarbonisation of the primary aluminium production process, work by the IAI[iv] demonstrates that a 1.5 degree aligned aluminium sector can only be achieved through the collaborative and combined action of all players along the supply chain, through process and energy-related emissions reduction, resource efficiency (including but not limited to increased recycling) and low-carbon procurement practices.

With its full aluminium value chain membership and certification programme, based on third-party assurance and multi-stakeholder governance structure, ASI is in a unique position to hold producers, transformers and purchasers of aluminium (as well as generators and recyclers of scrap) to account against this required action, no matter where they sit in the sector. The GHG Emissions Pathway method developed and endorsed by ASI is thus applicable to all, covering direct and (upstream) indirect emissions.

While for primary producers, it focuses on deep process and energy-system decarbonisation, for downstream Entities (in addition to improved process efficiency) the focus is on a transition to low carbon procurement - only achievable if the primary industry decarbonises rapidly and at scale, if post-consumer scrap quantity and quality recovery improves and ultimately if pre-consumer scrap generation is reduced.

Early decisions by ASI's Climate Change Working Group included a commitment to use and reference, where possible, existing (1.5 degree aligned) tools, approaches and data. These include, with respect to emissions accounting, the Greenhouse Gas Protocol[vi,vii]; for the whole of global economy carbon budgets and slopes, the IEA Net Zero Emissions Scenario[v]; and for the global aluminium sector, the International Aluminium Institute (IAI) 1.5 Degree Scenario[iv], IAI/Mission Possible Partnership (MPP) scenarios for primary aluminium (cradle to gate) and recycling (gate to gate)[viii]; and frameworks including the Sustainable Aluminum Finance Framework[ix], RMI Horizon Zero Reporting Guidance[x] and Science Based Targets Initiative[xi].

The ASI Climate Change Working Group interpreted "All Direct and Indirect GHG emissions" as "cradle-to-gate" emissions for a given Entity or set of Entities. This is broadly equivalent to GHG Protocol corporate accounting[vi] scopes 1, 2 and 3 (categories 1, 3 and 4) for smelter Casthouses and scopes 1, 2 and 3 category 1 for subsequent Supply Chain Activities, applied across the Entity certification scope. The definition may change in future years as materiality of other scope 3 categories changes and/or data availability improves.

The method developed follows a "Sectoral Decarbonisation Approach (SDA)", requiring convergence on a target emissions intensity (or intensities) in 2050 by similarly scoped Entities, with differing baseline emissions (taking care that no Entities describe Pathways that increase their emissions intensity).

The SDA requires:

1. A reference sectoral slope (or slopes) that is generated from sectoral 1.5 degree emissions budget data (numerator) over the target period:
2. Sectoral activity data –production/output or procurement/input tonnages (denominator).

Using these pieces of information, ASI describes specific methods applicable for primary aluminium, casthouses, semi-fabrication and Material Conversion processes.

Through the use of relatively few pieces of Entity specific data for a given baseline year - for primary aluminium, cradle to gate emissions intensity; for all other processes, purchased aluminium emissions intensity and process emissions intensity – the method describes Entity-specific emissions reduction slope(s) to 2050, including Intermediate Target years, against which the Entity will need to demonstrate performance as part of subsequent ASI Audits. A companion Excel-based tool has been published by ASI to ease calculation.

Even though now endorsed and published, we can expect the method to evolve in the coming months and years as the science and underlying emissions data matures. In 2024, for instance, the ASI Climate Change Working Group will have a particular focus on land use change related emissions, which are relatively poorly quantified for the sector, on opportunities for methods focused on mining and refining and on updates to sectoral slopes.

Key messages on this Method

- Simplified for ease of use by all ASI Entities and ASI Auditors.
- Derived from existing 1.5°C scenarios for the aluminium sector, in turn broadly aligned with the IEA *Net Zero Emissions* (NZE) scenario.
- Covers majority (>95%) of Aluminium sector emissions sources as currently defined, but likely to evolve as future emissions sources are more accurately quantified (e.g. land-use related emissions).
- Does not prioritise or limit the use of Entity-defined allocation approaches[xii] for input materials (including Pre-consumer Scrap).
- References third party transparency and carbon footprint accounting guidance[vi,vii,x,xiii].
- Applies across Supply Chain Activities within and between Entities, but not to specific product or shipment outputs.
- Employs a "Sectoral Decarbonisation Approach": convergence on a sectoral emissions intensity target along a 1.5°C Pathway (slope) by (similarly scoped) Entities/assets/corporations/processes, no matter the starting point (baseline).
- Rules for baseline year and Intermediate Target setting are defined.
- Flexible applicability: singular portfolio (Entity) slope, individual Supply Chain Activity slopes or slopes measured across a number of Entities (corporate or group scale).
- For Primary aluminium:
    - Fixed boundary, mine to smelter Casthouse (measured at Casthouse output)
    - Cradle to gate emissions (all direct and upstream indirect)
    - Electrolytic metal only –metal tapped from potroom and subsequently cast
    - Choice of slope - all emissions in a single Pathway or electricity and non-electricity emissions split in two Pathways
- For Casthouses (remelting) and Semi-fabrication
    - Two Pathways per supply chain activity (SCA):
        1) Single procurement slope: scope 3 (indirect emission) category 1 (purchased goods and services) for aluminium inputs only
        2) Process emissions slope: scopes 1 & 2 (direct emissions from owned or controlled sources, and indirect emissions from the generation of purchase energy, respectively)
    - Only two data points are required to generate slopes for each SCA.
- For Material Conversion
    - Single procurement slope (scope 3 category 1)
    - Only one data point is required to generate a slope.

Challenges and limitations

In developing this method the ASI Climate Change Working Group, ASI Standards Committee and ASI Board (November 2023) addressed a number of challenges:

1. Requirement for sectoral reference slopes for Casthouses, with a mix of electrolytic, cast primary and recycled inputs, and for Supply Chain Activities downstream of the Casthouse, requiring emissions and activity data at common points in the supply chain.
2. Applicability to Entities with variable shares of Primary Aluminium in their input and output metal.
3. Utility and application to Entities using different allocation approaches to the carbon footprint of scrap[xii] (as output from and as inputs to their processes).
4. Requirement for reference slopes and methods for standalone processes UPSTREAM of the Smelter Casthouse (e.g., Bauxite Mining and Alumina Refining).

The method outlined below attempts to address items 1-3 above.

Due to limited time and data, item (4) wasn't resolved in 2023. However, this affects fewer than five currently certified ASI Entities (i.e. non-integrated mines/refineries). The ASI Standards Committee has therefore decided to exempt stand-alone Mines and Refineries from use of this method in its first iteration. ASI will work on reference slopes for mining and refining in 2024, for inclusion in an updated version of the method.

Entities can use the associated Microsoft Excel Workbook to generate Entity-level GHG Pathway slopes; box text in the following method indicates the worksheets to be used or referenced.

The Sectoral Decarbonisation Approach (SDA)

SDA Calculations

The Sectoral Decarbonisation Approach (SDA) is a method to derive a company specific benchmark from sector specific decarbonisation trajectory. The calculation steps are as follows:

$$\boldsymbol{d = CI_b - SI_{2050}}$$

d: Initial performance in base year relative to 2050 sector target
CI_b: Company emissions intensity in base year
SI_{2050}: Sector emissions intensity in year 2050

$$\boldsymbol{p_y = \frac{SI_y - SI_{2050}}{SI_b - SI_{2050}}} = \frac{\text{Intensity reduction from target year to 2050}}{\text{Intensity reduction from base year to 2050}}$$

p_y: Decarbonisation index of the sector in year y
SI_y: Sector emissions intensity in year y
SI_b: Sector emissions intensity in base year
SI_{2050}: Sector emissions intensity in 2050

$$\boldsymbol{CI_y = d \times p_y + SI_{2050}}$$

CI_y: Company emissions intensity benchmark in year y

Figure 1 Sectoral Decarbonisation Approach (SDA) calculation steps from Center for Climate Aligned Finance Sustainable Aluminum Finance Framework[ix]

A reference cradle-to-gate sectoral emissions intensity slope is already well articulated (by IAI) for Primary Aluminium[iv,viii] (cast electrolytic metal measured at the output of the Smelter Casthouse). Although this covers the majority of current sectoral emissions, it is not applicable to all ASI Entities, in particular those downstream of the (Smelter) Casthouse:

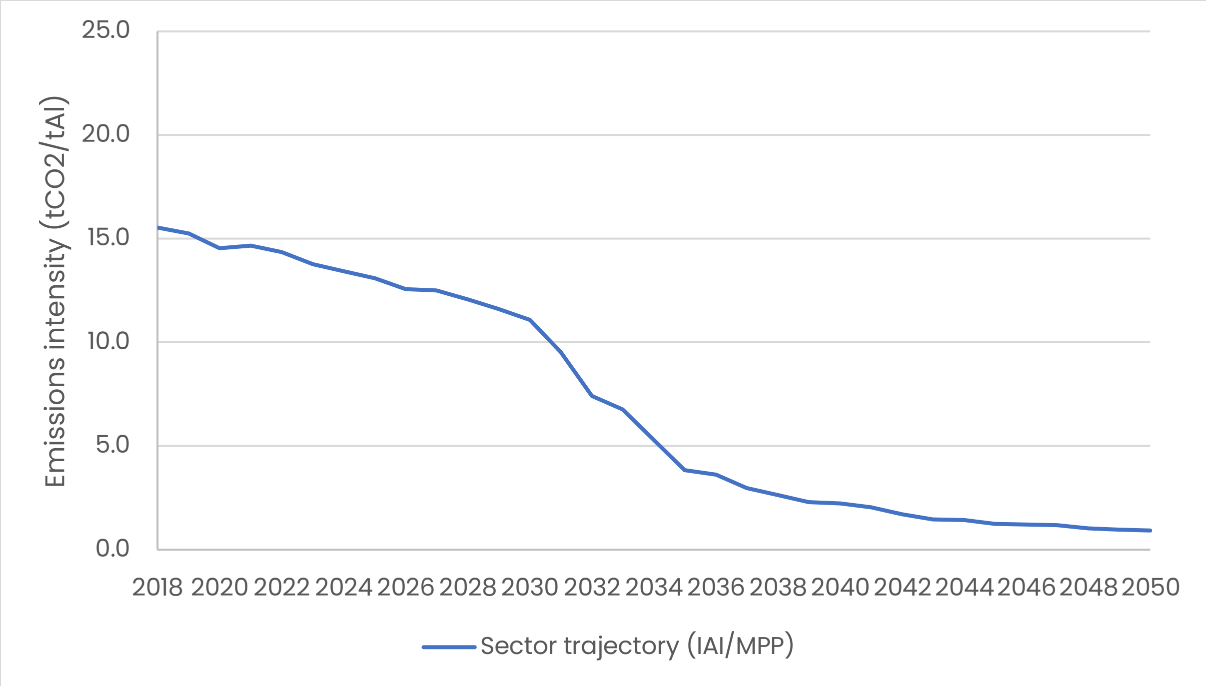

Figure 2 Primary Aluminium Sector 1.5 Degree-Aligned Global Average Emissions Intensity (cradle-to-gate)

Further work by the *Center for Climate Aligned Finance*[ix] has split this reference slope into electricity- and non-electricity-related emissions curves. This is useful because, for Primary Aluminium production, the emissions from electricity used in electrolysis (a key process in aluminium production) vary significantly by power source and are the main factor in total emissions. By splitting the calculations, we can more accurately track and address the different rates at which these emissions sources change.

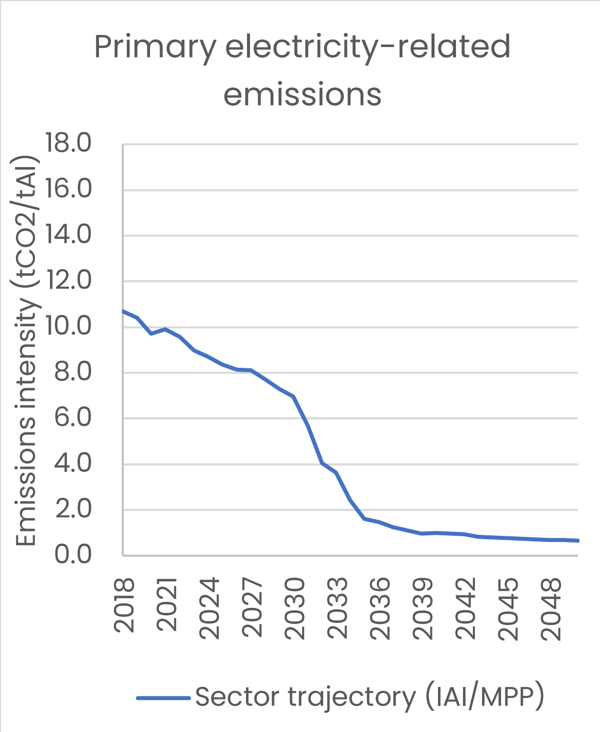

Figure 3 Primary Aluminium Sector Electricity-related Emissions Intensity Pathway (cradle-to-gate)

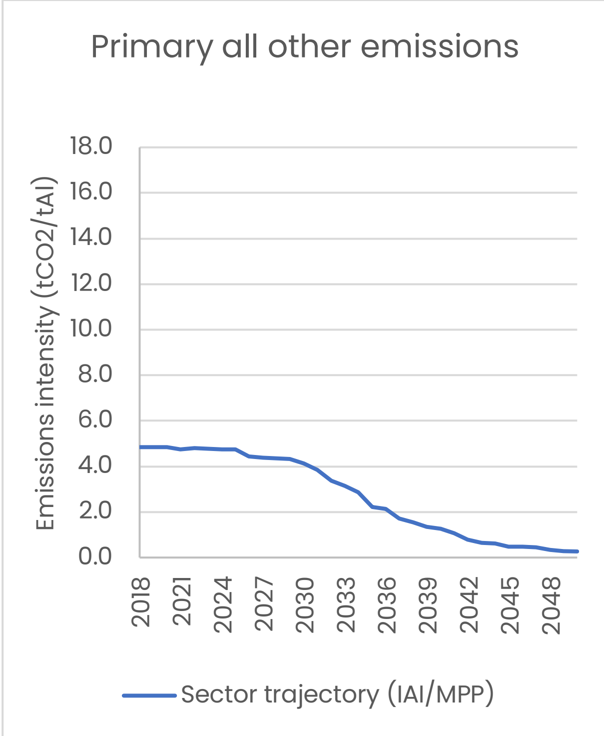

Figure Primary Aluminium Sector Other Emissions Intensity Pathway (cradle-to-gate)

Using these slopes, the SDA calculation above can be applied to Smelter Casthouses using 100% electrolytic aluminium with a range of baseline emissions intensities to plot 1.5 degree aligned pathways specific to the individual Smelter Casthouse. In order to be 1.5 degree aligned, the Entity would have emissions intensity performance in a given Intermediate Target year be at or below the given slope.

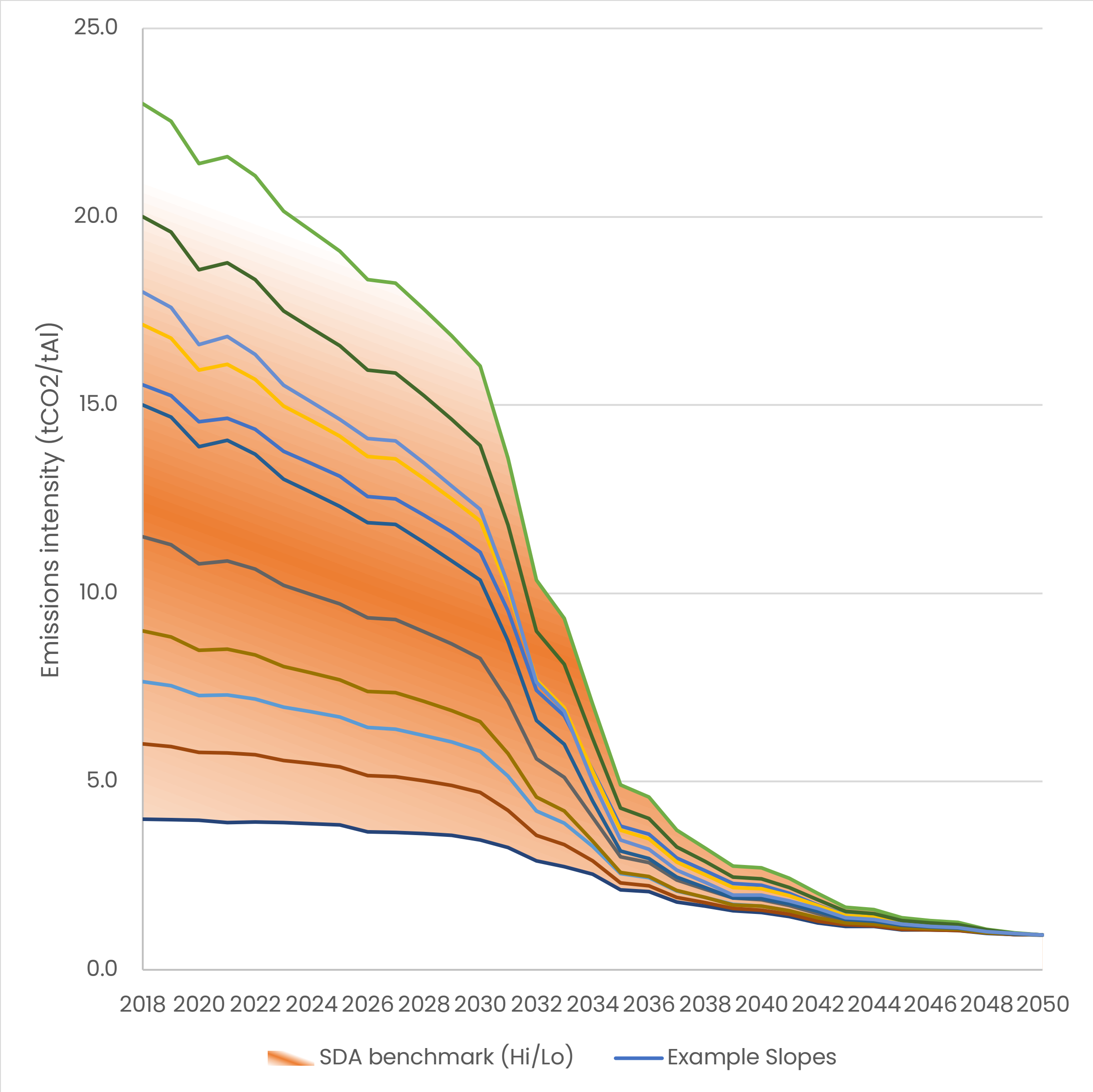

Figure 4 Example Emission Intensity Pathways (slopes) for Smelter Casthouses - 100% electrolytic metal (cradle-to-gate)

Sectoral Reference Slopes

EXCEL WORKSHEET:	Sectoral Slopes

Primary Aluminium

As described above, reference slopes exist for Primary Aluminium[iv,viii], measured at the Smelter Casthouse and these are used unchanged in this method, although an option is given for Entities to use single slopes or split slopes (split between electricity and non-electricity emissions).

An option is also included for a single (mass-weighted) Entity slope across multiple Smelter Casthouses within a given (Entity) portfolio.

Smelter Casthouses that remelt scrap are not addressed by the IAI/MPP[iv,viii] published sectoral cradle-to-gate slopes; the treatment of scrap in such situations is described in the Casthouse section below.

Casthouse and Post-Casthouse (Semi-fabrication and Material Conversion)

For both Semi-fabrication and Material Conversion activities, the approach proposed is a dual slope:

1. A slope for GHG emissions associated with Aluminium procurement by the Entity. This includes scope 3 (indirect emission) category 1 (purchased goods and services) related to metal inputs, with choice of allocation approach left to the Entity (though with requirements for transparency of choice and underlying data);
2. A slope for GHG emissions associated with the process. This includes scopes 1 & 2 (direct emissions from owned or controlled sources, and indirect emissions from the generation of purchase energy, respectively)

This dual approach meets the requirements of covering "all Direct and Indirect emissions", as defined by the Climate Change Working Group as being cradle to gate, albeit not in a singular slope.

Center for Climate Aligned Finance sectoral gate to gate slopes[ix] (IAI/MPP derived[iv,viii]) are used for Casthouse and Semi-fabrication process emissions.

One challenge for Material Conversion process emissions is that there is no published sectoral data for these processes. These are likely to be low compared to scope 3 category 1 emissions embodied in the input Aluminium material. Thus, for Material Conversion, conformance against only one slope (procurement) is required.

Future iterations of this method may include emissions related to processes after the semi-fabrication stage. While no annual sectoral slope exists for non-primary cradle-t-gate system boundaries, IAI do publish 1.5 degree scenario emissions data (and associated activity data) for key years to 2050 (2018, 2030, 2035, 2040, 2045, 2050)[iv]:

INTERNATIONAL ALUMINIUM

1.5° Scenario for the Aluminium Sector

Table 1: 1.5 GHG Budget Aluminium Sector

	CO_2e emissions (Mt)					
	2018	2030	2035	2040	2045	2050
Electricity (Electrolysis)	670	461	74	15	6	6
Electricity (Other)	33	27	20	14	9	4
Aluminium Industry	279	231	176	120	76	31
Aluminium in Other Sectors + Transport	77	64	49	34	21	9
PFC	35	29	22	15	10	4
Aluminium Sector	1,095	813	341	198	121	53

Table 2: 1.5 Budget Aluminium Sector by Process

	CO_2e emissions (Mt)					
	2018	2030	2035	2040	2045	2050
Primary Aluminium	1,037	756	289	155	87	35
Electrolysis	823	586	165	75	40	18
Refining	171	136	99	63	37	13
Recycled Aluminium	19	22	20	16	10	8
Internal Scrap/Fabrication Scrap	11	9	7	5	3	1
Semis Process	29	26	24	23	21	8
Aluminium Sector	1,095	813	341	198	121	53

Table 3: 1.5 Production

	Aluminium (Mt)					
	2018	2030	2035	2040	2045	2050
Primary Aluminium	64	66	69	71	70	68
Recycled Aluminium	32	49	57	66	74	81
New Scrap/Manufacturing Scrap	13	16	15	15	14	13
Old Scrap/Post-Consumer Scrap	19	33	42	52	60	68
Internal Scrap/Fabrication Scrap	33	36	34	32	30	27
Semis Shipments	95	118	126	138	144	150
Final Product Shipments	82	103	112	123	131	137

New Scrap + Internal Scrap = Pre-Consumer Scrap
Recycled Aluminium = Includes Alloying Elements and Metal Losses
Primary Aluminium = Tapped from Electrolytic Cells or Pots

Table 4: 1.5 Intensity Data (Process Emissions)

	CO_2e emissions intensity (tonnes per tonne)					
	2018	2030	2035	2040	2045	2050
Primary Aluminium	16.1	11.5	4.2	2.2	1.2	0.5
Recycled Aluminium (Gate to Gate)	0.6	0.5	0.4	0.2	0.1	0.1
Semis Process (Gate to Gate)	0.3	0.2	0.2	0.2	0.1	0.1

Figure 5 IAI Dataset '1.5 degrees scenario – a model to drive emissions reduction'

Sectoral procurement intensities can be calculated for these key years by dividing the total emissions cradle-to-gate of input materials at each process stage (Casthouse, Semi-fabrication, Material Conversion) by the output activity data of the preceding stage.

For intervening years (between the IAI key dates) some options were explored (estimates based on linear interpolation and growth interpolation) but the proposed method is to apply the primary intensity slope to the known Casthouse, Semi-fabrication and Material Conversion intensities to estimate (as primary process emissions dominate all emissions intensities post-Smelter).

Casthouse:

- Numerator (emissions of input material): Table 2 row 'Primary Aluminium' (in IAI data above)
- Denominator (Casthouse input activity): Table 3 rows 'Primary Aluminium' + 'Recycled Aluminium' + 'Internal Scrap/Material Conversion Scrap'

For 2018, from IAI published data above:

= Total emissions (Mt CO_2e)/activity (Mt Al)

= (1,037)/(64+32+33) = 1,037/129 = **8.0 t CO_2e/t Al**

Semi-Fabrication:

- Numerator (emissions of input material): Table 2 rows 'Primary Aluminium' + 'Recycled Aluminium' + 'Internal Scrap/Material Conversion Scrap'
- Denominator (semi-fabrication input activity = Casthouse output activity): Table 3 rows 'Primary Aluminium' + 'Recycled Aluminium' + 'Internal/Material Conversion Scrap'

For 2018, from IAI published data above:

= Total emissions (Mt CO_2e)/activity (Mt Al)

= (1,037+19+11)/(64+32+33) = 1,066/129 = **8.2 t CO_2e/t Al**

Material Conversion:

- Numerator (emissions of input material): Table 2 row 'Aluminium Sector'
- Denominator (fab input activity = semi-fabrication output activity): Table 3 row 'Semis Shipments'

For 2018, from IAI published data above:

= Total emissions (Mt CO_2e)/activity (Mt Al)

= 1,095/95 = **11.5 t CO_2e/t Al**

For calculation functions see: EXCEL WORKSHEET: Sectoral Slopes ROWS 19, 21 & 22

Representative Slopes

EXCEL WORKSHEETS: - Primary Archetype Data Tables - Primary (no split) Data Table - Casthouse Procurement Data Table - Semi-fabrication Procurement Data Table - Post-Semi-fabrication Procurement Data Table - Recycling G2G Data Table - Semi-fabrication G2G Data Table

Based on the sectoral average intensity reference slopes, for each activity, archetypal cradle-to-gate slopes have been developed using the SDA calculation articulated above.

These representative slopes are applied on year 2018 intensities that reflect the upper and lower bounds of global performance (but never below the 2050 target intensity) and at an appropriate increment. These are outlined below:

Emissions intensity (cradle to gate) t CO_2e/t Al

Data Table	Baseline upper bound	Baseline lower bound (2050 target)	Annual increment
Primary – electricity	20.0	0.7	-0.1
Primary – non-electricity	10.0	0.3	-0.1
Primary – total	30.0	1.0	-0.1
Casthouse procurement	30.0	0.2	-0.1
Semis procurement	20.0	0.4	-0.1
Post-semis procurement	20.0	0.5	-0.1
Recycling G2G	0.600	0.080	-0.005
Semis G2G	0.500	0.060	-0.005

Pre-2018 Baseline Years

Responding to the fact that some Businesses may have pre-existing baseline years that precede 2018 (the earliest year for which 1.5 aligned sectoral reference slopes exist, per IEA/IAI/MPP), the ASI Standards Committee requested slopes calculated retrospectively from 2016.

Published data[iv] indicates an increase in sectoral emissions between 2016 and 2018, but the ASI Standards Committee is clear that Entity slopes should not be "allowed" to have an upwards trajectory. Thus, 2018 data has been used for years 2016 and 2017 across all supply chain activities. This means that Entity slopes with pre 2018 baselines essentially remain flat until 2018.

This is shown in: EXCEL WORKSHEET: Sectoral Slopes COLUMNS C & D

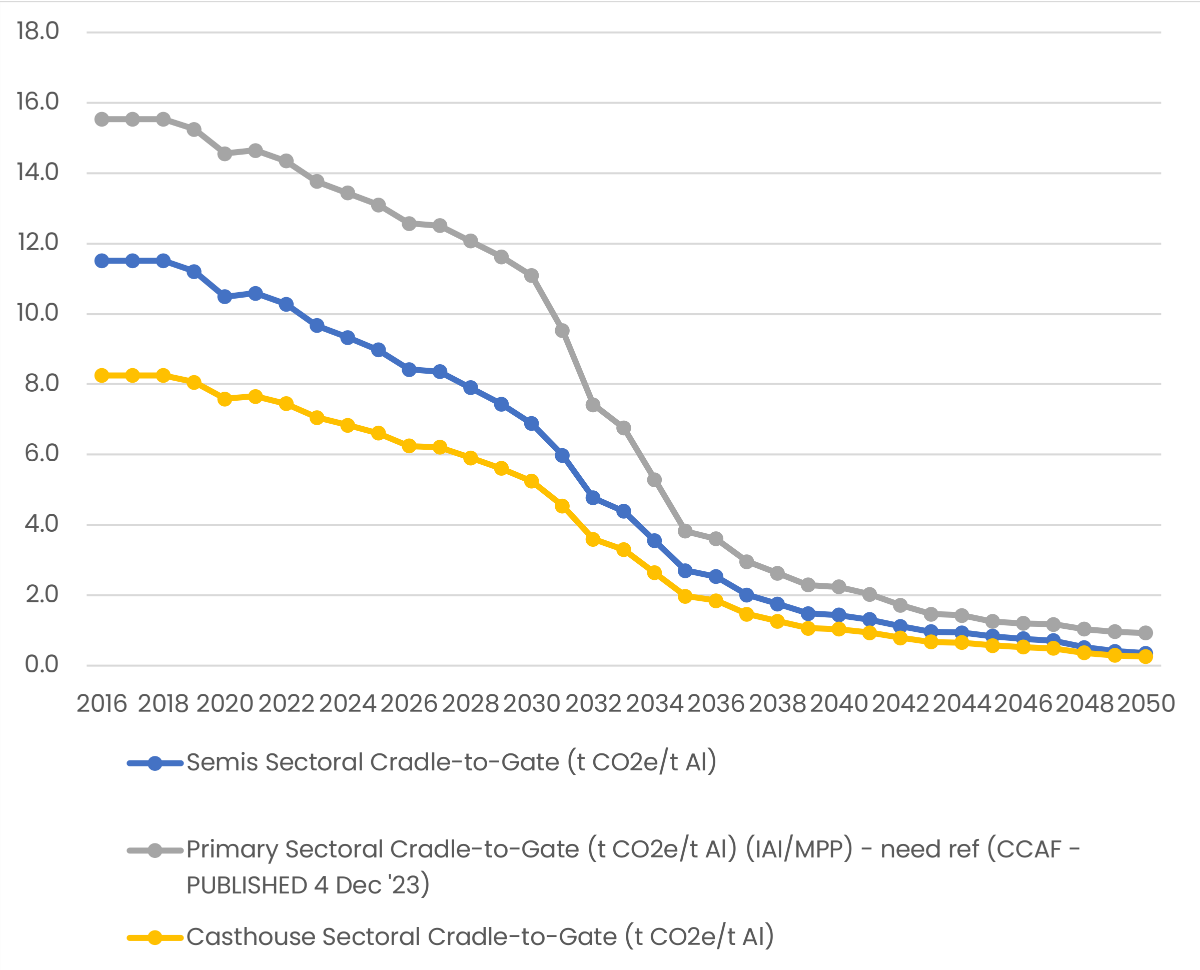

Figure 6 Primary, Casthouse (all primary and recycled) and Semi-fabrication Sector 1.5 Degree-Aligned Global Average Emissions Intensity (cradle-to-gate)

Guidance for Entities

Choice of Baseline Year

EXCEL WORKSHEET: - Baseline year

Entities that are developing GHG Pathways for the first time are encouraged to use the most recent year for which data is available as the baseline year.

If an Entity has more detailed data for a previous year this is acceptable for validation purposes, as long as most recent year data is also disclosed.

If the chosen baseline year is more than 3 years prior to the initial ASI Performance Standard Certification/Re-Certification Audit that is assessing conformance with Criterion 5.3 (e.g. to align with a corporate baseline), the most recent year data should indicate already achieved performance in line with the Entity Pathway in order for the Entity to be in conformance. The baseline year should be fixed for the duration of the Pathway.

Intermediate Targets must cover a period no greater than five years from the chosen baseline year.

Conformance

The table below sets what the GHG Pathway requirements are for different Supply Chain Activities (SCA) of Entities. Stand-alone Bauxite Mining or Alumina Refining Entities are thus excluded from the scope of the method in its first iteration.

<table>
<tr><th></th><th colspan="3">GHG Pathways Slope(s)</th></tr>
<tr><th></th><th>Cradle-to-gate</th><th>Process (scope 1&2)</th><th>Procurement (scope 3 category 1)</th></tr>
<tr><td>Stand-alone Bauxite Mine or Refinery</td><td>✗</td><td>✗</td><td>✗</td></tr>
<tr><td>Smelting (100% electrolytic)</td><td>✓
• Measured at Casthouse output
• Choice of electricity/non-electricity split or single slope</td><td>✗</td><td>✗</td></tr>
<tr><td>Casthouses (including Smelters with Remelting/Refining)</td><td>✗</td><td>✓</td><td rowspan="3">✓
• Choice of individual SCA slopes or single integrated slope</td></tr>
<tr><td>Semi-fabrication</td><td>✗</td><td>✓</td></tr>
<tr><td>Material Conversion</td><td>✗</td><td>✗</td></tr>
</table>

In addition to articulating a GHG Pathway that aligns with (is at or below) the generated Entity slope, conformance with ASI Performance Standard Criterion 5.4 in subsequent Audits would require demonstration of performance that follows (is at or below) the GHG Pathway, averaged over the certification period.

> ***5.4 GHG Emissions Management****. The Entity shall implement the necessary Management System, evaluation procedures, and operating controls to achieve performance aligned to the GHG Emissions Reduction Plan and targets developed in Criterion 5.3*

For example, a (year 2023 baseline) conformant GHG Pathway audited in 2024 that indicates emissions intensity targets over the period 2023-2026 (for a re-certification audit in 2027) of 8.6 (baseline in 2023), 8.4 (2024), 8.2 (2025), 7.8 (2026), would need to demonstrate an average production weighted emissions performance of (8.4+8.2+7.8)/3 = 8.1 over the 3-year period since the last Audit.

Entities with baseline years greater than 3 years prior to the initial Audit would need to demonstrate such performance in the initial Audit, as per choice of baseline year above.

Applicability

While Pathway slopes are specific to Supply Chain activities (Primary cradle-to-gate; Casthouse & Semi-fabrication process; Casthouse Semi-fabrication & Material Conversion procurement), Entities have flexibility in the application of such Pathways across the Business.

As shown below, Entities may apply slopes at group or business unit level (across multiple Entities and even including non-ASI certified assets), they may apply slopes to individual assets within Entities, or multiple assets within Entities.

Note that <u>all</u> Certification Scope assets/Supply Chain Activities that are within the Certification Scope of an ASI Entity have to be included in the Group-level Pathways.

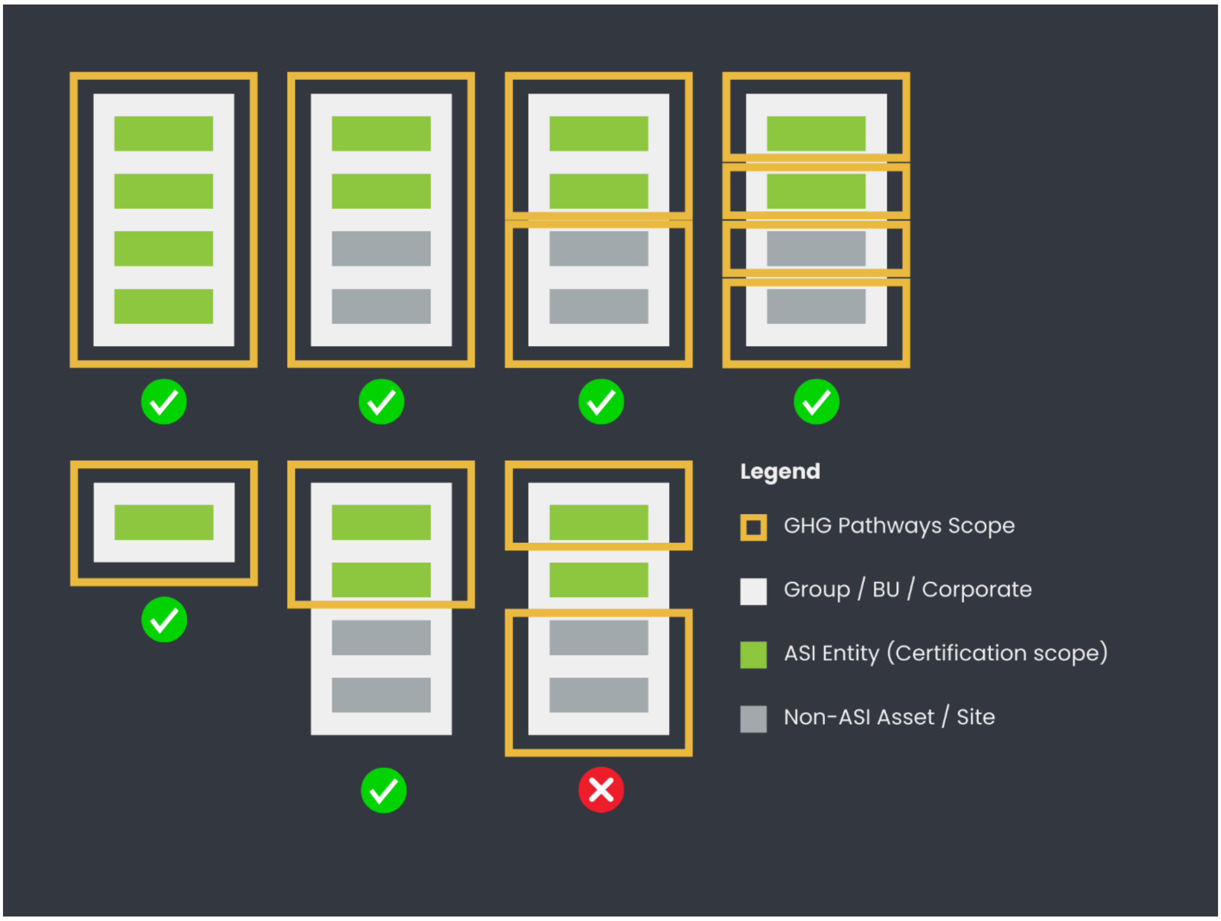

Figure 7 Flexible Applicability of Entity-level Pathways Scope

How to use the Excel Worksheet

For Primary Aluminium (Cradle to Gate)

EXCEL WORKSHEET: Primary C2G (100% electrolytic)

Smelter Casthouses that do not process any scrap (other than run-around scrap) can use the simplified sheet shown above, with a choice to split or combine electricity and non-electricity related emissions.

NOTE that if ANY Smelter Casthouse in the Entity portfolio does not split emissions, then the whole portfolio should use the combined approach.

NOTE too that electricity-related emissions are those from *all* processes cradle to gate, not only electrolysis.

Users enter the following baseline year data for each Smelter Casthouse in the (Entity) portfolio to generate mass-weighted average slope(s). Entities do not have to use this portfolio average approach however – separate slopes per Casthouse can also be articulated (with a separate sheet for each) or other formulations as per the **Applicability** section.

The data to be entered is BASE YEAR emissions intensity and total (Casthouse) production, which reflects 100% electrolytic metal. If the contribution of electricity related emissions to this intensity is known, there is the option to add this data to generate split slopes, although this is optional.

Emissions intensity (carbon footprint) should be calculated in accordance with IAI *Good Practice Guidance for Calculation of Primary Aluminium and Precursor Product Carbon Footprints v2.0*[xiii].

Scope 3 data can be derived using IAI *Scope 3 Calculation Tool & Guidance*[xiv] if required.

SMELTER (CRADLE TO GATE) MEASURED AT CASTHOUSE OUTPUT (COLD METAL) in Baseline YEAR (2021)	Production (t Al)	Cradle to Gate Emissions Intensity (t CO2e/t Al)	...of which Electricity Emissions Intensity, if known (t CO2e/t Al)	Non-Electricity Emissions Intensity (t CO2e/t Al)
Smelter casthouse A				0.0
Smelter casthouse B				0.0
Smelter casthouse C				0.0
Smelter casthouse D				0.0
....INSERT row(s) above to increase portfolio				0.0
Entity production weighted average	0	0.0	0.0	0.0

Figure 8 Calculation Worksheet Data Entry - Primary C2G (100% electrolytic)

The sheet auto-calculates non-electricity related intensities (where relevant) and mass-weighted average intensities across the Entity portfolio, and uses this to generate Entity-specific slope(s), which are plotted on a chart along with the sectoral average, for reference.

The Figure below shows an example of an Entity slope, split between electricity and non-electricity related emissions, alongside sectoral slopes (dotted lines):

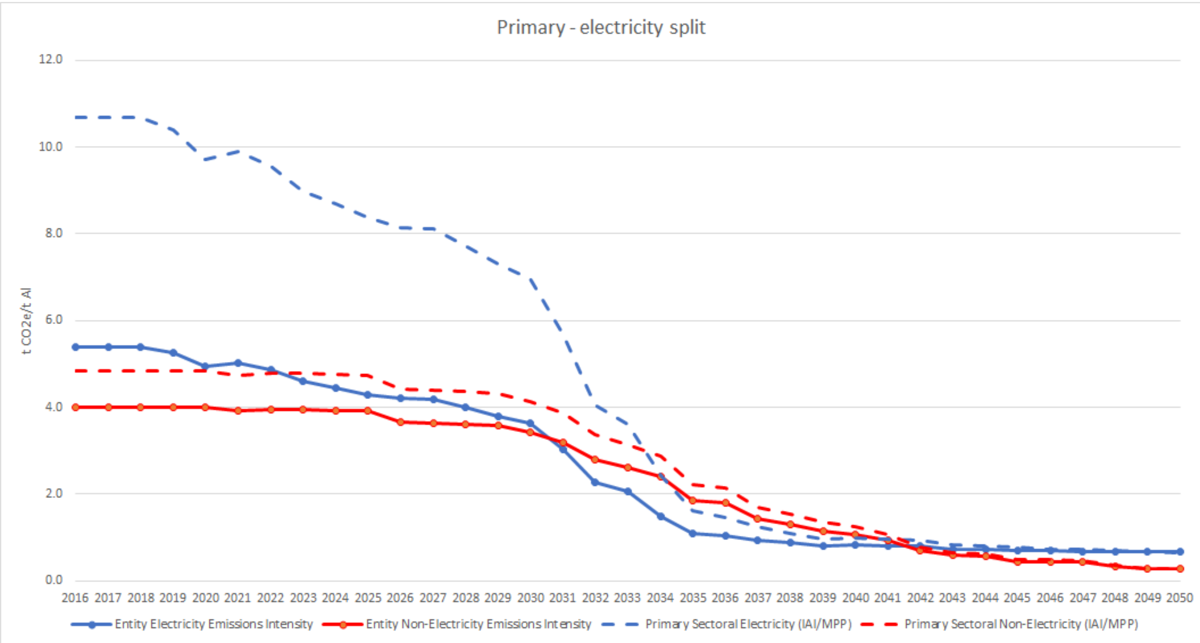

Figure 9 Example of Smelter Casthouse Entity-specific slope, split between electricity and non-electricity related emissions, plotted against the average sectoral emissions

While this method is primarily for use by ASI Certifying Entities, it can be used by any Smelter or group of Smelters to describe 1.5 degree aligned GHG Emission reduction Pathways.

However, for ASI Entities, ASI Performance Standard Criterion 5.2 (shown below) also applies and takes precedence over Criterion 5.3.

Performance Standard v3.1 Criterion 5.2 –
Aluminium Smelter GHG Emissions Intensity

Where an Entity is engaged in Aluminium Smelting and where the Aluminium Smelter:

a. Started production after 2020, the Entity shall demonstrate that the average Mine to Metal Emissions intensity is below 11.0 tonnes CO2e per metric tonne of cast Aluminium (t CO2e/t Al).

b. Was in production up to and including 2020, the Entity shall demonstrate that Mine to Metal Emissions intensity:

i. Is below 11.0 t CO2e/t Al.

or

ii. Has been reduced by a minimum 10% over the previous three reporting periods and that the Entity has established GHG Emissions abatement plans that ensure Mine to Metal Emissions intensity is:

a. below 13.0 t CO2e/t Al by end 2025, and
b. below 11.0 t CO2e/t Al by end 2030

Thus, high-emitting Entities with Criterion 5.3-conformant GHG Pathways would also need to meet the thresholds described in Criterion 5.2, meaning that their emissions slopes would be much steeper than described by the SDA to 2030 – in fact they converge with the sectoral average by 2025 (for Smelters in operation prior to 2020) or 2030 (for Smelters starting operations post-2020), rather than 2050:

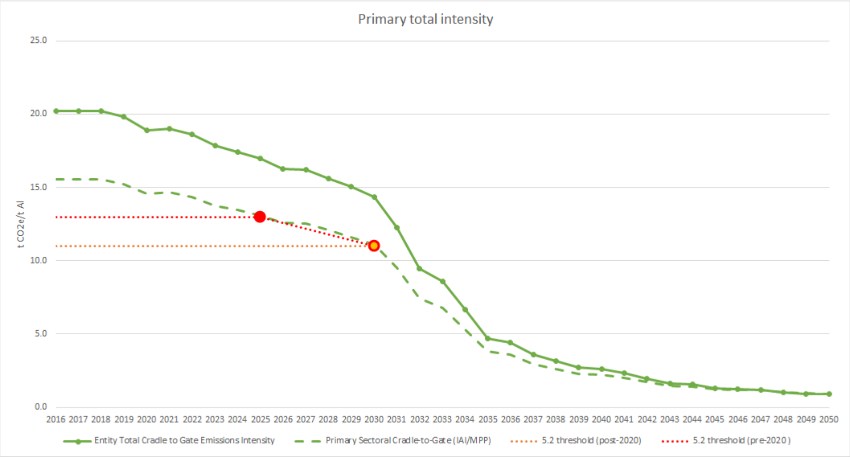

Figure 10 High Emitting Smelter Casthouse Entity Pathway, Sectoral Pathway and Criterion 5.2 Thresholds (2025 & 2030)

For Casthouse and Post-Casthouse containing Entities

EXCEL WORKSHEET: Casthouse & Post-Casthouse Data Entry

ASI Entities which transform Scrap, cast/cold metal, Semi-fabricated or Fabricated Aluminium (predominantly in the Industrial User or downstream Production & Transformation membership categories) should use this sheet to determine their procurement Pathway, scope 3 category 1 (which is a function of the carbon footprint of the input material). For Entities with for semi-fabrication production and casting processes, this sheet is to be used to determine a a scope 1 and 2 Pathway.

This sheet is also to be used by Smelter Casthouse remelting quantities of purchased cold metal/scrap.

The Entity needs to include only one piece of baseline year information per production stage to determine the procurement slope and (for Casthouse and Semi-fabrication) one piece of baseline year information per production stage to determine the scope 1 and 2 (process) slope:

1. Casthouse:

   Non-Smelter procurement:

   - Average mass-weighted emissions intensity of input aluminium (cold metal + liquid metal + scrap (with yield factor applied) entering the Entity certification scope (i.e., purchased or transferred from outside the Entity) in the baseline year.

   Smelter procurement:

   - Average mass-weighted emissions intensity of input aluminium (cold metal + liquid metal + scrap (with yield factor applied) entering the Casthouse process in the baseline year.

   Process emissions:

   - Intensity (scope 1 and 2) of the casting process in the baseline year, measured at Casthouse output across whole Entity portfolio.

2. Semi-fabrication
    - Average mass-weighted emissions intensity of cast aluminium entering the Entity certification scope (i.e., purchased or transferred from outside the Entity) in the baseline year.
    - Not including metal from integrated Casthouse processes (this is captured in the prior process stage (Casthouse).
    - Intensity (scope 1 and 2) of all semi-fabrication processes in the baseline year, measured at semi-fabrication output across whole Entity portfolio.
3. Material Conversion
    - Average mass-weighted emissions intensity of semi-fabricated and fabricated aluminium entering the Entity certification scope (i.e., purchased or transferred from outside the Entity) in the baseline year.
    - Not including metal from integrated semi-fabrication processes (which is captured in the prior process stage (semi-fabrication)

	A	B	C	Type of INPUT to which column B and C applies (column A applies to whole process)
	Process Scope 1+2 Intensity (t CO2e/t Al)	Scope 3 Cat.1 average intensity of PURCHASED Aluminium (including scrap) (t CO2e/t Al) OR, if smelter casthouse: Average emissions intensity of Aluminium INPUT to the casthouse (including liquid electrolytic tapped from pots, cold metal and scrap)	Mass of aluminium INPUT (t Al), Only required if Entity wishes to use a single integrated (multi-process) procurement slope	
Casthouse in Baseline YEAR (2020)				= purchased scrap (not including internal scrap) plus aluminium metal (cold or liquid)
Semi-fabrication process in Baseline YEAR (2020)				= purchased casthouse products (not including those internally produced in integrated casthouse)
Fabrication process in Baseline YEAR (2020)				= purchased semi-fabricated & fabricated products (not including those internally produced in integrated semi-fab or fabrication process)
			0	

Figure 11 Calculation Worksheet Data Entry - Casthouse & Post-CH

The sheet auto-calculates Entity-specific slopes, which are also plotted on separate charts, along with the sectoral slopes for reference.

An integrated procurement slope, mass-weighting inputs across all supply chain activities included, can also be calculated and plotted and the Entity can choose to use this slope instead of multiple procurement slopes. In such a case, the input masses of aluminium (metal and scrap) in the baseline year to which the material footprint must be included in (C).

Process emissions slopes are not integrated and always refer to the individual Supply Chain Activity process outputs.

Emissions intensities (carbon footprints) of input material should include all emissions that are covered by the sectoral system boundary for that process stage, e.g. the share of primary aluminium should include those calculated in accordance with IAI *Good Practice Guidance*[xiii]; cold metal inputs should include emissions associated with prior processes (scope 3 category 1).

Figure 12 Individual Casthouse and Post-Casthouse Procurement & Process Slope Examples

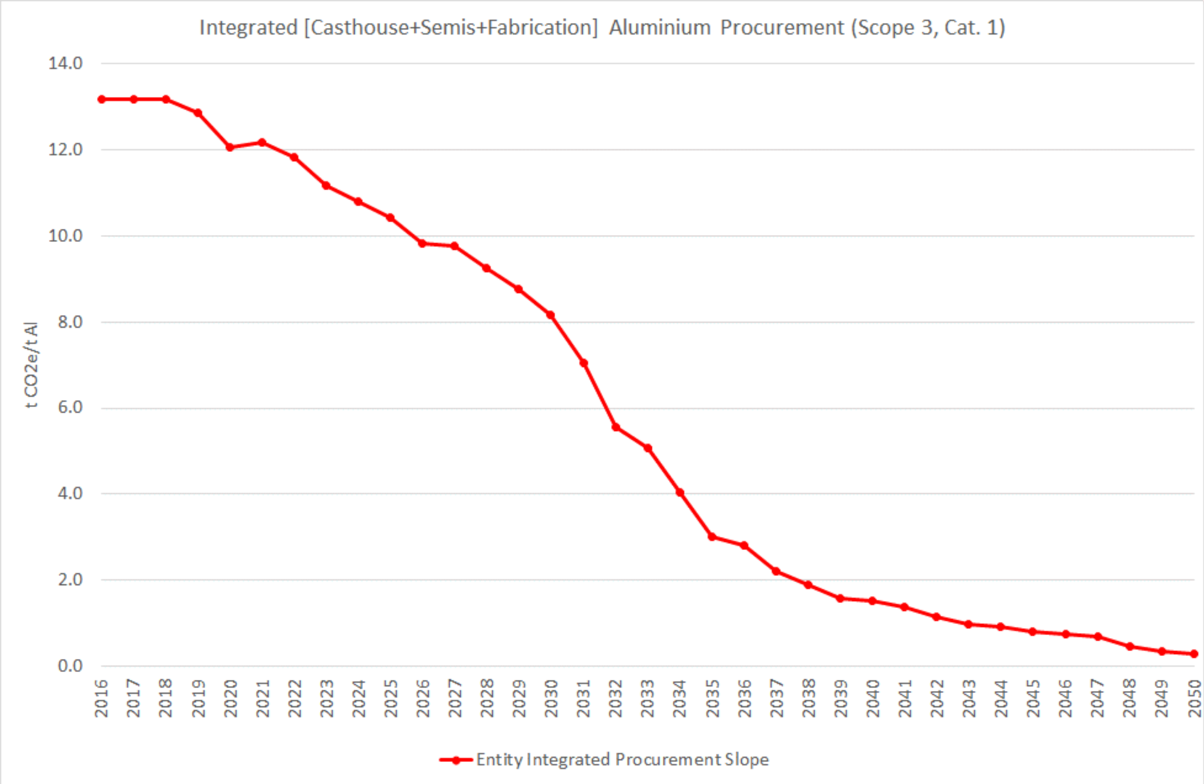

Figure 13 Example Integrated Procurement Slope

The allocation of an emissions burden to the scrap itself (i.e., embodied carbon) is a decision for the Entity – the sectoral slope does not change accordingly (although the Entity slope will). However, Entities should align with the IAI's *Guidelines on Transparency – Aluminium Scrap*[xv], when calculating and communicating the emissions intensity of scrap containing products.

This is an area for further refinement, but in the early years, where primary production emissions dominate, the method captures the most material emissions for Entities and for the sector.

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[iii] International Aluminium Institute (IAI) (2023), *Statistics: Greenhouse Gas Emissions – Aluminium Sector* (25 January 2023), https://international-aluminium.org/statistics/greenhouse-gas-emissions-aluminium-sector/

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[vii] GHG Protocol (2017), *The Aluminium Sector Greenhouse Gas Protocol (Addendum to the WRI/WBCSD Greenhouse Gas Protocol): Greenhouse Gas Emissions Monitoring and Reporting by the Aluminium Industry – revised edition*, https://ghgprotocol.org/sites/default/files/2023-03/aluminium_1.pdf and https://ghgprotocol.org/sites/default/files/2023-03/Aluminium%20Sector%20GHG%20Workbook%20-%20version%202_1_0.xls

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[xii] IAI (2023), DRAFT FOR REVIEW: *Reference Document on Carbon Footprint Calculations of Aluminium Scrap*, https://international-aluminium.org/resource/public-review-guidelines-on-transparency-aluminium-scrap/

[xiii] IAI (2021), *Good Practice for Calculation of Primary Aluminium and Precursor Product Carbon Footprints*, https://international-aluminium.org/resource/good-practice-for-calculation-of-primary-aluminium-and-precursor-product-carbon-footprints/

[xiv] IAI (2022), *Scope 3 Calculation Tool & Guidance*, https://international-aluminium.org/resource/iai-scope3-calcuation-tool-and-guidance/

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