Carbon Performance assessment of coal mining companies: note on methodology

April 2025

Simon Dietz, Nikolaus Hastreiter and Hayeon Cho

Transition Pathway Initiative

LSE Grantham Research Institute on Climate Change and the Environment

About the LSE Transition Pathway Initiative Centre

The Transition Pathway Initiative Centre (TPI Centre) is an independent, authoritative source of research and data on the progress of corporate and sovereign entities in transitioning to a low-carbon economy.

The TPI Centre is part of the Grantham Research Institute on Climate Change and the Environment, which is based at the London School of Economics and Political Science (LSE). It is the academic partner of the Transition Pathway Initiative (TPI), a global initiative led by asset owners and supported by asset managers, aimed at helping investors assess companies' preparedness for the transition to a low-carbon economy and supporting efforts to address climate change. As of April 2025, over 150 investors globally, representing more than US$80 trillion combined Assets Under Management and Advice, have pledged support for TPI.[1]

The TPI Centre provides research and data on publicly listed equities, corporate bond issuers, banks, and sovereign bond issuers. The TPI Centre's company data:

- Assess the quality of companies' governance and management of their carbon emissions and of risks and opportunities related to the low-carbon transition.
- Evaluate 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.
- Form the basis for the Climate Action 100+ Net Zero Company Benchmark Disclosure Framework assessments.
- Are published alongside the methods online and fully open access at www.transitionpathwayinitiative.org.

About the authors

Simon Dietz is the Research Director at the TPI Centre and a Professor of Environmental Policy in the Department of Geography and Environment at the London School of Economics and Political Science.

Nikolaus Hastreiter is a Policy Fellow at the TPI Centre and a PhD student at the London School of Economics and Political Science, Department of Geography and Environment.

Hayeon Cho is a Research Analyst at the TPI Centre.

Acknowledgements

The authors acknowledge Ali Amin and Dan Gardiner's key contributions to the methodology development.

The views in this report are those of the authors and do not necessarily represent those of the host institutions or funders. The authors declare no conflict of interest in preparing this report. For the full disclaimer about the data and information published in this report, see page 26.

This paper was first published in April 2025 by the TPI Centre.

Suggested citation: Dietz S, Hastreiter N, Cho H (2025) *Carbon Performance assessment of coal mining companies: note on methodology*. London: Transition Pathway Initiative Centre, London School of Economics and Political Science.

[1] This figure is subject to market price and foreign exchange fluctuations and, as the sum of self-reported data by TPI supporters, may double count some assets.

Contents

1. The TPI Centre's use of the Emissions Contraction Approach (ECA)

The TPI Centre's Carbon Performance assessments have historically assessed companies' emission pathways on an emissions intensity basis – that is, the volume of greenhouse gas (GHG) emissions per unit of economic output. Coal mining is the first sector that we assessed based on absolute emissions rather than emissions intensities. This approach reflects the unique decarbonisation challenges specific to coal mining. Achieving net zero in this sector ultimately requires an almost complete phase-out of coal production. Unlike other industries, where efficiency improvements and new production methods can reduce emissions intensity while maintaining output, coal mining's main decarbonisation strategy of phasing out production cannot meaningfully be assessed on an intensity basis. This is because coal production and Scope 1-3 emissions would reduce roughly proportionally.

To account for these sector-specific characteristics, we introduce the Emissions Contraction Approach (ECA). The ECA remains grounded in the Sectoral Decarbonisation Approach (SDA), which the TPI Centre applies to all its Carbon Performance assessments. This section outlines the rationale behind using the ECA and explains why an alternative method is necessary for assessing the sector's alignment with international climate goals.

1.1. The Sectoral Decarbonisation Approach

The TPI Centre's Carbon Performance assessments are based on the SDA[2], which evaluates companies' emissions intensities. The SDA translates GHG emissions targets made at the international level (e.g. under the 2015 Paris Agreement to the UN Framework Convention on Climate Change) into appropriate benchmarks, against which the performance of individual companies can be compared.

The SDA recognises that different sectors of the economy (e.g. food 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. The SDA therefore adopts 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.

The SDA can be applied by taking 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 Assessment Model (IAM), and these models usually allocate emissions reductions by region and by sector according to where it is cheapest to reduce emissions and when. Cost-effectiveness is, however, subject to some constraints, such as political and societal 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.

[2] The Sectoral Decarbonisation Approach (SDA) was created by CDP, World Resources Institute (WRI) and the World Wide Fund for Nature (WWF) in 2015. See https://sciencebasedtargets.org/resources/files/Sectoral-Decarbonization-Approach-Report.pdf

- In order to compare companies of different sizes, sectoral emissions are normalised by a relevant measure of sectoral activity (e.g. physical production or 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 model where possible.
- Companies' recent and current emissions intensity is calculated, and their future emissions intensity is estimated based on emissions targets they have set (this assumes companies 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.

1.2. The Emission Contraction Approach (ECA)

Decarbonisation pathways for coal mining are characterised by a steep decline in coal production. In the International Energy Agency's (IEA) Net Zero by 2050 scenario, global production of thermal and metallurgical coal falls by 92% and 91% respectively between 2023 and 2050 [1]. This implies that both types of coal mining companies will have to significantly reduce their coal output.

There are two main decarbonisation strategies coal mining companies can adopt: they can diversify their product portfolio away from coal assets; or they can wind down their 'pure-play' coal business. The latter approach focuses on the reduction of output rather than diversification. Diversification strategies can be assessed with the TPI Centre's diversified mining methodology [2], which is based on the SDA outlined above. However, for wind-down strategies, the ECA is more appropriate because coal production and Scope 1-3 emissions would reduce roughly proportionally. There would therefore be hardly any change to a company's emissions intensity: the pathway would resemble a flat line. Some reduction in emissions intensity could be achieved by abating operational Scope 1 and 2 emissions, but since these emissions account for a small share of coal miners' total carbon footprint (see Tables 2.1. and 2.2.), the impact would be small.

Like the SDA, the ECA is based on sectoral carbon budgets that are derived from an IAM. However, instead of dividing the sectoral carbon budget by a sector-specific activity metric, the benchmark pathways represent the relative (percentage) change in absolute emissions. The relative change in companies' absolute emissions is then compared with the absolute emissions reduction rate of the coal mining sector in the low-carbon benchmark.

The ECA is intended to respond to the question of managed phase-outs, which has been raised by investor alliances, such as the Glasgow Financial Alliance for Net Zero (GFANZ) and the Institutional Investors Group on Climate Change (IIGCC) [3; 4]. The ECA is not the first method to assess companies' transition efforts on the basis of absolute emissions. The Science-Based Targets initiative (SBTi) uses a similar method, the Absolute Contraction Approach (ACA), to assess absolute Scope 1 and 2 (and in certain cases also Scope 3) targets [5]. The key difference is that the ACA applies an economy-wide emissions reduction rate to all sectors while the ECA is based on a sector-specific carbon budget.

1.3. The complementarity of absolute and intensity approaches

Absolute emissions approaches, such as the ECA, and emissions intensity approaches, such as the SDA, each come with their own strengths and limitations. They should not be seen as mutually exclusive, but rather as complementary methods for assessing companies' alignment with climate targets.

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

The benefit of emissions intensity as a metric is that it enables companies' carbon footprints to be compared, controlling for the important factor of company size. Absolute emissions are strongly correlated with company size, so comparisons between companies using this metric can be more reflective of their relative size than how carbon-efficient their production activities and products are. The SDA was developed to extend the emissions intensity approach from historical and current carbon footprints to the ambition of future targets. By requiring greater emission reductions from companies with higher starting intensities, it puts the onus on the most carbon-intensive companies to act. Furthermore, assuming emission reductions are cheaper the more carbon-intensive a company's starting point is (because the easy and cheap measures have not yet been deployed), it also promotes overall economic efficiency. Another factor to consider is that companies undergo structural changes over time. Acquisitions and divestments – and wider market fluctuations – can result in important changes in companies' absolute emissions. While intensity pathways are not immune to such impacts, they tend to be less volatile as they normalise emissions relative to activity.

However, as mentioned above, intensity approaches are unsuitable for assessing the ambition of company strategies involving the winding down of high-carbon assets and reducing carbon-intensive production, because both emissions and activity would fall in concert. In addition, intensity approaches do not necessarily guarantee that overall absolute emissions stay within the global carbon budget that is set by the relationship between carbon emissions and temperature rise. While the SDA derives emissions intensity benchmarks from calculating forecasted activity in relation to absolute emissions, the global carbon budget could be breached if overall activity grows faster than projected. Absolute emissions approaches ensure that companies meet their targets by directly reducing their total carbon footprint. If all companies align with a climate target through the ECA, the underlying carbon budget cannot be exceeded, as all companies are required to reduce their absolute emissions at the same rate.

In conclusion, the choice between an absolute and an intensity approach depends on the goal of the analysis and the characteristics of the sector. Absolute and intensity approaches can be used in combination to evaluate companies' transition efforts. For example, diversified mining companies involved in coal mining can be assessed using the SDA for their overall portfolio, while the ECA can be employed for an additional assessment of their coal business.

2. Applying the ECA to the coal mining sector

2.1. The coal mining sector's role in climate change

The coal mining sector is globally significant, not only in terms of carbon emissions, but also economic weight: the combined market capitalisation of the 20 largest coal miners amounted to over US$584 billion in 2023.[4] The vast majority of the sector's lifecycle emissions, i.e. all emissions associated with the sector's activities, stem from the use of sold products (Scope 3 Category 11). These emissions result from the combustion of thermal coal for energy in buildings and electric power plants and the combustion of metallurgical coal in steel manufacturing. With an average emissions factor[5] of 94.6 tCO_2/TJ, thermal coal is the most carbon-intensive of the commonly used fossil fuels [6].

Total global combustion of thermal and metallurgical coal produced 15,667 megatonnes (Mt) CO_2 in 2023. The IEA expects total global emissions from coal to fall to just 158 Mt by 2050 in its Net Zero Emissions by 2050 (NZE) Scenario. Some of the emissions reductions will come from the demand side through carbon capture and storage (see Section 5.2), but they are mostly driven by a significant decrease in the supply of coal. The IEA's NZE estimates that thermal coal would need to be phased out of global electricity generation by 2040 [1].

2.2. Selecting coal mining companies for assessment: thermal coal and metallurgical coal

In selecting the coal sector companies to use for our Carbon Performance assessment, we first take all companies included in the sub-sector 'coal' of the Industry Classification Benchmark v2.6 [7] and then further screen the companies to determine whether they operate coal mining activities. This excludes companies involved in, for example, coal trading rather than mining, electricity generation with thermal coal, or steel production with metallurgical coal. As in other sectors, we select the largest companies by free-float market capitalisation.

While thermal and metallurgical coal have similar geological origins, their properties and structures are different, and their end uses vary considerably. Thermal coal is mostly burned for electricity generation, whereas metallurgical coal is mostly used in steel manufacturing. Such differences in application mean that these two types of coal will be phased out at different speeds in low-carbon transition scenarios. We therefore categorise coal mining companies into two distinct sub-sectors: thermal coal mining and metallurgical coal mining, and calculate separate benchmark paths for them.[6]

2.3. Deriving the benchmark pathways

The key input for calculating benchmarks under the ECA is a timeline for absolute GHG emissions reductions that is consistent with meeting a particular climate target (e.g. limiting global warming to 1.5°C). Following the decarbonisation scenarios of other TPI Centre assessments, three scenario benchmarks are used for coal mining:

[4] Based on data provided by FTSE-Russell.

[5] An emission factor is a coefficient used to quantify the amount of GHG emissions that a specific activity, such as combusting one tonne of coal, emits into the atmosphere.

[6] Peat and lignite accounted for only 4% of global coal supply in 2023 [1]. We therefore excluded them from this assessment.

1. A National Pledges scenario, which is consistent with the global aggregate of emissions reductions related to policies introduced or under development as of mid-2023. According to the IEA, this scenario does not take for granted that all government targets will be achieved. Instead, it takes a granular, sector-by-sector look at existing policies and measures. This scenario gives a probability of 50% of holding the global temperature increase to 2.4°C by 2100 [8].

2. A Below 2°C scenario, which is consistent with the overall aim of the Paris Agreement to limit global warming, albeit at the lower end of the range of ambition. This scenario gives a probability of 50% of holding the global temperature increase to 1.7°C by 2100 [8].

3. A 1.5°C scenario, which is consistent with the overall aim of the Paris Agreement to hold "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" [8]. This scenario gives a probability of 50% of holding the global temperature increase to 1.4°C by 2100 [8].

As well as emissions from the combustion of coal, industry emission projections are needed to construct benchmark pathways for coal mining. While the majority of lifecycle emissions from the sector come from the combustion of coal that is sold, operational emissions from coal mining are also significant, accounting for approximately 1,652 $MtCO_2e$ in 2021. Additionally, methane from coal mining accounts for one-third of total methane emissions related to energy production [9]. Overall, three types of emissions projections are needed to construct benchmark pathways for coal mining companies:

- Downstream use of sold products' emissions from the combustion of thermal and metallurgical coal.
- Operational methane emissions leaked from thermal and metallurgical coal mines.
- Operational CO_2 emissions from extracting and processing coal.

We obtain all three of these inputs from IEA publications [1; 9; 10], basing the three benchmarks above on the Stated Policies Scenario (STEPS), Announced Pledges Scenario (APS) and NZE scenario, respectively.

Although combined downstream emissions from the combustion of thermal and metallurgical coal are available for all scenarios, totals split by type of coal are not published. We instead use projections of thermal and metallurgical coal supply and apply emissions intensity factors from the IPCC [6].[7] These bottom-up estimates assume that the emissions intensities of coal combustion remain constant. This implies that mitigation actions taken by end-users of coal, in the form of carbon capture and storage, for example, are not deducted from the coal sector's downstream emissions. Although customer mitigation actions are desirable, we do not include them in the scope of this assessment. This point is discussed in greater detail in Section 5.2.

Projections of methane released during coal mining are available by type of coal for the APS. Projections of total methane emissions from all types of coal are also available for the NZE scenario [10]. We assume that the split by type of coal is the same in the APS and NZE scenarios. To estimate methane emissions from coal mining in the STEPS, we estimate a linear relationship between methane and mined coal (again by type) based on the data available for the APS.

While the projections take into consideration various methane leaks from coal operations, e.g. during mining, processing, transport and storage of coal, methane emissions from closed and abandoned coal mines are not included. This is consistent with company reporting, as coal miners do not tend to routinely disclose methane emissions from their closed and abandoned mines. This lack of reporting is problematic as methane emissions from closed and abandoned mines that remain under the ownership of companies still represent a potential transition or liability risk. The TPI Centre will monitor the reporting situation of methane and may adjust the benchmarks to include these emissions in the future.

[7] Projections for coal supply are available for 2030, 2035 and 2050. To obtain a 2040 projection, we assume that coal supply falls in line with global emissions from coal combustion (excluding emissions captured by end-users).

Operational CO_2 emissions from extracting and processing coal are available for the year 2021 [9]. They account for approximately one-third of total operational GHG emissions from global coal supply in 2021. As no scenario-specific projections are available, it is assumed that these operational CO_2 emissions fall in parallel with methane emissions. Similarly, in the absence of projections by type of coal, we split operational CO_2 emissions according to the split of mined thermal and metallurgical coal supply.

Lastly, we add up the three types of emissions to obtain the total absolute emissions from thermal coal and metallurgical coal.

2.4. Choosing the baseline period

Since the ECA assesses the relative change in coal miners' emissions, we need to establish a baseline to index the benchmarks. One option is to index to a single historical year, such as 2021. However, to enable comparisons between the benchmarks and individual companies, company pathways must also be indexed. Compared to sector-wide pathways, individual company pathways are significantly more volatile due to various factors, including economic conditions, mergers and acquisitions, and divestment. Indexing to a single year may therefore present a misleading picture of a company's actual emission trajectory due to year-on-year fluctuations. For example, if a company reports unusually high emissions in the indexed year right before a major divestment, its forward-looking indexed pathway would show a steep drop in the following years. This could misleadingly suggest that the company has already significantly wound down its coal assets.

To mitigate such short-term anomalies, we adopt a three-year averaging approach. Specifically, the baseline period is established as the average emissions from 2019-2021, indexed to 100%. All past and future values are calculated relative to this baseline. For example, the relative emissions reduction for 2030 is determined by averaging emissions over the period 2028-2030 and dividing by the 2021 value, which represents the 2019-2021 baseline.

Figures 2.1 and 2.2 show the benchmark pathways for thermal coal and metallurgical coal mining, respectively, in terms of absolute carbon emissions from 2021 to 2050. Tables 2.1 and 2.2 provide the underlying data.

Figure 2.1. Absolute emissions benchmark pathways for thermal coal

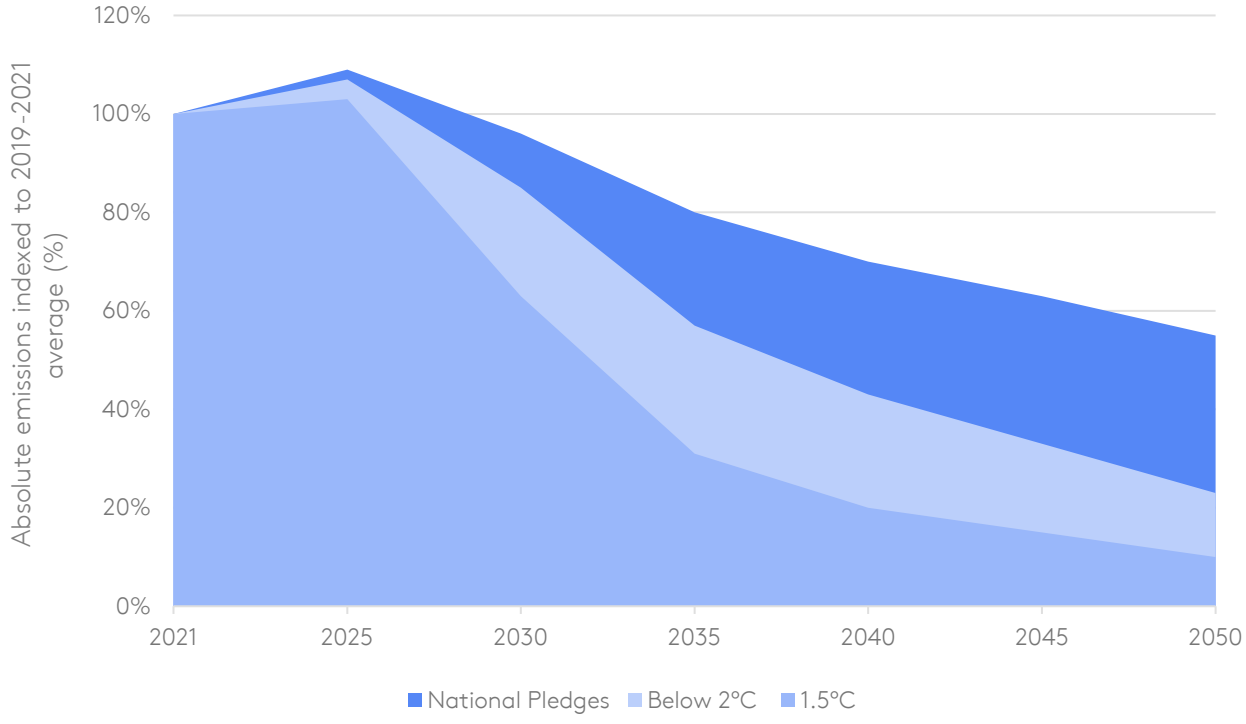


Table 2.1. Absolute emissions benchmark pathways for thermal coal

	2021	2030	2040	2050
National Pledges scenario				
	2019-2021 average	2028-2030 average	2038-2040 average	2048-2050 average
Methane emissions from thermal coal mining ($MtCO_2$)	712	626	457	418
Emissions from extracting and processing thermal coal ($MtCO_2$)	400	385	279	213
Emissions from the combustion of thermal coal ($MtCO_2e$)	11,017	10,684	7,785	6,027
Total carbon emissions ($MtCO_2e$) **(A)**	12,130 **(B)**	11,696	8,521	6,657
Thermal coal supply (Mtce)	4,515	4,379	3,191	2,470
Indexed reduction from 2019-2021 average (%) **(A/B)**	**100%**	**96%**	**70%**	**55%**
Below 2°C scenario				
	2019-2021 average	2028-2030 average	2038-2040 average	2048-2050 average
Methane emissions from thermal coal mining ($MtCO_2$)	712	486	185	133
Emissions from extracting and processing thermal coal ($MtCO_2$)	400	281	107	77
Emissions from the combustion of thermal coal ($MtCO_2e$)	11,017	9,599	4,976	2,637
Total carbon emissions ($MtCO_2e$) **(A)**	12,130 **(B)**	10,366	5,269	2,847
Thermal coal supply (Mtce)	4,515	3,934	2,040	1,081
Indexed reduction from 2019-2021 average (%) **(A/B)**	**100%**	**85%**	**43%**	**23%**
1.5°C scenario				
	2019-2021 average	2028-2030 average	2038-2040 average	2048-2050 average
Methane emissions from thermal coal mining ($MtCO_2$)	712	281	54	30
Emissions from extracting and processing thermal coal ($MtCO_2$)	400	158	29	19
Emissions from the combustion of thermal coal ($MtCO_2e$)	11,017	7,248	2,399	1,125
Total carbon emissions ($MtCO_2e$) **(A)**	12,130 **(B)**	7,688	2,482	1,175
Thermal coal supply (Mtce)	4,515	2,970	983	461
Indexed reduction from 2019-2021 average (%) **(A/B)**	**100%**	**63%**	**20%**	**10%**

Figure 2.2. Absolute emissions benchmark pathways for metallurgical coal

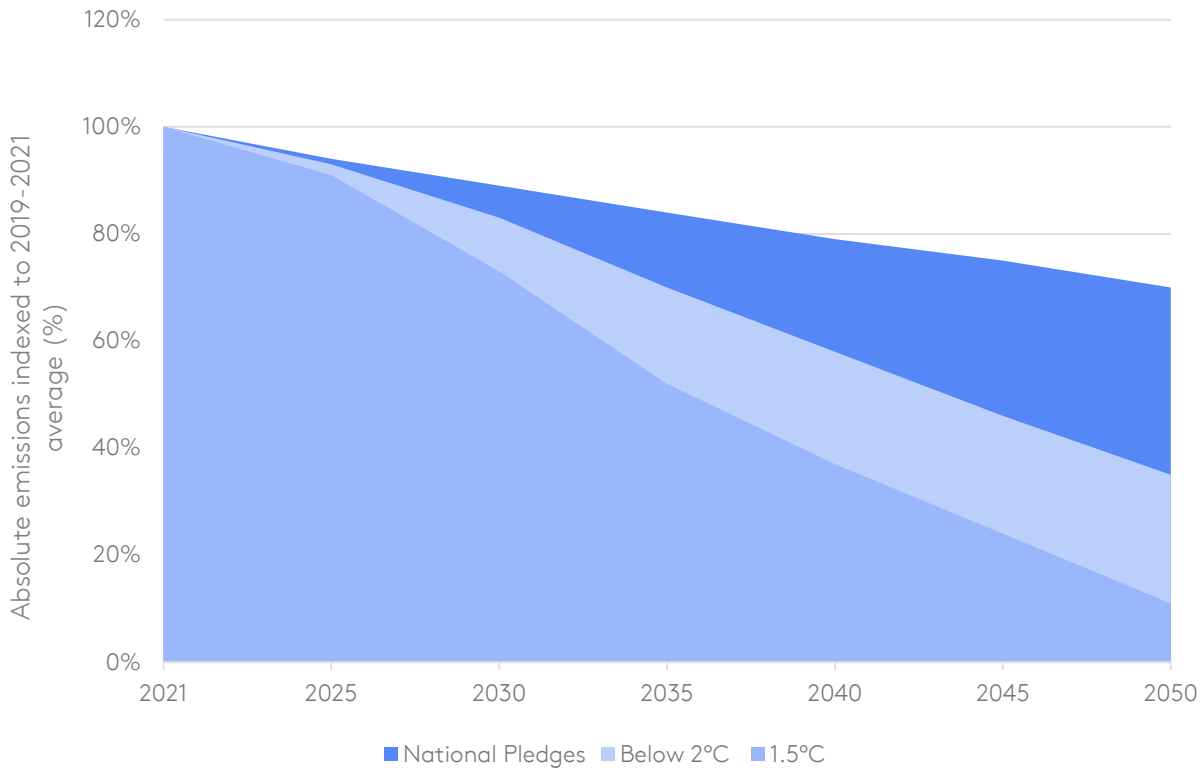


Table 2.2. Absolute emissions benchmark pathways for metallurgical coal

	2021	2030	2040	2050
National Pledges scenario				
	2019-2021 average	2028-2030 average	2038-2040 average	2048-2050 average
Methane emissions from metallurgical coal mining ($MtCO_2$)	312	249	201	191
Emissions from extracting and processing metallurgical coal ($MtCO_2$)	90	81	72	62
Emissions from the combustion of metallurgical coal ($MtCO_2e$)	2,741	2,482	2,217	1,947
Total carbon emissions ($MtCO_2e$) **(A)**	3,143 **(B)**	2,813	2,489	2,199
Metallurgical coal supply (Mtce)	1,015	919	821	721
Indexed reduction from 2019-2021 average (%) **(A/B)**	**100%**	**89%**	**79%**	**70%**
Below 2°C scenario				
	2019-2021 average	2028-2030 average	2038-2040 average	2048-2050 average
Methane emissions from metallurgical coal mining ($MtCO_2$)	312	218	101	75
Emissions from extracting and processing metallurgical coal ($MtCO_2$)	90	62	33	26
Emissions from the combustion of metallurgical coal ($MtCO_2e$)	2,741	2,344	1,683	1,002
Total carbon emissions ($MtCO_2e$) **(A)**	3,143 **(B)**	2,624	1,817	1,104
Metallurgical coal supply (Mtce)	1,015	868	623	371
Indexed reduction from 2019-2021 average (%) **(A/B)**	**100%**	**83%**	**58%**	**35%**
1.5°C scenario				
	2019-2021 average	2028-2030 average	2038-2040 average	2048-2050 average
Methane emissions from metallurgical coal mining ($MtCO_2$)	312	126	29	17
Emissions from extracting and processing metallurgical coal ($MtCO_2$)	90	40	12	5
Emissions from the combustion of metallurgical coal ($MtCO_2e$)	2,741	2,131	1,119	320
Total carbon emissions ($MtCO_2e$) **(A)**	3,143 **(B)**	2,297	1,161	342
Metallurgical coal supply (Mtce)	1,015	789	415	119
Indexed reduction from 2019-2021 average (%) **(A/B)**	**100%**	**73%**	**37%**	**11%**

3. Carbon Performance assessment: general considerations

3.1. Emissions reporting boundaries

Companies disclose emissions using different organisational boundaries. There are two high-level approaches: (i) the equity share approach; and (ii) the control approach, where control can be defined as financial or operational. Companies are free to choose which organisational boundary to set in their voluntary disclosures, and there is variation across the companies assessed by the TPI Centre.

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

- The boundary that has been set appears to enable a representative assessment of the company's emissions; and
- The same boundary is used for reporting company emissions and activity to obtain a consistent estimate of emissions.

Currently, limiting the assessment to one particular type of organisational boundary would severely restrict the breadth of companies that can be assessed.

When companies report emissions using both equity share and control approaches, a reporting boundary is chosen based on which method provides the longest available time series or is the most consistent with disclosure on activity and any targets.

3.2. Data sources and validation

All of the TPI Centre's assessments are based on 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 our 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:

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

Once a preliminary Carbon Performance assessment has been made, it is subject to the following procedure to provide quality assurance:

- Internal review: the preliminary assessment is reviewed by an analyst who was not involved in the original assessment.
- Company review: the reviewed assessment is sent to the company, which has the opportunity to review it and confirm the accuracy of the disclosures used. This review includes all companies, including those that provide unsuitable or insufficiently detailed disclosures.
- Final assessment: feedback from the company is reviewed and incorporated if it is considered appropriate. Only information in the public domain can be accepted as a basis for any change.

3.3. Responding to companies

Giving companies the opportunity to review their Carbon Performance assessments is an integral part of the TPI Centre's quality assurance process. Each company receives its draft assessment and the data that underpins 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 or representation, our process is as follows:

- The TPI Centre reviews the information provided by the company. At this point, additional information may be requested.
- If it is concluded that the company's challenge has merit, the assessment is updated.
- If it is concluded that there are insufficient grounds to change the assessment, the original assessment is published.
- If the company requests an explanation regarding its feedback after the publication of its assessment, the TPI Centre 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, the new disclosure is noted. For corrections, we take this into consideration immediately, whereas general assessment updates will be incorporated in the next assessment cycle.

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 Centre website and the company is identified as having challenged its assessment.

3.4. Presentation of assessment on the TPI Centre website

The results of the Carbon Performance assessments are posted on the TPI Centre's online tool (www.transitionpathwayinitiative.org/tpi/sectors). On each company page, its emissions intensity pathway is plotted on the same chart as the benchmark pathways for the relevant sector.
Different companies can also be compared on the tool's main page, with the user free to choose which companies to include in the comparison.

4. Specific considerations for the assessment of coal miners

4.1. Measuring companies' absolute emissions

To measure companies' decarbonisation efforts using the ECA, a key consideration is that the vast majority of lifecycle emissions stem from the combustion of thermal and metallurgical coal by end-users. Therefore, the scope of a company assessment should include emissions from the use of sold products, as well as the contribution from direct and indirect operational emissions (i.e. Scope 1 and 2).

Hence, in the coal mining sector, the specific measure of absolute emissions used by the TPI Centre is:

- Scope 1, 2 and 3 (Category 11, use of sold products) GHG emissions from thermal coal and metallurgical coal in units of tonnes of CO_2 equivalent (tCO_2e), indexed to the 2019-2021 average.

Scope 1 and 2 emissions (operational emissions)

Most coal mining companies disclose Scope 1 and 2 emissions generated by their operations. These can be directly used if they are specific to coal mining operations. When these are missing, Scope 1 and 2 emission figures from coal mining are estimated using an industry-wide average emissions intensity per tonne of mined thermal or metallurgical coal (0.276 tCO_2e/t). This average intensity is derived from the benchmark data provided in Tables 2.1 and 2.2 by dividing carbon and methane emissions from coal extraction and processing by total coal supply.

Where operational emissions from coal mining are disclosed, but a split of emissions by type of coal is not available, we estimate them using the company-specific ratio of thermal and metallurgical coal sales.

If neither production nor sales disclosures are available, we are unable to estimate Scope 1 and 2 emissions for thermal and metallurgical coal.

Scope 3 emissions (Category 11, use of sold products)

The majority of emissions stem from the coal combustion activities of coal companies' clients – the Scope 3 category 11 emissions. Ideally, coal mining companies would disclose emissions related to this category broken down by thermal and metallurgical coal. However, companies rarely disclose such detailed data as calculating Scope 3 emissions is complicated, disclosure is voluntary, and figures are often provided on a "best effort" basis.

In the absence of adequate and consistent Scope 3 disclosure, the TPI Centre calculates these emissions by applying IPCC emissions intensity factors of 2.4 tCO_2e/t for thermal coal and 2.7 tCO_2e/t for metallurgical coal [6] to companies' sales volumes. Where coal sales data are not available, they can be approximated using coal production volumes. This is consistent with our methodology to estimate Scope 3 category 11 emissions for the oil and gas and diversified mining sectors.

As with Scope 1 and 2 emissions, we are unable to estimate Scope 3 category 11 emissions if neither production nor sales disclosures are available for thermal and metallurgical coal.

4.2. Measuring companies' emission reductions

As we do for the benchmarks, we index companies' absolute emissions to their 2019-2021 average. Most companies assessed by the TPI Centre provide sufficient data to estimate historical emissions from coal mining operations[8]. However, where historical data are incomplete – specifically, when companies do not

[8] 84% out of the 32 companies with available data assessed in 2023/24.

have required data covering the 2019-2021 period – we use the latest year of disclosure and assume emissions remain constant in earlier years. This allows us to approximate the company's baseline emissions for 2019-2021. Assuming emissions remain constant relative to the most recent disclosure data is consistent with the approach the TPI Centre has adopted in other sectors.

4.3. Coverage of emission reduction targets

There are various types of emission reduction targets that coal mining companies disclose, but they can be broadly categorised into absolute emission targets and emissions intensity targets. Absolute emission targets are expressed in terms of a decrease in the total amount of emissions a company aims to emit by a certain date. By contrast, emissions intensity targets are expressed in emissions per unit of output/activity and make no direct reference to total emissions. Targets can cover different scopes of emissions and apply only to specific operations, or to the whole organisation.

The TPI Centre incorporates different types of targets into its Carbon Performance assessment. In particular, we are faced with the following permutations:

- Absolute targets relating to operational emissions (either Scope 1 or Scope 1 and 2): as these targets only cover part of total emissions, assumptions are required to calculate how emissions outside the scope of the target evolve. Consistent with the approach used in other sectors assessed by the TPI Centre, we assume the absolute emissions of activities outside the scope of the target remain constant at the level in the latest disclosure year. In the coal mining sector, companies typically do not specify how their operational emission targets apply separately to thermal and metallurgical coal. In this case, we assume that reduction efforts are uniform across both types of coal.

- Comprehensive absolute targets including Scope 1, 2, and 3 use of sold products: these targets are usually expressed as percentage reductions against a base year. This type of target would include net zero targets. We apply the disclosed percentage reduction to the TPI-calculated emissions in the designated base year.

- Emissions intensity targets: To date, we have not come across an intensity target in the coal sector. However, should this occur in the future, the same approach would be adopted as in other sectors assessed by the TPI Centre. Specifically, the emissions intensity target would be converted into an absolute target, assuming that a company's thermal coal and metallurgical coal sales grow in line with coal supply as projected in the National Pledges scenario. If both an absolute and intensity target are disclosed, we verify that both are consistent with or complement each other. If so, we prefer the absolute target. If not, further research is needed to accurately reflect the company's decarbonisation pathway.

- Production-based target: In contrast to other sectors, the TPI Centre incorporates production-based targets in its assessment of coal mining companies, as they are the main lever available to coal companies to reduce their carbon footprint. Quantified targets to reduce the sales or production of coal products can directly be translated into corresponding Scope 3 downstream emissions by applying relevant emissions factors.

Some companies disclose net targets. Unlike gross targets, net targets include emissions offsets or negative emissions, either within company boundaries or outside them. Currently, the TPI Centre accepts both types of targets and does not make an explicit distinction between them. Although we recognise that there are additional risks related to relying heavily on offsetting, in principle, it is a cost-effective mechanism to reduce emissions. Moreover, companies rarely disclose the detailed contribution of offsets to their overall targets.

Some companies disclose a target range, in which case the lowest end of the range is used. Most companies express targets relative to emissions in a base year (e.g. 2010), but some companies disclose targets without disclosing the base year. In this case, we assume that the base year is the latest year of disclosure prior to the publication of the target.

4.4. Worked examples

Company A: a straightforward calculation

Step 1: Calculating Scope 1 and 2 emissions

Company A reports its operational emissions (including methane emissions) for its coal mining operations. For example, in 2019, the company reported Scope 1 and 2 emissions of 7.5 $MtCO_2e$ for thermal coal and 0.8 $MtCO_2e$ for metallurgical coal. These figures are used directly without any adjustment.

Step 2: Calculating Scope 3 emissions

Company A reports sales volumes for thermal coal and metallurgical coal. We estimate corresponding Scope 3 category 11 emissions by using IPCC emissions factors of 2.4 tCO_2/t for thermal coal and 2.7 tCO_2/t for metallurgical coal. For example, in 2019, the company reported a thermal coal sales volume of 125 Mt and a metallurgical coal sales volume of 17 Mt. Hence, the estimated Scope 3 emissions are calculated as 125 * 2.4 = 300 $MtCO_2e$ for thermal coal and 17 * 2.7 = 46 $MtCO_2e$ for metallurgical coal. Adding Scope 1 and 2 emissions to estimated Scope 3 emissions, the total Scope 1-3 emissions for thermal coal in 2019 amount to 7.5 + 300 = 307.5 $MtCO_2e$, while metallurgical coal totals 0.8 + 46 = 46.8 $MtCO_2e$.

Step 3: Calculating the baseline value (2019-2021 emissions average)

Following the same method, company A's total Scope 1-3 emissions for 2020 and 2021 are estimated at 230 $MtCO_2e$ and 220 $MtCO_2e$ for thermal coal, and 34 $MtCO_2e$ and 38 $MtCO_2e$ for metallurgical coal, respectively. To establish a baseline for indexing, the average emissions across 2019-2021 are calculated as (307.5 + 230 + 220) / 3 = 252.5 $MtCO_2e$ for thermal coal and (46.8 + 34 + 38) / 3 = 39.6 $MtCO_2e$ for metallurgical coal.

Step 4: Calculating the target year value

Company A has set a target to reduce absolute Scope 1-3 emissions from coal mining operations by 35% by 2035 compared to 2019 levels and to achieve net zero emissions by 2050. We assume this target applies uniformly to both types of coal. The 2035 emissions target is estimated as 307.5 * (1-35%) = 200 $MtCO_2e$ for thermal coal and 46.8 * (1-35%) = 30.5 $MtCO_2e$ for metallurgical coal, while both coal types are expected to reach 0 $MtCO_2e$ by 2050.

Step 5: Calculating the indexed target value

To determine the 2035 indexed target value, we estimate 2033 and 2034 emissions values by interpolating between the latest year of disclosed historical emissions, i.e., 2021, and the target year 2035. The 2033-35 averages equal 201 $MtCO_2e$ for thermal coal and 31 $MtCO_2e$ for metallurgical coal. Therefore, the 2035 indexed percentage is calculated as 201 (2033-2035) / 252.5 (2019-2021) = 79% for thermal coal and 31 (2033-2035) / 39.6 (2019-2021) = 78% for metallurgical coal.

Following the same approach for the 2050 indexed target value, the 2048-2050 average is calculated using interpolated values for 2048 and 2049 and equals 13.3 $MtCO_2e$ for thermal coal and 2 $MtCO_2e$ for metallurgical coal. Therefore, the 2050 indexed percentage is calculated as 13.3 (2048-2050) / 252.5 (2019-2021) = 5% for thermal coal and 2 (2048-2050) / 39.6 (2019-2021) = 5% for metallurgical coal.

Step 6: Comparing the pathway with the benchmarks

Comparing company A's emissions pathway against the benchmark scenarios (see Figure 4.1 and Figure 4.2), its thermal coal pathway falls well within the National Pledges scenario for both the short (2028) and medium term (2035) and aligns with the 1.5°C benchmark in the long term (2050). For metallurgical coal, its emission pathway exceeds all benchmarks until 2028. However, by 2035, it falls below the National Pledges benchmark and aligns with the 1.5°C benchmark by 2050.

Figure 4.1. Company A's emission pathway for thermal coal

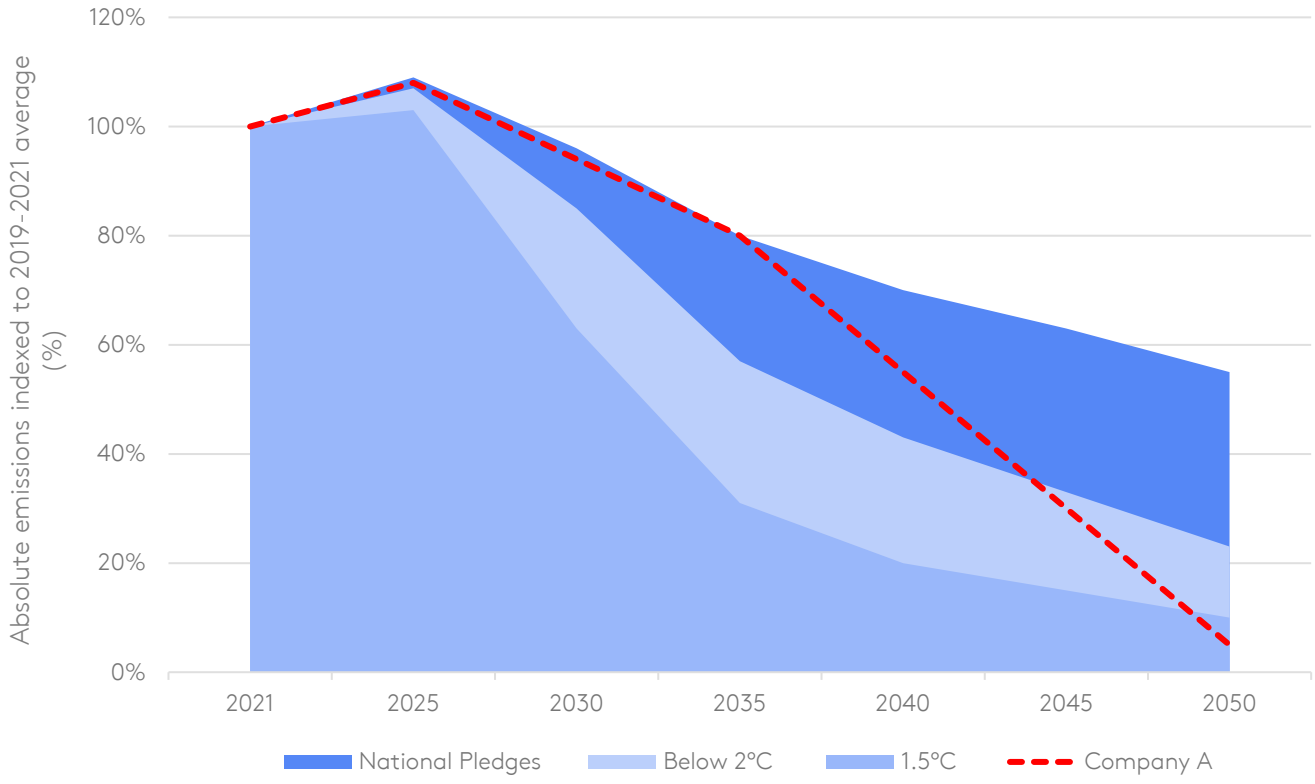
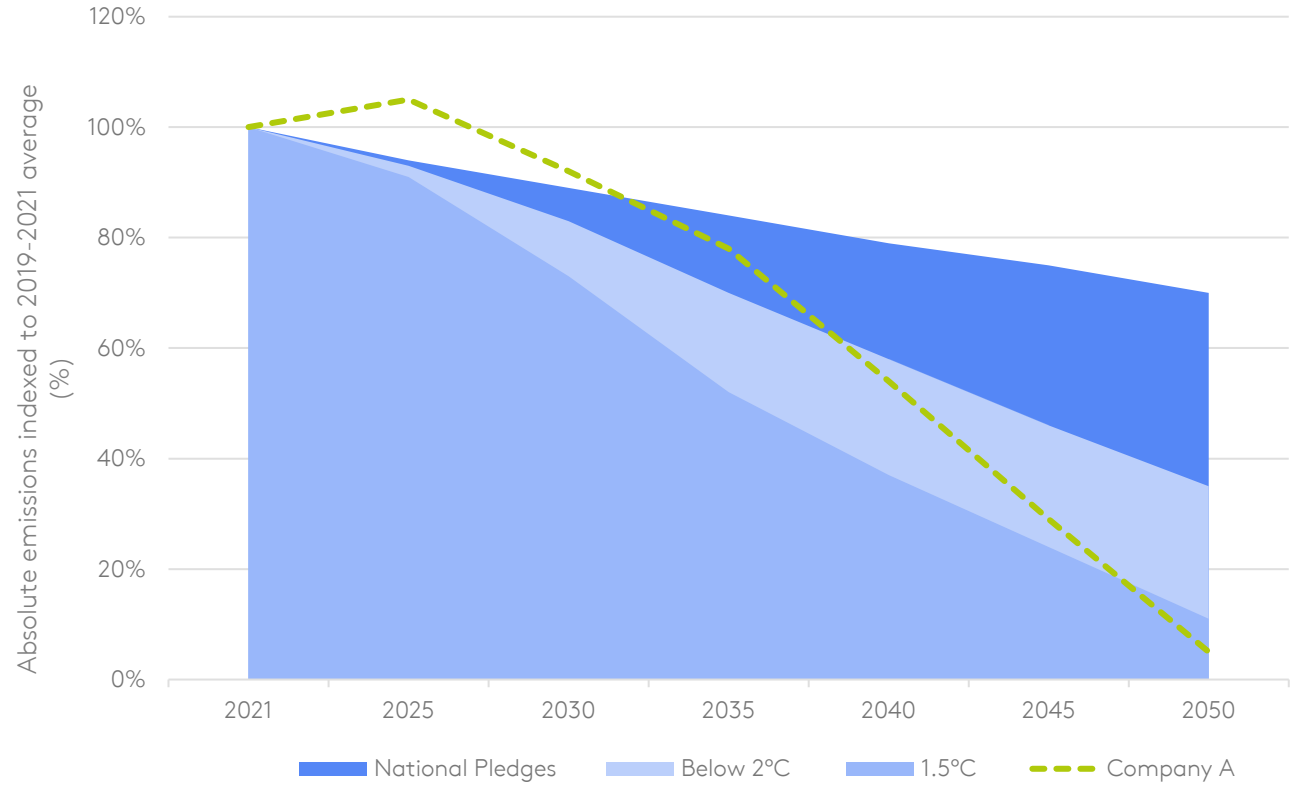


Figure 4.2. Company A's emission pathway for metallurgical coal



Company B: company-wide emissions reporting and operational emissions target (most common case)

Step 1: Calculating Scope 1 and 2 emissions

Company B reports its operational emissions on a company-wide basis but does not split its emissions by coal type. However, as the company reports production volumes for thermal coal and metallurgical coal, we can estimate Scope 1 and 2 emissions separately by applying an industry-wide emissions intensity factor of 0.284 tCO_2e per tonne of mined coal. For example, in 2019, the company reported a thermal coal production volume of 130 Mt and a metallurgical coal production volume of 20 Mt. Scope 1 and 2 emissions for thermal coal are estimated as 130 * 0.284 = 37 $MtCO_2e$ and 20 * 0.284 = 6 $MtCO_2e$ for metallurgical coal.

Step 2: Calculating Scope 3 emissions

Company B reports sales volumes for thermal coal and metallurgical coal. Scope 3 Category 11 emissions are estimated by using IPCC emissions factors, based on sales volumes. In contrast, production volumes are used to calculate Scope 1 and 2 emissions, as operational emissions are generated by the company's coal mining operations. For example, in 2019 the company reported thermal coal sales of 125 Mt and metallurgical coal sales of 17 Mt. By applying an emission factor of 2.4 tCO_2/t for thermal coal and 2.7 tCO_2/t for metallurgical coal, the estimated Scope 3 emissions are calculated as 125 * 2.4 = 300 $MtCO_2e$ for thermal coal and 17 * 2.7 = 46 $MtCO_2e$ for metallurgical coal. Adding estimated Scope 1 and 2 emissions, the total Scope 1-3 emissions for thermal in 2019 amount to 37 + 300 = 337 $MtCO_2e$ and for metallurgical coal to 6 + 46 = 52 $MtCO_2e$.

Step 3: Calculating the baseline value (2019-2021 emissions average)

Following the same method, company B's total Scope 1-3 emissions for 2020 and 2021 are calculated for thermal and metallurgical coal, respectively. To establish a baseline for indexing, the average emissions across 2019-2021 are calculated as 336 $MtCO_2e$ for thermal coal and 52 $MtCO_2e$ for metallurgical coal.

Step 4: Calculating the target year value

Company B has set a company-wide target to reduce its absolute Scope 1 and 2 emissions by 35% by 2035 compared to 2019 levels. Although the company does not specify whether the target explicitly applies to its coal mining business, the TPI Centre includes the target in the assessment since coal mining revenue accounts for more than 95% of the company's overall revenues. We assume this target applies uniformly to both coal types. Hence, the 2035 emission target is estimated as 37 * (1-35%) = 24 $MtCO_2e$ for thermal coal and 6 * (1-35%) = 3.7 Mt CO_2e for metallurgical coal. As the company has not set an emission reduction target for its Scope 3 emissions, we assume they remain constant at the level in the latest disclosure year (2021). Therefore, the total Scope 1-3 emissions for 2035 amount to 24 + 300 = 324 $MtCO_2e$ for thermal coal and to 3.7 + 46 = 49.7 $MtCO_2e$ for metallurgical coal.

Step 5: Calculating the indexed target value

To determine the 2035 indexed target value, we estimate 2033 and 2034 emissions by interpolating between the latest year of disclosed historical emissions, i.e., 2021, and the target yet 2035. Then, we calculate the 2033-2035 average, which amounts to 324 Mt CO_2e for thermal coal and 49 Mt CO_2e for metallurgical coal. Therefore, the 2035 indexed percentage is calculated as 324 / 336 = 96% for thermal coal and 49 / 52 = 94% for metallurgical coal.

Step 6: Comparing the pathway with the benchmarks

Comparing company B's emissions pathway to the benchmark scenarios, its thermal coal pathway is aligned with the National Pledges scenario in the short term (2028) and not aligned with any scenario in the medium and long term. For metallurgical coal, its emissions pathway exceeds all benchmarks in the short, medium and long term.

Figure 4.1. Company B's emission pathway for thermal coal

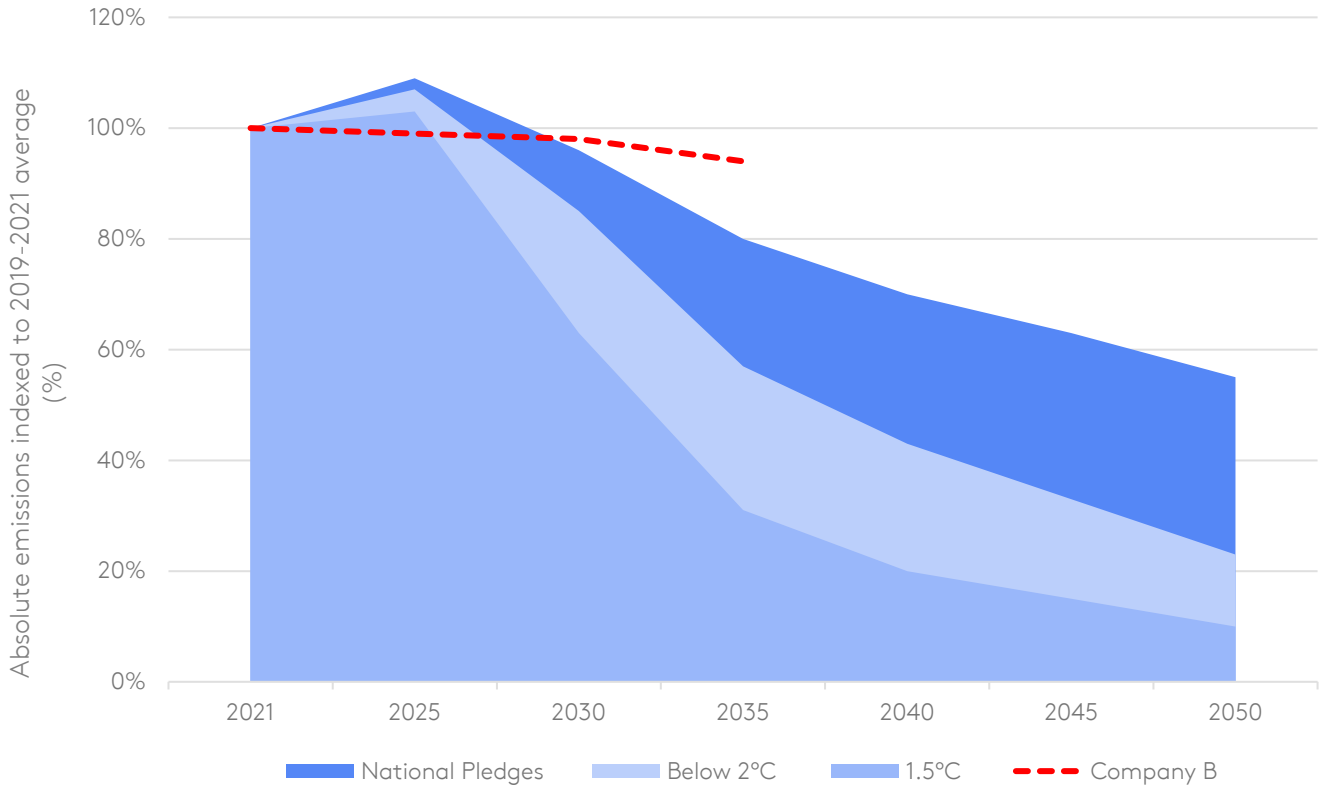


Figure 4.2. Company B's emission pathway for metallurgical coal

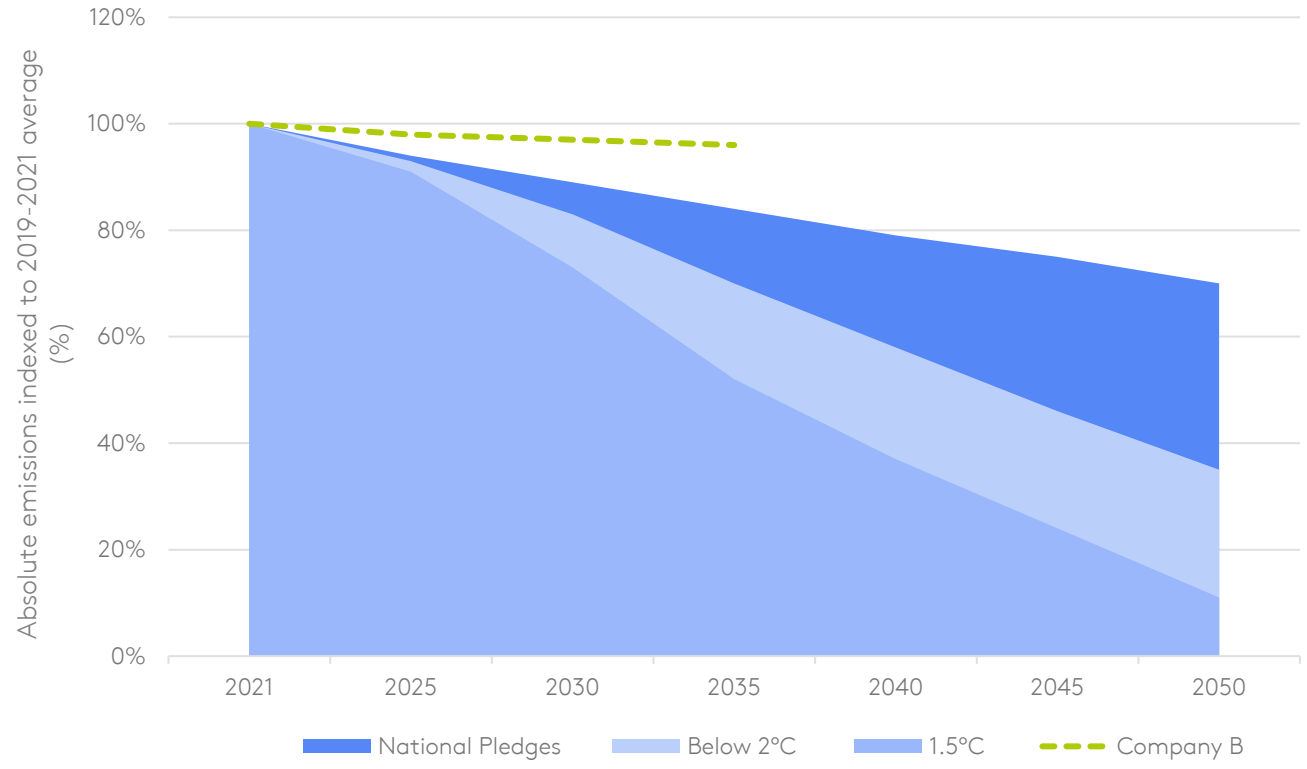


Table 4.1. Company A and B alignment scores against thermal coal and metallurgical benchmarks

Benchmark	2028	2035	2050
Company A			
Thermal Coal	National Pledges	National Pledges	1.5°C
Metallurgical Coal	Not Aligned	National Pledges	1.5°C
Company B			
Thermal Coal	National Pledges	Not Aligned	Not Aligned
Metallurgical Coal	Not Aligned	Not Aligned	Not Aligned

5. Discussion

The ECA is a new TPI Centre methodology that offers a way to effectively assess the Carbon Performance of thermal coal and metallurgical coal mining companies according to the specific characteristics of their low-carbon transition.

The Carbon Performance assessment is designed to be robust yet easy to understand and use. There are inevitably many nuances surrounding each company's individual performance, how it relates to the benchmarks, and why. Investors may wish to dig deeper into companies' assessments in their engagements with them to better understand these details.

5.1. General issues

The ECA methodology builds on the SDA, which compares a company's emission pathway with sector-specific benchmarks that are consistent with international climate targets (i.e. limiting global warming to 1.5°C, well below 2°C, and the sum of National Pledges).

The TPI Centre mainly uses the modelling of the IEA to calculate benchmark pathways. While such economy-energy models offer a number of advantages, they are also subject to limitations. In particular, model projections often turn out to be wrong. The comparison between companies and the benchmark pathways might then be inaccurate. Models tend to be regularly updated with the aim of improving their accuracy, and the TPI Centre updates its benchmark pathways accordingly. Nevertheless, in such a forward-looking exercise, there is no way to avoid the uncertainty created by projecting into the future.

We use companies' self-reported emissions and activity data to derive emissions intensity pathways. Therefore, companies' pathways are only as accurate as the underlying disclosures.

Estimating the historical and especially the future emissions of companies involves a number of assumptions. Therefore, it is important to bear in mind that, in some cases, the emissions pathway drawn for each company is an estimate made by the TPI Centre, 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 completely characterise the emissions pathway.

5.2. Issues specific to the coal mining sector

- The ECA's use of absolute emissions involves benchmarking companies against the same emission reduction rate, which imposes a one-size-fits-all solution that does not account for varying costs of emission reduction across companies. This also affects the emissions intensity approach insofar as it requires companies to converge with sectoral benchmarks. However, in the case of coal, such variations in transition costs may be small as companies' main decarbonisation lever is to shut down coal mining activities. Some coal mines may be easier to shut down or have higher operational emissions than others, but we mitigate this concern by including operational emissions in the analysis.
- Changes in market share, such as through mergers and acquisitions, can lead to significant fluctuations in companies' emission pathways. However, these fluctuations indicate shifts in transition risks: acquiring additional coal assets increases a company's transition risk. Ultimately, all coal assets must be wound down.
- No established mechanism currently exists to track Scope 3 emission reduction targets that explicitly rely on customer mitigation actions, such as the use of carbon capture and storage or the purchase of carbon offsets. They are therefore excluded from the assessment boundary of the ECA methodology, which only considers a coal mining company's own transition effort.

- A minor share of coal supply is utilised for industrial purposes other than combustion by end-consumers, such as in chemical products.[9] However, no scenario-specific projections regarding the evolution of this share are available. The most straightforward assumption would be that it remains constant. Considering that the indexed pathways represent changes in reduction rates, such an adjustment would have a negligible impact on both the benchmarks and the company assessments.
- Assessments are complicated by the trading activities of coal companies, which we believe are widespread but may not be fully disclosed. Although it is operationally very different to coal mining, trading carbon-intensive products also creates transition risks, given the dependence of companies' revenues on underlying carbon-intensive products. Excluding them would risk a decarbonisation strategy simply transferring transition risk to an unassessed activity without any decarbonisation taking place.
- The TPI Centre aims to exclude 'financial trading', in which no change in ownership of the underlying asset takes place, from its assessments. However, based on public disclosure, this is not straightforward to distinguish from other forms of trading. We therefore encourage companies to explicitly disclose financial trading volumes.

[9] Coal consumed for non-energy use accounted for less than 5% of total coal consumption in 2017 [11].

References

[1] IEA (2024) *World energy outlook*. Paris, IEA. www.iea.org/reports/world-energy-outlook-2023 n5

[2] Dietz S, Jahn V, Scheer A, Cho H (2024) Carbon Performance assessment of diversified mining: note on methodology. London: Transition Pathway Initiative Centre, London School of Economics and Political Science. https://transitionpathwayinitiative.org/publications/uploads/2024-carbon-performance-assessment-of-diversified-mining-note-on-methodology

[3] Glasgow Financial Alliance for Net Zero [GFANZ] (2022) *The Managed Phaseout of High-emitting Assets*. https://assets.bbhub.io/company/sites/63/2022/06/GFANZ_-Managed-Phaseout-of-High-emitting-Assets_June2022.pdf

[4] Institutional Investors Group on Climate Change [IIGCC] (2023) *Net Zero Standard for Oil and Gas*. https://www.iigcc.org/resources/net-zero-standard-for-oil-gas

[5] Science-Based Targets Initiative [SBTi] (2021) Understand the methods for science-based climate action. Blog post. 25 February. https://sciencebasedtargets.org/news/understand-science-based-targets-methods-climate-action

[6] Intergovernmental Panel on Climate Change [IPCC] (2006) 2006 *IPCC Guidelines for National Greenhouse Gas Inventories*. https://www.ipcc.ch/report/2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/

[7] FTSE Russell (2019) *Industry Classification Benchmark v 2.6*. https://www.ftserussell.com/data/industry-classification-benchmark-icb

[8] IEA (2023) *World energy outlook*. Paris, IEA. www.iea.org/reports/world-energy-outlook-2023

[9] IEA (2023) *Global Methane Tracker*. Paris, IEA. https://www.iea.org/reports/global-methane-tracker-2023

[10] IEA (2022) *Coal in Net Zero Transitions*. Paris, IEA. https://www.iea.org/reports/coal-in-net-zero-transitions

[11] IEA (2019) *World Energy Balance*. https://www.oecd.org/publications/world-energy-balances-25186442.htm

Disclaimer

1. Data and information published in this report and on the TPI Centre website is intended principally for investor use but, before any such use, you should read the TPI Centre's website terms and conditions to ensure you are complying with some basic requirements which are designed to safeguard the TPI Centre while allowing sensible and open use of the methodologies and of the TPI data processed by the TPI Centre. References in these terms and conditions to "data" or "information" on the website shall include the Carbon Performance data, the Management Quality indicators or scores, and all related information.
2. By accessing the data and information published in this report and on the website, you acknowledge that you understand and agree to the website terms and conditions. In particular, please read paragraphs 4 and 5 below, which detail certain data use restrictions.
3. The processed data and information provided by the TPI Centre can be used by you in a variety of ways – such as to inform your investment research, your corporate engagement and proxy-voting, to analyse your portfolios and publish the outcomes to demonstrate to your stakeholders your delivery of climate policy objectives and to support the TPI Centre in its initiative. However, you must make your own decisions on how to use the TPI Centre's data as the TPI Centre cannot guarantee the accuracy of any data made available, the data and information on the website is not intended to constitute or form the basis of any advice (investment, professional or otherwise), and the TPI Centre does not accept any liability for any claim or loss arising from any use of, or reliance on, the data or information. Furthermore, the TPI Centre does not impose any obligations on supporting organisations to use TPI Centre data in any particular way. It is for individual organisations to determine the most appropriate ways in which the TPI Centre data can be helpful to their internal processes.
4. Subject to paragraph 3 above, the Management Quality and the Carbon Performance indicators that are part of the TPI online tool and available publicly on the TPI Centre's website are:
    - Free, if they are used for internal and not for commercial purposes, including for research, as one of the inputs to inform portfolio construction, for financial decision-making including cases of lending and underwriting, for engagement and client reporting, for use in proprietary models as part of climate transition analysis and active investment management.
    - Restricted, unless licensed where the use is for further commercial exploitation through redistribution, derived data creation, analytics, and index or fund creation (inclusive of where the index is used as the basis for the creation of a financial product, or where TPI data is a key constituent of a fund's construction).
    - For the terms of use of the sources supporting the TPI Centre's methodologies, please refer to the individual sectoral Carbon Performance methodology notes. To produce the corporate data, the Centre analysts may use CDP data as a secondary input for verification purposes, in addition to companies' published sources.
5. Notwithstanding any other provision of these website terms and conditions, none of the data or information on the website may be reproduced or made available by you to any other person except that you may reproduce an insubstantial amount of the data or information on the website for the uses permitted above.
6. The data and information on the website may not be used in any way other than as permitted above. If you would like to use any such data or information in a manner that is not permitted above, you will need the TPI Centre's written permission. In this regard, please email all inquiries to info@transitionpathwayinitiative.org.

Use of Intergovernmental Panel on Climate Change (IPCC) data

As TPI uses IPCC data, please note the following:

- Use of IPCC data, IPCC databases, and/or IPCC tools and scenarios is at the User's sole risk. Under no circumstances shall the IPCC, World Meteorological Organization (WMO) or United Nations Environment Programme (UNEP) be liable for any loss, damage, liability, or expense incurred or suffered that is claimed to have resulted from the use or accessing of IPCC data, IPCC databases, tools, and/or scenarios, including, without limitation, any fault, error, omission, interruption, or delay with respect thereto. Nothing herein shall constitute or be considered to be a limitation upon or a waiver of the privileges and immunities of WMO or UNEP, which are specifically reserved.

LSE Transition Pathway Initiative Centre

Grantham Research Institute on Climate Change and the Environment

London School of Economics and Political Science

Houghton Street

London WC2A 2AE, UK

T +44 (0)20 7107 5027

E tpi@lse.ac.uk

Transition Pathway Initiative

c/o UNPRI Association

5th Floor, 25 Camperdown Street

London E1 8DZ, UK

T +44 (0)20 3714 3141

E info@transitionpathwayinitiative.org

@tp_initiative

transitionpathwayinitiative.org

Transition Pathway Initiative

Grantham Research Institute on Climate Change and the Environment