Carbon Performance assessment of aluminium producers: note on methodology

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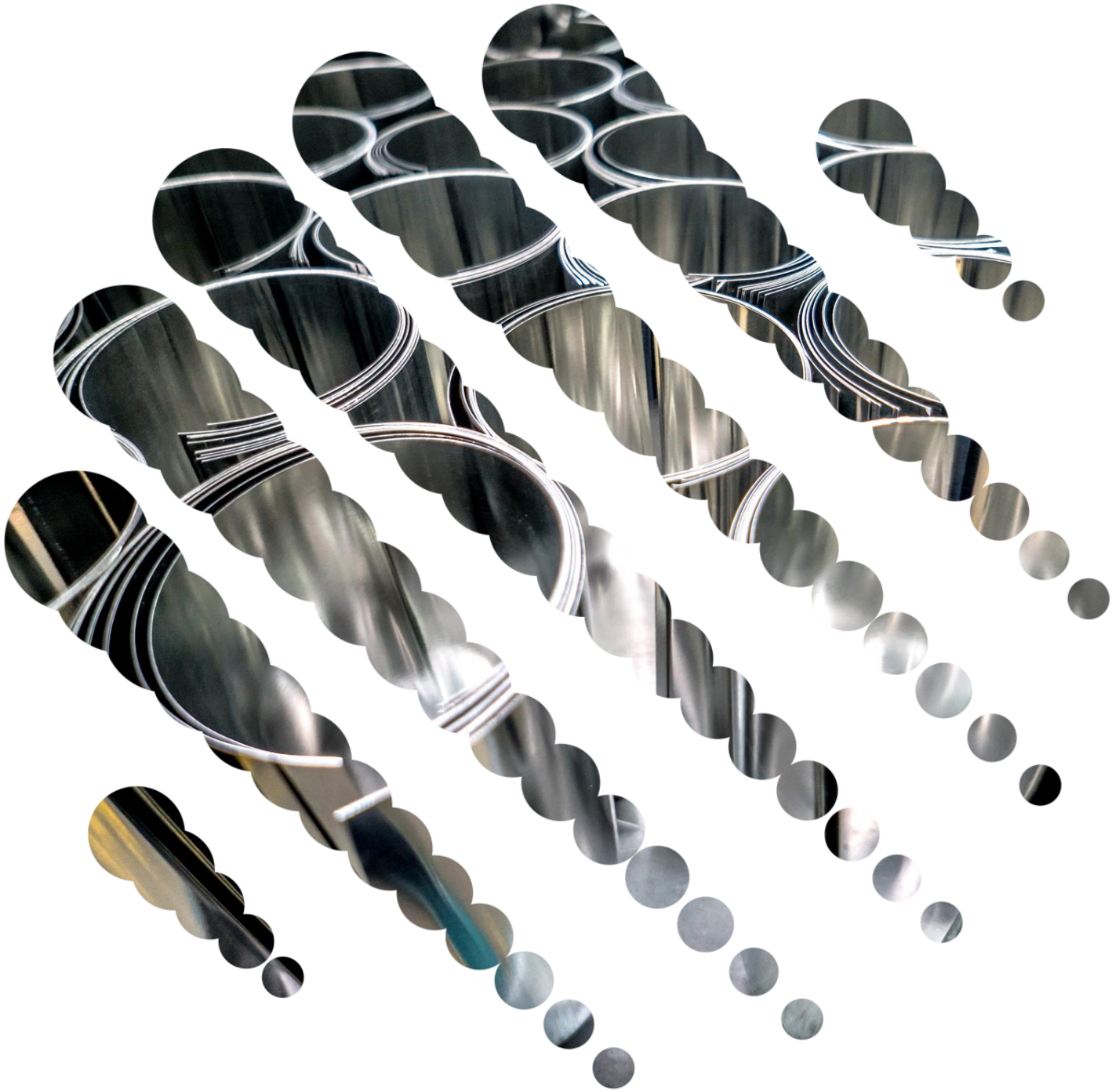

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Transition Pathway Initiative

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1. INTRODUCTION

The Transition Pathway Initiative Global Climate Transition Centre (TPI Centre) is an independent, authoritative source of research and data on the progress of the financial and corporate world in transitioning to a low-carbon economy. The TPI Centre was established in 2022 at the Grantham Research Institute on Climate Change and the Environment, which is based at the London School of Economics and Political Science (LSE). The TPI Centre is the academic partner of the Transition Pathway Initiative (TPI), a global initiative led by asset owners and supported by asset managers. As of April 2023, over 130 investors globally, representing more than US$50 trillion combined Assets Under Management and Advice, have pledged support for TPI. Using companies' publicly disclosed data, the TPI Centre:

- Assesses the quality of companies' governance and management of their carbon emissions and of risks and opportunities related to the low-carbon transition, in line with the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD).
- Assesses whether companies' current and planned future emissions are aligned with international climate targets and national climate pledges, including those made as part of the Paris Agreement.
- Provides the data for the Climate Action 100+ Net Zero Company Benchmark.
- Publishes its methods and results online and fully open access at www.transitionpathwayinitiative.org and on GitHub.

Investors are encouraged to use the data, indicators and online tool to inform their investment research, decision making, engagement with companies, proxy voting and dialogue with fund managers and policy makers, bearing in mind the Disclaimer in section 6. Further details of how investors can use TPI assessments can be found on our website.

This note provides an overview of the latest methodology used by TPI in its assessment of the Carbon Performance of aluminium producers. This is the third update to our aluminium sector methodology, following previous publications in February 2019 and 2021.

2. THE BASIS FOR TPI'S CARBON PERFORMANCE ASSESSMENT: THE SECTORAL DECARBONIZATION APPROACH

TPI's Carbon Performance assessment is based on the Sectoral Decarbonization Approach (SDA).[1] The SDA translates greenhouse gas emissions targets made at the international level (e.g., under the Paris Agreement to the UN Framework Convention on Climate Change) into appropriate benchmarks, against which the performance of individual companies can be compared.[2]

The SDA is built on the principle of recognising that different sectors of the economy (e.g., oil and gas production, electricity generation and automobile manufacturing) face different challenges arising from the low-carbon transition, including where emissions are concentrated in the value chain, and how costly it is to reduce emissions.

Therefore, the SDA takes a sector-by-sector approach, comparing companies within each sector against each other and against sector-specific benchmarks, which establish the performance of an average company that is aligned with international emissions targets.

Applying the SDA can be broken down into the following steps:

- A global carbon budget is established, which is consistent with international emissions targets, for example keeping global warming below 2°C. To do this rigorously, some input from a climate model is required.
- The global carbon budget is allocated across time and to different regions and industrial sectors. This typically requires an integrated economy-energy model, and these models usually allocate emissions reductions by region and by sector according to where it is cheapest to reduce emissions and when (i.e., the allocation is cost-effective). Cost-effectiveness is, however, subject to some constraints, such as political and public preferences, and the availability of capital. This step is therefore driven primarily by economic and engineering considerations, but with some awareness of political and social factors.
- In order to compare companies of different sizes, sectoral emissions are normalised by a relevant measure of sectoral activity (e.g., physical production, economic activity). This results in a benchmark pathway for emissions intensity in each sector:

$$\text{Emissions intensity} = \frac{\text{Emissions}}{\text{Activity}}$$

  Assumptions about sectoral activity need to be consistent with the emissions modelled and therefore should be taken from the same economy-energy modelling, where possible.
- Companies' recent and current emissions intensity is calculated and their future emissions intensity can be estimated based on emissions targets they

[1] The Sectoral Decarbonization approach (SDA) was created by CDP, WWF and WRI in 2015.
[2] Another initiative that is also using the SDA is the Science Based Targets Initiative.

have set (i.e. this assumes companies exactly meet their targets).[3] Together these establish emissions intensity pathways for companies.

- Companies' emissions intensity pathways are compared with each other and with the relevant sectoral benchmark pathway.

[3] Alternatively, future emissions intensity could be calculated based on other data provided by companies on their business strategy and capital expenditure plans.

3. HOW TPI IS APPLYING THE SDA

3.1. Deriving the benchmark paths

The key inputs to calculating the benchmark paths are:

- A time path for carbon emissions, which is consistent with the delivery of a particular climate target (e.g., limiting global warming to 1.5°C). Consistency requires that cumulative carbon emissions are within the associated carbon budget.
- A breakdown of this economy-wide emissions path into emissions from key sectors (the numerator of sectoral emissions intensity).
- Consistent estimates of the time path of physical production from, or economic activity in, these key sectors (the denominator of sectoral emissions intensity).

For the aluminium sector, TPI obtains these inputs from the International Aluminium Institute (IAI) [1], as well as the International Energy Agency (IEA) via its *Energy Technology Perspectives* (ETP) [2], [3] and *World Energy Outlook* (WEO) reports [4].

The first two versions of TPI's aluminium sector methodology used data from the IEA. However, IEA stopped publishing aluminium sector data for all its scenarios in 2020. The IAI collects data from aluminium manufacturers worldwide and has developed several sector decarbonisation scenarios [1]. We have analysed total emissions from the aluminium sector in the IAI scenarios and established that they are consistent with the carbon budget allocated to aluminium in the equivalent IEA scenarios.[4]

TPI uses the IAI's and IEA's work to derive three emissions benchmarks, against which companies are evaluated:

1. A **1.5 Degrees** benchmark, which is consistent with the overall aim of the Paris Agreement at the high end of the range of ambition, namely to limit "the increase in the global average temperature to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels" [6].
2. A **Below 2 Degrees** scenario, which is also consistent with the overall aim of the Paris Agreement to limit warming, albeit at the middle of the range of ambition [6].
3. A **National Pledges** scenario, which is consistent with the global aggregate of emissions reductions related to policies introduced or under development as of mid-2021 [7].

We use IAI data on aluminium production and associated emissions for the 1.5 Degrees, Below 2 Degrees, and National Pledges benchmarks. The IAI's modelling output includes direct CO_2 emissions from alumina refining and aluminium manufacturing (process-related and energy-related emissions excluding emissions

[4] The IAI's 1.5 Degrees and Below 2 Degrees scenarios are consistent with the IEA's Net Zero Emissions (NZE) Scenario [5] and Sustainable Development Scenario (SDS) [3], respectively.

from own electricity generation), direct perfluorocarbon (PFC) emissions, and emissions from electricity consumption, including emissions from self-generated power in the aluminium sector.

We use these data points directly for the two most ambitious aluminium benchmarks, 1.5 Degrees and Below 2 Degrees, after making an adjustment to account for the fact that the IAI scenarios include emissions related to semi-finished products, which are outside the scope of our company assessments. Semi-finished products are produced from aluminium ingots or billets through rolling, extrusion, forging and casting [8]. According to the IAI's 2018 emissions data [1], emissions from semis production represented 11.8% of process emissions and 2.3% of indirect emissions from electricity consumption. Moreover, the proportion of semis production in overall production remains constant in all IAI scenarios. Therefore, we make constant downwards adjustments to direct emissions and electricity emissions in the IAI database of 11.8% and 2.3%, respectively.

The third IAI scenario is labelled Business as Usual, but in fact our analysis of the aluminium sector's share of broader industry emissions shows that this scenario is consistent with IEA's Stated Policies (STEPS) scenario, which includes national emissions reduction policies. Therefore, we use direct emissions and PFC emissions figures from IAI's Business as Usual scenario in our National Pledges benchmark. For indirect emissions from electricity consumption in our National Pledges benchmark, we obtain historical electricity emissions (2014-2018) from IAI and then assume they decrease at the same rate as the grid emissions intensity in the TPI Electricity Utilities National Pledges benchmark, which is based on IEA data. Using ETP 2017 [3] data on regional aluminium production under the Reference Technology Scenario, we derive a weighted-average reduction rate for the grid intensity, which we apply to the sector's electricity emissions.

For example, in 2018 the electricity emissions of the aluminium sector were 687 MtCO2e, the ratio of OECD to non-OECD production was 28% and the grid intensities for the OECD and non-OECD regions were 0.35 tCO2e/MWh and 0.57 tCO_2e/MWh respectively. Similarly, the growth rate for grid intensities from 2018 to 2019 are -5.96% for OECD countries and -0.60% for non-OECD countries. Therefore, the aluminium electricity emissions are estimated to be 687 * ((1-5.96%) * 28% + (1-0.60%) * 72%) = 672 MtCO2e in 2019. Given that the National Pledges scenario involves less ambitious emissions reductions than the Below 2 Degrees scenario, we ensure that benchmark values for the former are always higher or equal to those in the latter.

Figure 1 Benchmark global carbon intensity benchmarks for the aluminium sector

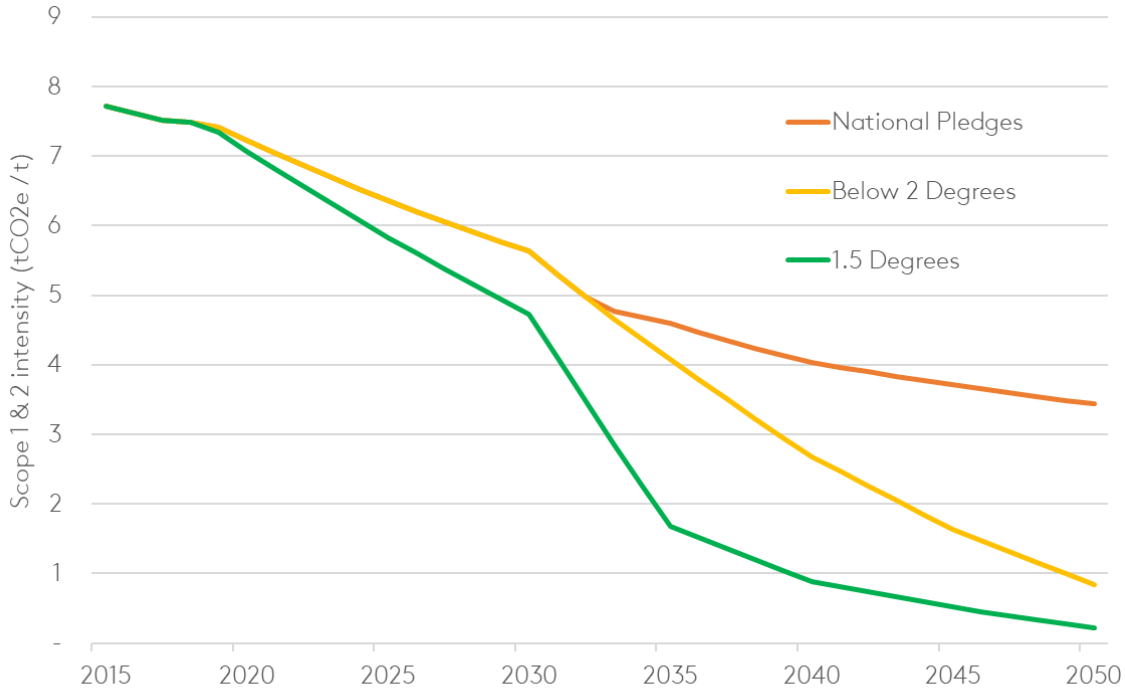


Figure 1 shows the emissions intensity benchmarks for the aluminium sector, while Table 1 provides the underlying data on emissions and aluminium production. For example, under the Below 2 Degrees scenario in 2025, global Scope 1 and 2 emissions from the aluminium sector are projected to be 898 mega tonnes of CO_2. Scope 1 PFC emissions are projected to be 35 Mt CO_2e. Under the same scenario, total aluminium production is projected to be 147 Mt in 2025. Therefore, the carbon intensity of an aluminium producer aligned with the Below 2 Degrees scenario is at most (898 + 35) / 147 = 6.36 tonnes of CO_2e per tonne of aluminium produced.

Table 1 Projections of emissions and aluminium production used to calculate intensity benchmarks (Source: IAI, IEA and own calculations)

	2018	2025	2030	2040	2050
National Pledges scenario					
Scope 1+2 CO_2 emissions ($MtCO_2$)	**933**	**843**	**793**	**800**	**765**
Scope 1 PFC emissions (Mt CO_2e)	35	37	37	45	48
Aluminium production (Mt)	**129**	**147**	**159**	**202**	**232**
Carbon intensity (tCO_2e / t aluminium)	**7.49**	**6.36**	**5.63**	**4.19**	**3.50**
Below 2 Degrees Scenario					
Scope 1+2 CO_2 emissions (Mt CO_2)	**933**	**898**	**861**	**513**	**175**
Scope 1 PFC emissions (Mt CO_2e)	35	35	35	28	19
Aluminium production (Mt)	**129**	**147**	**159**	**202**	**232**
Carbon intensity (tCO_2e / t aluminium)	**7.49**	**6.36**	**5.63**	**2.68**	**0.83**

	1.5 Degrees Scenario				
Scope 1+2 CO_2 emissions (Mt CO_2)	**933**	792	680	135	37
Scope 1 PFC emissions (Mt CO_2e)	35	29	26	13	4
Aluminium production (Mt)	**129**	141	150	170	188
Carbon intensity (tCO_2e / t aluminium)	**7.49**	**5.83**	**4.73**	**0.88**	**0.22**

3.2. Calculating company emissions intensities

TPI's assessments of corporate emissions intensity pathways are based on public disclosures by companies. In any given sector, disclosures that are useful to TPI's Carbon Performance assessments tend to come in one of three forms:

1. Some companies disclose their recent and current emissions intensity and some companies have also set future emissions targets in intensity terms. Provided these are measured in a way that can be compared with the benchmark scenarios and with other companies (e.g., in terms of scope of emissions covered and measure of activity chosen), these disclosures can be used directly. In some cases, adjustments need to be made to obtain estimates of emissions intensity on a consistent basis. The necessary adjustments will generally involve sector-specific issues (see below).
2. Some companies disclose their recent and current emissions on an absolute (i.e., un-normalised) basis. Provided emissions are appropriately measured, and an accompanying disclosure of the company's activity can be found that is also in the appropriate metric, recent and current emissions intensity can be calculated by TPI.
3. Some companies set future emissions targets in terms of absolute emissions. This raises the particular question of what to assume about those companies' future activity levels. The approach taken by TPI is to assume company activity increases at the same rate as the sector as a whole (i.e., this amounts to an assumption of constant market share), using sectoral growth rates in order to be consistent with the benchmarks. While companies' market shares are unlikely to remain constant, there is no obvious alternative assumption that can be made, which treats all companies consistently. Sectoral production growth rates from the IAI's Business as Usual scenario are used.

The length of companies' emissions intensity paths will vary depending on how much information companies provide on their emissions since 2013, as well as the time horizon for their emissions targets.

3.3. Emissions reporting boundaries

Company emissions disclosures vary in terms of the organisational boundary that a company sets. There are two high-level approaches: the equity share approach and the control approach, and within the control approach there is a choice of financial

or operational control. Companies are free to choose which organisation boundary to set in their voluntary disclosures and there is variation between companies assessed by TPI.

TPI accepts emissions reported using any of the above approaches to setting organisation boundaries, as long as:

1. The boundary that has been set appears to allow a representative assessment of the company's emissions intensity;
2. The same boundary is used for reporting company emissions and activity, so that a consistent estimate of emissions intensity is obtained.

At this point in time, limiting the assessment to one particular type of organisation boundary would severely restrict the breadth of companies TPI can assess.

When companies report historical emissions or emission intensity under *both* the equity share and control approaches, as is sometimes the case, TPI chooses the reporting boundary that seems most appropriate, based on the criteria of consistency with the reporting of activity, consistency with the target, and the length of the available time series of disclosures.

3.4. Data sources and validation

All company data in TPI come from companies' own disclosures. The sources for the Carbon Performance assessment include responses to the annual CDP questionnaire, as well as companies' own reports, e.g., sustainability reports.

Given that TPI's Carbon Performance assessment is both comparative and quantitative, it is essential to understand exactly what the data in company disclosures refer to. Company reporting varies not only in terms of what is reported, but also in terms of the level of detail and explanation provided. The following cases can be distinguished:

- Some companies provide data in a suitable form and they provide enough detail on those data for analysts to be confident appropriate measures can be calculated or used.
- Some companies also provide enough detail, but from the detail it is clear that their disclosures are not in a suitable form for TPI's Carbon Performance assessment (e.g., they do not report the measure of company activity needed). These companies cannot be included in the assessment.
- Some companies do not provide enough detail on disclosed data and these companies are also excluded from the assessment (e.g., the company reports an emissions intensity but does not explain precisely what it refers to).
- Some companies do not disclose their carbon emissions and/or activity.

Once a company's preliminary Carbon Performance assessment has been made based on the principles and procedures described above, it is subject to the following quality assurance:

- *Internal findings review*: the preliminary assessment is reviewed by analysts who were not originally involved in making it.
- *Company review*: once the initial findings review is complete, TPI writes to companies with their assessment and requests companies to review it and confirm the accuracy of the company disclosures being used. The company review includes all companies, i.e., it also includes those who provide unsuitable or insufficiently detailed disclosures.
- *Final assessment*: company assessments are reviewed and, if it is considered appropriate, revised.

3.5. Responding to companies

Allowing companies the opportunity to review and, if necessary, correct their assessments is an integral part of TPI's quality assurance process. We send each company its draft TPI assessment and the data that underpin the assessment, offering them the opportunity to review and comment on the data and assessment. We also allow companies to contact us at any point to discuss their assessment.

If a company seeks to challenge its result/representation, our process is as follows:

- TPI reviews the information provided by the company. At this point, additional information may be requested.
- If it is concluded that the challenge has merit, the assessment is updated.
- If it is concluded that there are insufficient grounds to change the assessment, TPI publishes its original assessment.
- If the company requests an explanation regarding its feedback after the publication of its assessment, TPI explains the decisions taken.
- If a company requests an update of its assessment based on data publicly disclosed after the research cut-off date communicated to the company, TPI can note the new disclosure on the company's profile on the TPI website.
- If a company chooses to further contest the assessment and reverts to legal means to do so, the company's assessment is withheld from the TPI website and the company is identified as having challenged its assessment.

3.6. Presentation of assessment on TPI website

The results of the Carbon Performance assessment will be posted on the TPI website, within the TPI tool (http://www.lse.ac.uk/GranthamInstitute/tpi/the-toolkit/). On each company page, its emissions intensity path will be plotted on the same chart as the benchmarks for the relevant sector. Different companies can also be compared on the toolkit main page, with the user free to choose which companies to include in the comparison.

4. SPECIFIC CONSIDERATIONS IN THE ASSESSMENT OF ALUMINIUM PRODUCERS

4.1. Measure of emissions intensity

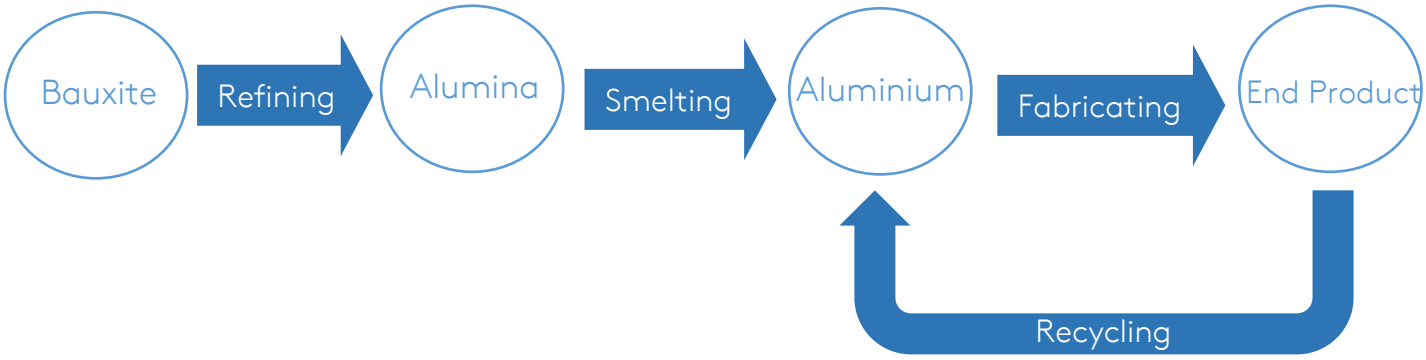
In the aluminium sector, the specific measure of emissions intensity used by TPI is:

- Scope 1 and 2 greenhouse gas emissions from aluminium production, per unit of (primary and recycled) aluminium produced, in units of metric tonnes of CO_2 equivalent per tonne of aluminium.

Unlike some other sectors assessed by TPI (e.g., cement and electricity utilities), Scope 2 emissions from purchased electricity are sufficiently important in the aluminium sector that they should be included in the measure of company emissions, alongside direct or Scope 1 emissions. According to IAI modelling, global Scope 2 emissions from aluminium production were 71% of total Scope 1 and 2 emissions in 2018 for example [1].

Three processes of aluminium production are of interest for the calculation of a company's primary and secondary aluminium emissions intensity, namely alumina refining, aluminium smelting and aluminium recycling (see Figure 2). Emissions from bauxite mining are not included in the Carbon Performance methodology for assessing aluminium producers, as this is considered within TPI's diversified mining methodology.

Figure 2 The aluminium production process



The objective of TPI's assessment is to only measure emissions from aluminium production, so that emissions arising from any other activities that companies are engaged in are excluded, otherwise companies' emissions intensity may be mis-estimated. However, some aluminium companies with additional businesses label their disclosed emissions as being operations-wide, rather than being specific to aluminium production. When this is the case, further assessment is required of whether the company in question has included significant sources of emissions other than aluminium production, or whether operations-wide and aluminium-production-specific emissions are equivalent, or at least approximately so.

The emissions profiles of primary and secondary (i.e. recycled) aluminium production are very different, with aluminium recycling typically accounting for 5% of the emissions needed to produce primary aluminium [9], [10]. Producing secondary aluminium therefore significantly reduces a company's overall emissions intensity. In cases where a company discloses secondary aluminium production numbers but not the corresponding emissions, TPI will assume that the emissions intensity of secondary aluminium is equal to 5% of its primary aluminium emissions intensity.

Once bauxite is refined into alumina, companies can decide to either smelt it into aluminium or sell it. When a company decides to sell some of its alumina, their final primary aluminium production no longer represents the amount of primary aluminium created from their alumina. Hence, dividing their emissions from the refining process by their reported primary aluminium production would result in an overestimation of their emissions intensity. Consequently, the alumina production volume needs to be converted to a primary aluminium production volume that the company *would have* produced had it not sold any of its alumina. We use the company's own reported rate to calculate the primary aluminium equivalent of their alumina. This conversion rate is on average 2 metric tonnes of alumina to 1 metric tonne of aluminium.

Companies have flexibility to disclose aggregate emissions data from different stages of the aluminium production process. This can lead them to include activities that are outside the scope of TPI's assessment. For example, a company involved in bauxite mining and alumina refining can disclose the sum of emissions from these activities. In this case, TPI needs to separate out the emissions from the activities relevant to our assessment. If production volumes are disclosed in a disaggregated manner, we use the ratio of bauxite to alumina production and apply it to the aggregate emissions figure.

Often, aluminium companies report their emissions in terms of CO_2-equivalent, capturing both CO_2 and non-CO_2 greenhouse gas emissions.[5] In cases where companies disclose only CO_2 emissions, we adjust the reported emissions by adding 4.27% to estimate total CO_2-equivalent emissions (as per IAI reported figures).

4.2. Coverage of aluminium-making facilities

While some aluminium producers disclose emissions from all their facilities, others explicitly do not, or it is unclear from their disclosures. When it is explicitly incomplete or unclear, further assessment is required of whether coverage is incomplete, to what extent it is incomplete and whether the omission of some facilities is likely to bias the estimate of a company's emissions intensity. Ultimately TPI makes a judgement on whether its estimate of a company's emissions intensity is likely to be biased, and sufficiently so for the company to be excluded from the Carbon Performance assessment, in line with the principles set out in Section 3.3 above.

[5] PFCs represent nearly all non-CO_2 greenhouse gases emissions in the aluminium sector.

4.3. Coverage of target

There are often differences in the scope of companies' emissions targets:

- In the aluminium sector, some companies have set specific targets to reduce Scope 1 and 2 emissions from alumina refining and aluminium smelting, while others have set targets covering company-wide Scope 1 and 2 emissions (i.e. covering more than just alumina refining and aluminium smelting). In the case of a pure-play aluminium producer, where a target covers more than just Scope 1 and 2 emissions from refining and smelting, it is assumed – in the absence of any other specific information – that the percentage reduction in emissions is uniform across activities (and scopes), so the target percentage (e.g. a 20% cut) can be directly applied to Scope 1 and 2 emissions from refining and smelting.
- By contrast, in the case of a diversified company involved in more sectors than just aluminium, it may be inappropriate to apply a company-wide target. In such cases, we (conservatively) assume that the targets are primarily met through mitigation in non-aluminium activities. If emissions reductions remain after non-aluminium mitigation options are exhausted, we apply the remaining reduction to the company's aluminium business.
- Some companies set targets that only apply to Scope 1 emissions, as opposed to Scope 1 and 2 emissions from aluminium production. Relevant emissions intensities that are not covered by the target are assumed to be unchanged from the latest disclosure year.
- Companies often express targets relative to emissions in a base year (e.g. 2007), but they do not always report Scope 1 and 2 emissions from aluminium production in the base year, instead reporting base year emissions in a different scope (e.g. they include upstream Scope 3 emissions in 2007). If a company does not report Scope 1 and 2 emissions from aluminium production in the base year, these are estimated using the ratio of Scope 1 and 2 emissions from aluminium production to emissions in the company's chosen scope over the last three years (cumulatively).[6]
- Some companies have set a target to be carbon neutral in their Scope 1, 2, and 3 lifecycle emissions. Companies could offset their emissions by, for example, restoring forests (which can serve as carbon sinks), or employing carbon capture and storage technologies. TPI can accept such targets in principle, subject to the use of offsetting being consistent with the benchmarks. However, the concept of "avoided emissions" through the use of aluminium, instead of more carbon-intensive metals such as steel, is not accepted, because it is inconsistent with the benchmarks.

[6] Due to the occasional practice of companies re-basing their emissions, this adjustment is preferred to using disclosures of base year Scope 1 and 2 emissions from aluminium production from past years' reporting.

4.4. Worked examples[7]

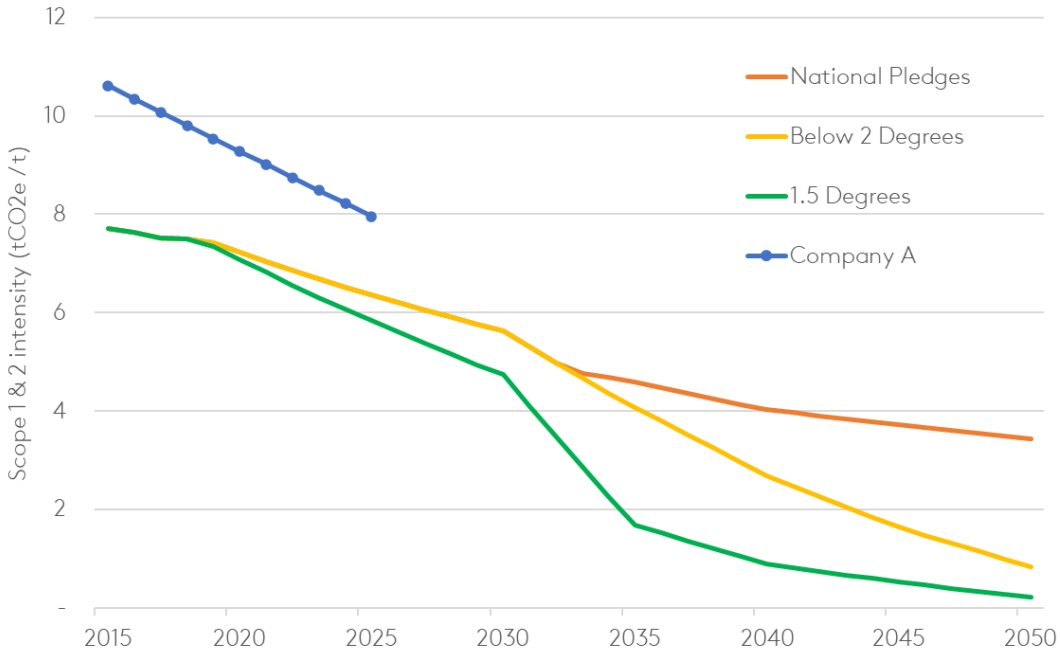
Company A: a simple case

Company A reports its historical emissions intensity, and it does so in the required metric, i.e. Scope 1 and 2 emissions from aluminium production per tonne of primary and secondary aluminium combined. For example, in 2018 it was 9.80 tCO_2e / t aluminium. After independently verifying the estimates using separate disclosures of emissions and aluminium production, these figures are used directly without adjustment.

Company A has also set a target to reduce the intensity of its Scope 1 and 2 emissions by 25% below the 2015 level by 2025. This target is stated to cover 100% of the company's Scope 1 and 2 emissions.

In 2015, the company's emissions intensity was 10.61 tCO_2e / t aluminium. Therefore in 2020 the target is to reduce its emissions intensity (total Scope 1+2 emissions) to (1-25%) x 10.61 = 7.96 tCO_2e / t aluminium.

Figure 3 Emissions Pathway of Company A



Company B: an absolute emissions target

Company B reports an operations-wide emissions intensity of aluminium production per tonne of primary and secondary aluminium for the last six years (2015-2021). For example, in 2015 the company reports its intensity per tonne of 'production volume'. Further investigation indicates that there are no significant sources of company emissions other than aluminium production, so operations-wide emissions are taken

[7] In the following examples, various numbers are rounded for ease of presentation.

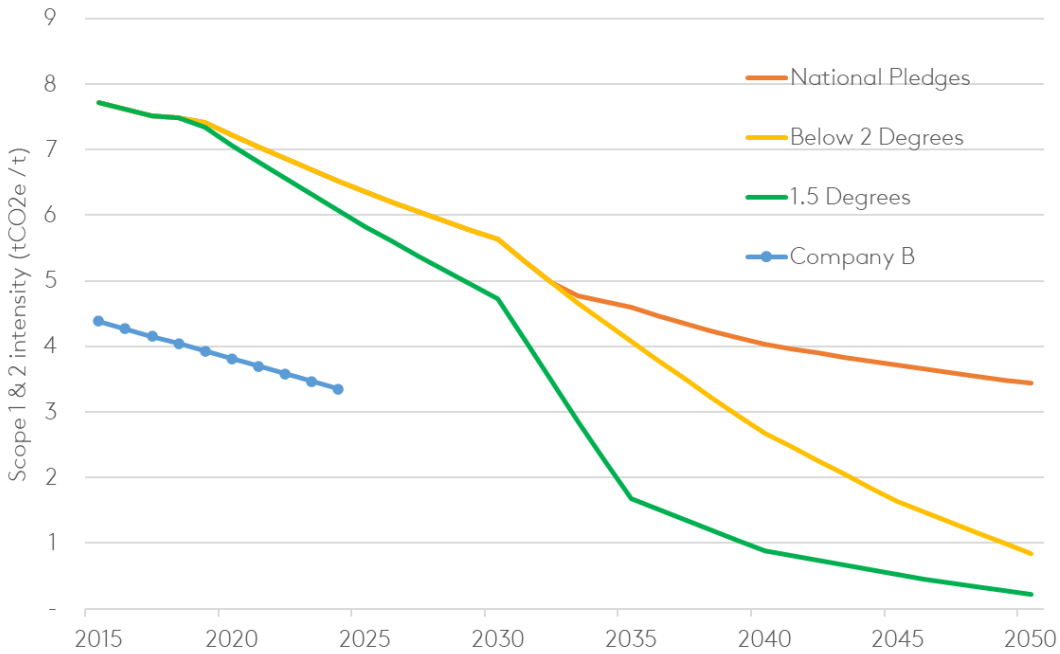
to be equivalent to aluminium-production-specific emissions. In 2015, the company's Scope 1 and 2 emissions intensity was 4.5 tCO_2e / t aluminium.

Company B has a target to reduce the **absolute** quantity of its Scope 1 and 2 emissions by 5% below the 2015 level by 2025. This target is said to cover 100% of the company's Scope 1 and 2 emissions from refining alumina and smelting aluminium.

In order to translate this information into an estimate of emissions intensity in 2025, the following steps are taken:

- The company discloses operations-wide Scope 1 and 2 emissions in 2015: 24.2 $MtCO_2e$. Total Scope 1 and 2 emissions in 2025, consistent with the target, can be estimated as 24.2 x (1 – 5%) = 22.99 $MtCO_2e$.
- The company has produced 6.52 tonnes of aluminium in 2021.
- As the company does not provide an intensity target, its aluminium production between 2021 and 2025 is assumed to grow at the same rate as global aluminium production according to the IAI's Business as Usual Scenario. In particular, the IAI projects that global aluminium production grows by 5.2% between 2021 and 2025. Therefore, the company's aluminium production in 2025 is its 2021 value, 6.52 Mt, multiplied by (1 + 5.2%) = 6.86 Mt aluminium.
- Dividing the company's estimated 2025 emissions by this estimate of aluminium production in 2025 gives an estimated intensity of 22.99/6.86 = 3.35 tCO_2e / t aluminium in 2025.

Figure 4 Emissions Pathway of Company B



5. DISCUSSION

This note describes the methodology followed by TPI in carrying out Carbon Performance assessments of aluminium producers.

TPI's Carbon Performance assessment is designed to be easy to understand and use, while robust. There are inevitably many nuances surrounding each company's individual emissions intensity pathway, how it relates to the benchmarks and why. Investors may wish to dig deeper to understand these.

5.1. General issues

The assessment follows the Sectoral Decarbonization Approach (SDA), which involves comparing companies' emissions intensity with sector-specific benchmark emissions intensities that are consistent with international targets (i.e. limiting global warming to 1.5°C, below 2°C, and the sum of National Pledges).

TPI uses companies' self-reported emissions and activity data to derive emissions intensities. Therefore, companies' pathways are only as accurate as the underlying disclosures. Estimating the recent, current, and especially the future emissions intensity of companies involves several assumptions. It is important to bear in mind that, in some cases, the emissions pathways drawn for each company is an estimate made by TPI, based on information disclosed by companies, rather than the companies' own estimate or target. In other cases, the information disclosed by companies is sufficient on its own to estimate the emissions intensity pathway.

5.2. Issues specific to aluminium producers

The principal challenge in the aluminium sector relates to differences between companies' organisational boundaries and consequent disclosure needs. Some companies are more vertically integrated (e.g., companies that also mine bauxite, or fabricate or extrude aluminium), others more horizontally integrated (e.g., general miners). Consequently, more detailed disclosure is required to distinguish the Scope 1 and 2 emissions from alumina refining, aluminium smelting, and recycling (within scope) from other company activities (outside scope). Furthermore, as described in section 4.1, companies may not always convert all the alumina they produce into aluminium and instead sell a portion of it. This requires us to estimate an alumina refining intensity on an aluminium basis using an alumina to aluminium conversion rate. However, for this more accurate calculation to be possible, companies need to disclose greater detail about their production and sales processes. These data are widely available or can be inferred from existing disclosures, but in some cases may represent a barrier to accurate assessment.

Historically, we have used IEA modelling to calculate low-carbon benchmarks for the aluminium sector. However, since 2020 IEA has stopped modelling aluminium as a separate industrial subsector. As we update our benchmarks regularly to reflect the latest historical data and higher levels of ambition for all sectors, we have chosen to use IAI modelling for this methodology update. Our new benchmarks are higher in intensity than their predecessors. This discrepancy could be explained by differences

in the definition of primary aluminium production. While the IAI provides a breakdown of the types of aluminium that are considered primary, recycled, and semi-fabricated, the IEA only provided figures for primary and recycled production. It may be that some semi-fabrication is included in the IEA's aluminium figures.

Finally, as detailed previously, the current benchmarks include both primary and secondary aluminium. According to the IAI [9], secondary aluminium is about 5% as emissions intensive as primary aluminium. Secondary production is a strong lever for the sector's decarbonisation and for individual companies to reduce their emissions intensities [11]. However, the combined sectoral benchmarks that treat primary and secondary production together may incentivise companies to increase their secondary production and delay the decarbonisation of primary production. We are exploring the possibility of creating split pathways for primary and secondary aluminium production, which would more directly incentivise producers to decarbonise primary production, rather than simply shift towards secondary production. IEA states that primary production must be decarbonised "as scrap availability will be insufficient for recycled production to meet all aluminium demand in the coming decades, given projections for economic growth in emerging markets" [11]. The IEA Aluminium Tracking Report reveals that the share of recycled production has remained constant at around 30% since the 2000's, with a modest recent increase to 34% in 2021. The growth in the share of secondary production is limited by the already high collection rates: over 95% for manufacturing scrap and over 70% for end-of-life scrap is recycled [11]. At present, the disclosure of aluminium producers is insufficiently granular to be compared to split emissions intensity benchmarks for primary and secondary aluminium production. TPI will continue to monitor the feasibility and appropriateness of developing split pathways.

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