SCIENCE BASED TARGETS

DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

SYNTHESIS REPORT: POWER SECTOR METRICS & METHODS

Version 1.0 First Consultation Draft

September 2025

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ABOUT SBTi

The Science Based Targets initiative (SBTi) is a corporate climate action organization that enables companies and financial institutions worldwide to play their part in combating the climate crisis.

We develop standards, tools and guidance which allow companies to set greenhouse gas (GHG) emissions reductions targets in line with what is needed to keep global heating below catastrophic levels and reach net-zero by 2050 at latest.

The SBTi is incorporated as a UK charity, with a subsidiary SBTi Services Limited, which hosts our target validation services. Partner organizations who facilitated SBTi's growth and development are CDP, the United Nations Global Compact, the We Mean Business Coalition, the World Resources Institute (WRI), and the World Wide Fund for Nature (WWF).

DISCLAIMER

VERSION HISTORY

Version	Change/update description	Release date
Version 1.0	Synthesis Report: Power Sector Metrics & Methods Draft Version 1.0	September 2025

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EXECUTIVE SUMMARY

In 2020, SBTi published the Quick Start Guide for Electric Utilities (SBTi, 2020) to support power companies in setting near-term science-based targets. Since then, the energy sector has seen major shifts driven by evolving policy landscape, cost breakthroughs in clean technologies, and structural changes in energy markets**.** In parallel, updated climate science and new global scenarios, such as the IEA's updated Net Zero scenario and the IPCC's latest scientific assessment, have redefined what constitutes a 1.5°C-aligned transition for electric utilities.

The report is intended to support the development and revision of SBTi's power sector standard and provide transparency into the implications of selecting specific metrics or target-setting methods.

This synthesis paper describes the assessment and selection process of the metrics and target-setting methods proposed for use in the power sector as well as highlighting key implementation challenges. The assessment against SBTi principles and testing of proposed adjustments has enabled proposals for more robust implementation of science-based targets These insights are used to formulate recommendations for SBTi's development of the Power Sector Net-zero Standard.

1. INTRODUCTION

1.1 Background

Metrics and target-setting methods play a pivotal role in the process of setting science-based targets by providing a solid foundation for defining, measuring, and tracking the climate performance of entities.

In addition to the metrics and target-setting methods currently used in SBTi standards, there exists an active community of researchers and method developers who have contributed significantly to improve the understanding of how to design and implement metrics and target-setting methods in the corporate sector. There also exist concerns and critiques about traditional GHG impact metrics and the claims that can be enabled by their use. Carbon budget conservation ideas that have underpinned SBTi methods have come under increasing scrutiny, and the operational challenges of using these metrics and methods has become apparent. Understanding and incorporating the latest thinking and best practices is necessary for SBTi standards to remain rigorous and credible over time.

1.2 Purpose and scope

This synthesis report is developed as part of the SBTi's Standard Operating Procedures This (SOP)[1] to provide recommendations for the revision and addition of new climate performance metrics and target-setting methods in SBTi Power Sector Net-zero Standard V1.0. It is limited to the power sector and addresses direct (scope 1) and indirect (scopes 2 and 3) emissions for key power sector activities. The report is intended to support the development and revision of SBTi's power sector standard and provide transparency into the implications of selecting a specific metric or target-setting method. It aims to address a number of critiques that have been raised in the academic literature and observed via ongoing company validations at the SBTi. This paper builds on the conclusions and recommendations of the synthesis report on scope 1 emissions metrics and methods developed in support of the Corporate Net-Zero Standard V2 (hereafter referred to as the CNZS).

There are three distinct research questions to be answered:

1. What metrics are necessary for measuring and tracking the climate performance of companies in the power sector?
2. What are suitable target-setting methods to derive net-zero aligned benchmarks that can inform science-based target setting for those metrics which are consistent with a transparent set of principles?
3. How should the metrics and methods be operationalised for power sector companies to use them to set targets?

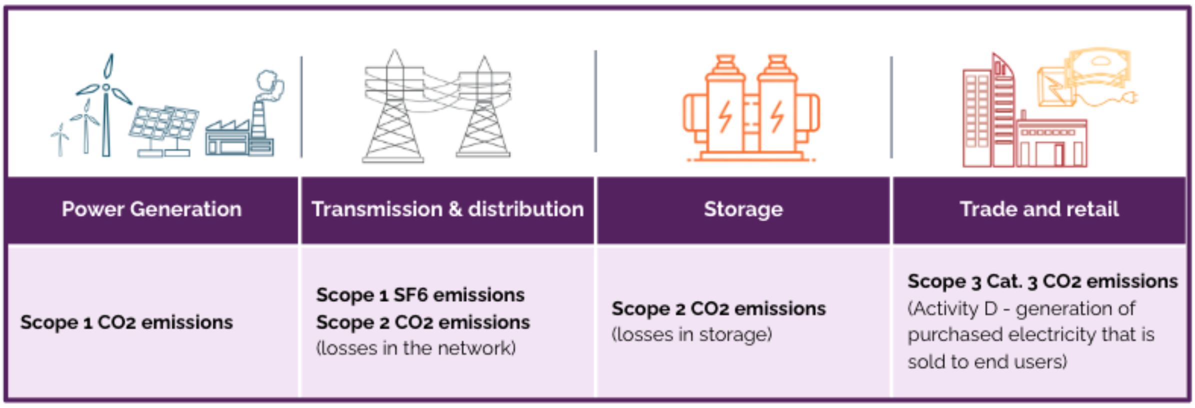
[1] Synthesis reports developed as part of the SBTi standard development process are informative documents that summarize research and analysis findings informing a new or updated standard. The inclusion of synthesis report findings related to technical foundations—metrics, methods, and/or pathways—in a standard is subject to the discretion of the standard development project team and the SBTi Technical Department. As such, some content in this synthesis report may not be present in the final published version of a new or updated standard.

2. OVERVIEW OF CURRENT LANDSCAPE

2.1 Power sector overview

SBTi first published guidance for target setting in the power sector in 2020 with its *Quick Start Guide for Electric Utilities* (SBTi, 2020). The forthcoming power sector standard provides greater detail and clarity on target-setting approaches within the sector, and expands its scope to a broader list of sector activities. Figure 2.1.1 provides a visual representation of the power sector activities that are within the scope of the power sector standard and this synthesis report. Those activities within and/or related to the power sector but not included in the scope of the power sector standard shall be subject to the target-setting guidance provided in the CNZS.

Figure 2.1.1 Activities and emissions in scope of the Power Sector Standard.



The updated power sector standard provides target-setting criteria and guidance for certain emissions scopes within each of the activities outlined above, while other activity-emissions scope combinations are subject to the guidance of the CNZS. This applicability framework is applied in this synthesis report and characterized in Table 2.1.1.

Table 2.1.1. Activity-emissions scope applicability framework in the SBTi Power Sector Standard.

Activity	Scope 1	Scope 2	Scope 3 category 3	Scope 3 all other categories
Power generation	Scope 1 CO_2 emissions from power generation	Refer to CNZS	Refer to CNZS	Refer to CNZS
Electricity transmission & distribution	Scope 1 SF_6 emissions from electricity transmission & distribution	Scope 2 CO_2 emissions from electricity transmission & distribution losses	Refer to CNZS	Refer to CNZS

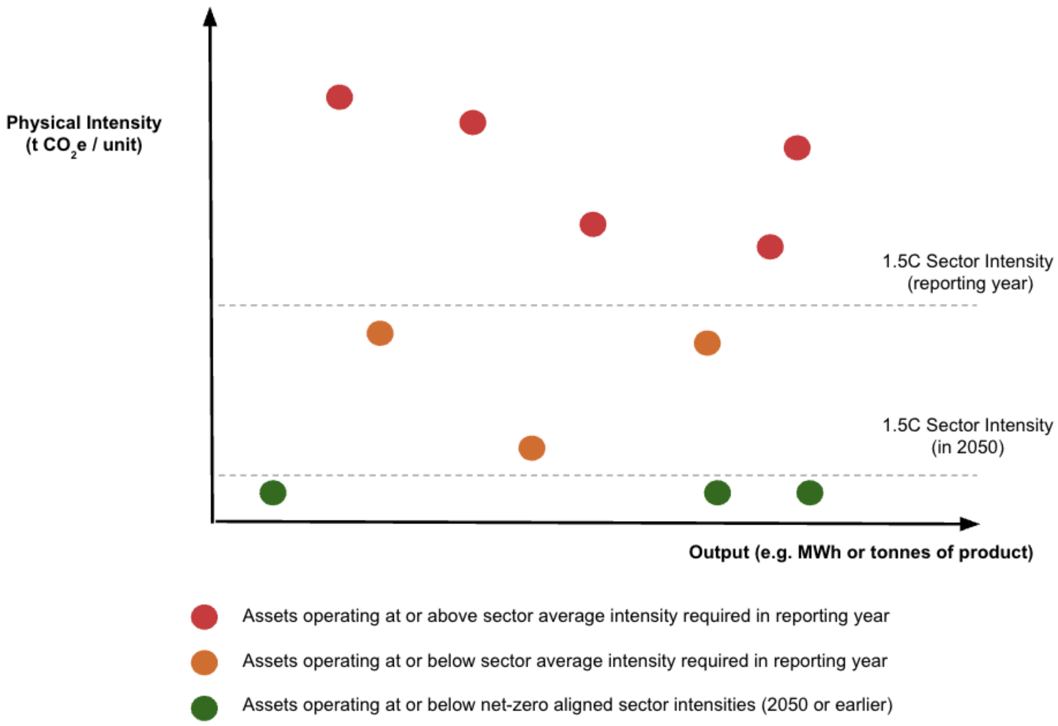
Activity	Scope 1	Scope 2	Scope 3 category 3	Scope 3 all other categories
Storage of electricity	Refer to CNZS	Scope 2 CO_2 emissions from electricity storage losses	Refer to CNZS	Refer to CNZS
Trade and retail of electricity	Refer to CNZS	Refer to CNZS	Scope 3 Category 3 CO_2 emissions from electricity purchased and resold to end consumer	Refer to CNZS

2.2 Metrics Overview

A metric is a quantitative measure used to assess, compare, or track performance, progress, or quality in a specific context. For SBTs, metrics represent measures of climate impact used to determine if an entity is "on track" to get to the desired performance levels on its transition to net-zero. Understanding the climate performance of an entity first requires a set of clear metrics that meaningfully represent its performance consistently over time. Many aspects of an entity's operations can be measured, including the entity's GHG emissions, the GHG intensity of its production, the types of technology used, the quantities of fossil fuels the entity purchases and uses on an annual basis, etc.

Figure 2.2.1 demonstrates that a portfolio of emitting assets within an organizational boundary can exhibit a wide range of operational output and physical emissions intensity. Depending on the value of physical intensity relative to sector average intensity levels at different points in time, a variety of different metrics may be suitable to track the performance of a group of emitting assets within an entity's organizational boundary.

Figure 2.2.1. Illustrative example of an asset portfolio by emissions intensity and output.



From this a number of metrics can be developed, including:

- Absolute emissions (t CO_2e): measures the aggregate absolute GHGs from all assets within the organizational boundary
- Physical emissions intensity (t CO_2e / unit output): measures the aggregate absolute GHGs per unit of production
- Technology share (%): measures the share of specific technology types used to generate the output
- Losses (%): measures the share of electricity losses relative to total electricity within an electrical system

Table 2.2.1 provides an overview of the proposed metrics within the scope of the power sector standard that are subject to assessment in this report.

Table 2.2.1. Description of metrics proposed for use in the power sector.

Metric	Type	Unit	Value chain applicability	Description
Physical emissions intensity	Impact	t CO2 / MWh	Power generation	Measures the aggregate absolute CO_2 emissions per unit of power generation within the organizational boundary.
Absolute emissions	Impact	t GHG	Power generation, electricity	Measures the aggregate absolute GHG emissions from all assets within the organizational

Metric	Type	Unit	Value chain applicability	Description
			transmission & distribution, sale of electricity, storage of electricity	boundary. Specific GHGs vary by value chain use case.
Technology share	Outcome	%	Power generation, sale of electricity	Measures the share of specific technology types or categories of technology types used to generate the output.
Feedstock share	Outcome	%	Power generation	Measures the share of specific feedstock types or categories of feedstock types used as an input for power generation
Losses	Outcome	%	Electricity transmission & distribution, storage of electricity	Measures the share of activity losses relative to total activity in a system.

2.3 Target-setting methods overview

Target-setting methods are mathematical formulae or algorithms used to calculate interim performance values that serve as the reference for entities to set targets. Methods are independent from but related to pathways and metrics. A target-setting method is applied to each target metric to determine the required interim performance value to guide the formulation of science-based, measurable, and time-bound targets aligned with pathways that are consistent with limiting warming to 1.5°C with no or limited overshoot. Pathways are used to determine the net-zero aligned benchmark for each metric, and as an input to the method. Table 2.3.1 provides a description of each of the methods mapped in this study.

Table 2.3.1. Description of target-setting methods proposed for use in the power sector.

Method	Description
Sectoral Decarbonization Approach (SDA)	Companies reduce annual emissions per unit of physical output by an amount calculated from the underlying sector pathway and company input data over the company target timeframe, assuming emissions intensity convergence for all companies in a sector in a fixed future year.

Technology Share Convergence (TSC)	The TSC uses pathways with pre-defined interim benchmarks values for eligible target years that each company must achieve. The method applies a sector convergence principle that requires all companies converge to the net-zero aligned technology share value by the net-zero target year, which also reflects the company’s starting point.
Linear Alignment Approach (LAA)	The Linear Alignment Approach applies a sector convergence principle that requires all companies to converge to the sector benchmark value in the net-zero year, which is independent of the company’s starting point.

3. EVALUATION METHODOLOGY

A broad range of target-setting approaches exist, some documented and used by the SBTi (SBTi, 2024), with others documented and evaluated in the academic literature. This review synthesizes key critiques of target-setting approaches available for use in the power sector and addresses known implementation challenges observed by power sector companies using SBTi methods.

Table 3.1. Outputs included in the evaluation methodology.

Assessment	Title	Status	Description
1	Metric selection	Mandatory	Assessment of appropriate climate related metrics must be covered in all synthesis reports.
2	Method selection and underlying allocation principles	Mandatory	Assessment of appropriate methods must be covered in all synthesis reports.
3	Differentiated requirements	Optional	This may be addressed in the standard itself. Differentiated requirements should be addressed if the standard is proposing different metrics/methods for different activity types e.g. low intensity asset portfolios may apply a different method compared to high intensity asset portfolios.
4	Base and reference years	Optional	This may be addressed in the standard itself.

3.1 Principles for selection of metrics and methods

Well-defined principles are needed to steer and justify expert judgments that must be applied when it comes to designing standards and selecting the technical foundations that underpin them. To navigate this complexity and to establish a set of credible metrics and methods, six principles were adopted to guide our selection of target-setting approaches (see Table 3.1.1). The principles are designed to enable flexibility in assessment of emerging science while maintaining coherence with SBTi's values and mission, and inherit from overarching Principles for the Development of SBTi Standards and Technical Foundations.

Here, we used the principles to derive strict criteria for metric and method selection. The principles and the precise assessment criteria are described in Table 3.1.1.

Table 3.1.1. Principles and assessment criteria for metric and method selection.

Principle	Description	Assessment Criteria
Ambitious	Ensure that entities decarbonise in line with the ambition required to limit warming to 1.5°C with no or limited overshoot.	Metric: Metrics for target setting should be benchmarkable against 1.5°C climate pathways e.g. global or cross-sector 1.5°C pathway. Method: The cumulative emissions imbalance over the SBT timeframe for all companies in target-setting sample. If the method results in a cumulative emissions imbalance of 5% or less, the principle is met.
Rigorous	Use the best available science, from authoritative sources, such as Intergovernmental Panel on Climate Change (IPCC), International Energy Agency and similar or related sources, and best practice in climate target setting and climate mitigation at the time of standard development.	Method: Principle can be met under two conditions: 1. Method has been 3rd party approved via peer-reviewed paper, or 2. Method has been published as a working paper and is intended to go through a peer review process.
Transparent	Ensure all relevant information is publicly available, and transparently documented, including explicit statements of assumptions and calculation procedures.	Metric and Method: Principle is only met if required documentation for the metric and method calculation and replication is publicly available.
Robust	Meaningfully represent the climate performance of an entity, and be consistent over time to enable credible claims throughout the target-setting and implementation journey, while reaching for a maximum level of comparability across entities.	Metric: Principle is assessed based on what factors may increase or decrease the value of the SBTi's metric. Principle is only met if factors that cause change are: 1. Elimination of emissions sources inside companies reporting boundary, or 2. Replacement of high GHG commodities with lower ones.
Actionable	Ensure all technical foundations are practical to design and implement leading to measurable action and progress in climate performance.	Method: Principle is qualitatively assessed based on the following factors: 1. Method is practical to design based on available pathways and input data; 2. Input variables are not required beyond reasonable business planning timeframes (historic or future activity projections); 3. Avoids input variables based on data not widely available or reported by companies e.g. regional / sectoral revenue granularity

Equitable	Reflect a transition to net-zero that recognizes the differentiation needed for entities of varying sizes, types, sectors, and geographies to undertake a science-based decarbonization journey that strives for equity.	Method: Principle can be met under following conditions, assessed qualitatively: 1. Differentiated responsibilities: allocation principle factors historic responsibility, and model can select different scenarios based on regional requirements; 2. Respective capabilities: allocation principle factors in capability / capacity to pay

4. METRIC AND TARGET-SETTING METHOD EVALUATION

4.1 Metric Evaluation

A metric is a quantitative measure used to assess, compare, or track performance, progress, or quality in a specific context. For SBTs, metrics represent measures of climate performance used to determine if an entity is "on track" to get to the desired performance levels on its transition to net-zero.

SBTi currently uses a single metric, physical emissions intensity, to define ambition and track performance for emissions in the power sector. In order to address critiques raised both in the academic community and by power sector entities setting SBTs, two additional metrics are proposed for adoption: absolute GHG emissions and technology share. All three metrics are summarized in Table 2.2.1.

These have been assessed against the three key principles that are applicable to metrics (see Table 4.1.1). This determines if a metric a) is easily benchmarkable against 1.5°C pathways (Ambitious), b) can be transparently calculated and replicated (Transparent), and c) can represent a measure of climate impact consistently over time (Robust).

Table 4.1.1. Evaluation of power sector metrics against principles.

	Power sector metrics				
Evaluation principle	**Physical emissions intensity ($t\ CO_2$ / MWh)**	**Absolute GHG emissions ($t\ CO_2e$)**	**Technology share (%)**	**Feedstock share (%)**	**Losses (%)**
Ambitious: benchmarkable against 1.5°C pathways (global or sector)	Yes[1]	Yes[1]	Yes[1]	Yes[1]	Yes[1]
Transparent (and verifiable)	Yes[2]	Yes[2]	Yes[3]	Yes[4]	Uncertain[5]
Robust: Consistent and robust over time	Uncertain[6]	Yes	Yes	Yes	Yes
Notes 1. Global, and sectoral pathways exist for all metrics. Physical intensity and technology					

share are constrained to only certain types of activities that are common in climate scenarios e.g. energy, industry, transport, etc.
2. Absolute and physical intensity metrics are commonly reported by entities with well defined calculation methodologies.
3. Share of power generation by asset type is a commonly reported metric.
4. Share of power generation feedstock is a commonly reported metric.
5. Accuracy of system loss measurements can vary based on multiple factors.
6. Reductions in value of physical intensity metrics can be achieved via activity growth or change in emissions performance.

4.1.1 Interpretation of evaluation results

This evaluation reveals several key insights when it comes to the selection of metrics:

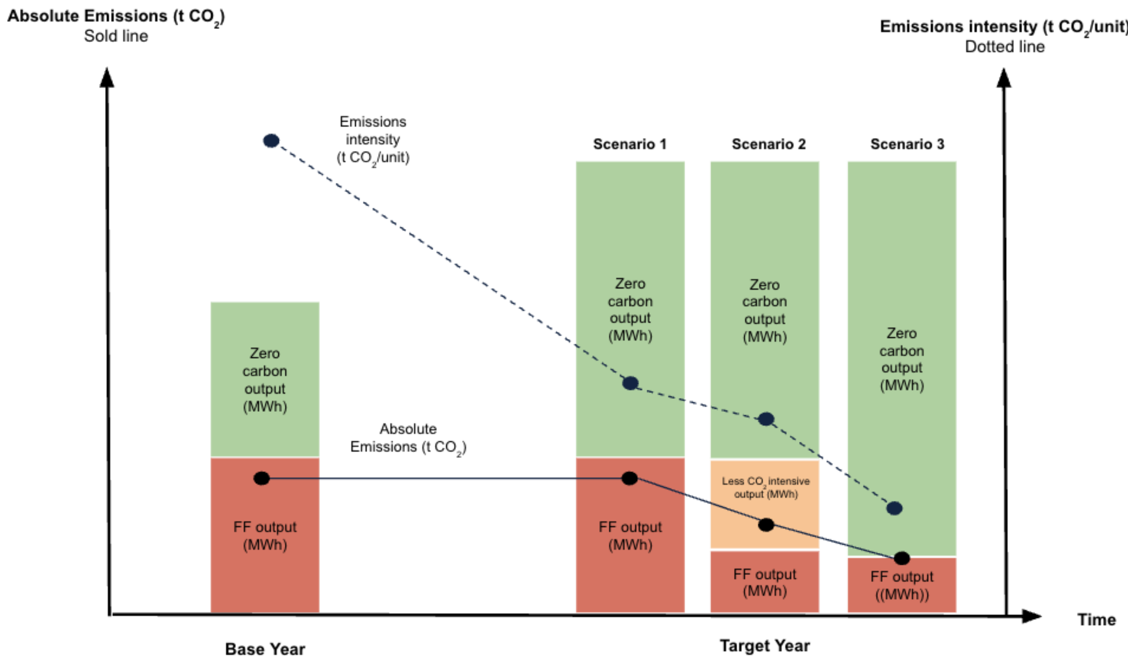
1. The absolute emissions metric is the most reliably robust over time because it can directly reflect the actual reduction of emissions volume to the atmosphere. However, absolute emissions metrics alone fail to address all outcomes required, as an entity might reduce its own absolute emissions without phasing out existing FF assets or even with the deployment of additional emission intensive capacity. This metric also ignores market dynamics and favors incumbents, who already have stocks of emitting assets that need to be decarbonised.
2. Physical emissions intensity metrics can be compared against pathways at specific points in time and do not explicitly represent cumulative emissions, although this can be derived. These intensity metrics require more monitoring than absolute emission metrics to determine what actually causes a change in the metric value, e.g. increase in activity or a reduction of emissions.
3. Technology share and feedstock share metrics do not directly measure emissions, and are more useful for providing insights into actions the entity is taking with its asset portfolio. Both these metrics and intensity metrics can show improved performance relative to benchmarks via the build out of low carbon capacity without the actual phaseout of existing high carbon capacity.
4. Loss metrics are subject to data quality constraints that can vary substantially depending on multiple factors, such as the type of system (i.e. transmission, distribution, or storage) and regional variations in infrastructure quality.

To illustrate the different roles these metrics can play in target setting, Figure 4.1.1 highlights how different metrics can be affected under different transition scenarios for a power generation company with both carbon emitting and zero carbon assets. Three transition scenarios are shown to highlight how the metrics change:

- **Scenario 1:** company adds output from zero carbon assets, while maintaining the same output from fossil fuel-based generation capacity.
- **Scenario 2:** company adds output from zero carbon assets and replaces high carbon intensity generation capacity (e.g. coal) with lower carbon intensity generation capacity (natural gas).
- **Scenario 3:** company adds output from zero carbon assets and phases out existing high carbon intensity generation capacity.

All scenarios in Figure 4.1.1 result in a decrease in emissions intensity of the owned assets, however absolute emissions would remain the same in Scenario 1. Replacing high intensity assets with lower intensity assets can reduce absolute emissions (Scenario 2), but this can obscure the fact that a new long-lived carbon emitting generation asset has been created. Only Scenario 3 features both the phasing down of existing emissions intensive assets and all new growth met by zero carbon sources. This illustration highlights that weighted average intensity metrics and even absolute GHG metrics may not fully and transparently incentivize the actions needed by entities that own and operate high emitting assets to move toward decarbonized power generation. Technology share metrics are therefore necessary complements to absolute and intensity based metrics as they more clearly indicate the types of power generation technologies that are being installed and phased out by the entity.

Figure 4.1.1. Representation of metrics applied for power generation targets.



4.2 Method evaluation

Target-setting methods are algorithms used to define future benchmarks for metrics. Methods are based on a number of inputs, including different company variables (e.g. base year emissions, activity projections) and climate pathways (e.g. global, regional, or sectoral pathways). The primary function of a method is to determine the benchmark value for the metric in the desired interim target year. SBT methods may use a number of different metrics to define ambition and assess progress, such as absolute emissions or emissions intensity. Depending on the type of metric, this may need to be converted into absolute terms by multiplying it by an activity projection in the target year. Establishing the absolute emissions benchmark in the target year enables either a path dependent point in time (% reduction from base year to target year) or a path independent cumulative budget approach (% reduction in emissions required to conserve budget between base and target year).

The six principles for the selection of metrics and methods (Table 3.1.1) are applied to three target-setting methods listed below. These methods are proposed for use in target setting for multiple power sector activities and emissions scopes, as indicated in Table 6.2.1. The assessment of methods for use in the power sector is shown in Table 4.2.1.

Table 4.2.1. Evaluation of power sector target-setting methods against principles.

	Power sector methods		
Evaluation principle	**Sectoral Decarbonization Approach (SDA)**	**Technology Share Convergence (TSC)**	**Linear Alignment Approach (LAA)**
Ambitious	Yes	Partly[1]	Yes
Rigorous	Yes	No[2]	No[2]
Transparent	Yes	Yes	Yes
Robust	Partly[3]	Yes	Yes
Actionable	Partly[4]	Yes	Yes
Equitable	Partly[5]	Partly[6]	Partly[7]

Notes

1. Alignment methods can be a useful proxy for decarbonization in the power sector, but because they cannot be directly linked to carbon budgets, they do not fully satisfy the Ambitious principle.
2. These proposed methods have not been subject to peer review or published as a working paper.
3. The SDA is subject to volatility caused by changing market share projections, which are required as a calculation input.
4. The SDA relies on market share projections that require continuous monitoring over time.
5. The SDA relies on grandfathering, but the convergence allocation ensures that entities with higher emissions must reduce emissions faster. Decarbonisation rates are based on cost-optimization rather than equity considerations, so equity principles are not inherent in the method design.
6. The TSC relies on convergence allocation that requires all power sector companies to reach interim and net-zero technology share benchmarks that reflect the starting point of a company.
7. The LAA relies on convergence allocation that requires all power sector companies to reach net-zero benchmarks regardless of the company's starting point.

4.2.1 Interpretation of evaluation results

The Ambitious principle holds that if all companies in a sample apply the same SBT method, a cumulative emissions budget for the sample should not be significantly exceeded, i.e. no greater than 5% exceedance. Absolute contraction is the most logically consistent with the ambition principle due to its simplicity and use of absolute emissions metrics. The SDA suffers somewhat from conditionality due to its reliance on intensity based allocation, i.e. it only ensures cumulative budget conservation if activity level assumptions are reasonably accurate and appropriate. Although the TSC ensures alignment with credible scenarios for asset decarbonization, because it relies on a non-emissions metric it is not as consistent with the ambition principle as other methods.

Bjørn et al. (2021) have undertaken the most comprehensive analysis to date of budget conservation (or emissions imbalance) of different target-setting methods. Annex A builds on the authors' original analysis and provides a more detailed overview of budget conservation for each method.

According to the Actionable principle, methods should be easy to develop and use by entities. In this sense, methods that minimize the number of input variables and assumptions are preferred, as this ensures less volatility over time due to changing boundaries and activity assumptions.

The TSC requires the least number of input variables, and is thus the most actionable method assessed. The SDA requires activity level projections, leading to more active monitoring and potentially more re-alignment over time. A more detailed review of the company input variables required for using each method is provided in Table 6.2.1.

5. TARGET DESIGN AND APPLICATION

Known cross-sector and power sector-specific challenges related to metrics and methods collected through internal discussions, external feedback from companies in the power sector, and critiques from the scientific literature, are summarized below in addition to proposed solutions/adjustments.

5.1 Cross-sector challenges

5.1.1 Scenario start year as common reference year

Target ambition and achievement are by definition relative to the reductions / increases put forth in the underlying pathway. SBTi does not currently require the scenario reference year to be consistent with the selected company base year. If the reference year of the company's journey differs from the start year of the pathway in use, it can be difficult to make an accurate assessment of the company's performance to date against the climate goals inherent to the pathway (Rekker et al., 2022) and to facilitate accurate cross company comparisons (Giesekam et al., 2021).

This issue is discussed extensively in the Corporate Net-Zero Standard V2 synthesis report for metrics and metrics, and the conclusions reached therein apply equally to the power sector.

5.1.2 Cumulative emissions budgets in target-setting approaches

SBTi currently employs a point in time approach where target ambition is defined by a reduction in emissions between two points in time, the base year and target year. This yields considerable flexibility for the company in its emissions reduction pathway between those two points - as long as target year ambition is met, the emissions in interim years are effectively disregarded. As a result, claims based on this target-setting approach regarding the company's contribution to global carbon budget conservation are not robust (Bjørn et al., 2023; Rekker et al., 2022; Hadziosmanovic et al., 2022).

The Corporate Net-Zero Standard V2 states that companies setting cross-sector targets shall be subject to a cumulative emissions target-setting approach in order to ensure that targets are sufficiently ambitious and robust. The same basic reasoning applies to the power sector, with some constraints. The SDA's reliance on company-level activity projections introduces an additional degree of uncertainty that should be reflected in any attempt to adjust ambition based on performance to date.

Instead of a strict budget-based approach, an intensity target adjustment is proposed that accounts for cumulative emissions performance to date by increasing the ambition of future physical intensity targets. Building on the methodology established by Rekker et al. (2022), Annex B identifies the risks of sector carbon budget overshoot when cumulative performance is not accounted for and describes the methodology used to convert performance to date in terms of cumulative emissions into a physical emissions intensity target adjustment.

5.2 Power sector-specific challenges

5.2.1 Differentiated requirements for asset portfolios

The level of metric and method differentiation and how it should be applied to different types of entities is a key concern given the very different asset portfolios of some companies within the power sector. The SDA is intended for use in sectors with homogeneous activities. As power sector company asset portfolios become increasingly heterogeneous or shift toward majority renewable generation, this raises questions about the suitability of the SDA as a target-setting method for all companies in this sector. Asset-level alignment target setting approaches may enable an equitable phaseout of high-emitting assets in line with 1.5°C pathways and for companies to ensure that a growing share of its assets are aligned with relevant carbon budgets. The technology share metric introduced in this synthesis report complements the existing emissions based metrics and allows stakeholders to better track the make up of the electricity generation asset portfolio.

The power sector also contains some entities which have a high share of low-carbon generation output, resulting in a generation intensity in the base year that is substantially lower than the sector average. Feedback from power generation companies that meet this profile suggests that very low base year generation intensity can yield interim SDA targets with highly ambitious reductions that companies struggle to achieve, having already undertaken substantial decarbonization. Such challenges may be due to factors beyond the company's control, e.g. region-specific power sector regulations that require a certain minimum level of baseline power generation from fossil fuels. This indicates a need to explore alternative target-setting methods for those companies that are already operating with substantially lower than average emissions.

The SDA Linear Convergence method adjustment aims to provide power sector companies with low intensity generation activities an alternative target-setting approach that yields more feasible targets. This approach is detailed in Annex C.

5.2.2 Aligning target-setting approaches with power sector activities

SBTi's current power sector guidance is limited to electricity generation, the primary source of emissions in the sector. However, there is a need for target-setting guidance tailored more specifically to other activities within the scope of power sector operations - electricity transmission and distribution, sale of electricity, and storage of electricity.

Feedback from external stakeholders suggest that novel target-setting approaches in addition to those within the scope of this report are not necessary. Rather, entities in the power generation sector require more explicit guidance on the appropriate target-setting approach to be used with specific combinations of power sector activities and emissions scopes. Building on the activity-emissions scope applicability framework in Table 2.1.1, Table 5.2.1 maps these activity-scope combinations to target-setting approaches. Any activity-scope combinations not explicitly included therein are subject to target-setting guidance in the CNZS.

Table 5.2.1. Mapping power sector activity-emissions scope combinations to target-setting approaches.

Activity-scope combinations			Target-setting approaches			
Activity	**Scope**	**Activity unit**	**Metric**	**Method**	**Function**	**Justification**
Power generation	Scope 1	kg CO_2 / MWh	Physical emissions intensity	SDA	Target setting	Measuring and tracking the performance of the production of homogeneous, high-emitting sectors with a physical emissions intensity metric aligns with SBTi's previous approaches. Targets that reduce the physical emissions intensity of electricity generation allow for carbon budget conservation without constraining power generation output.
		t CO_2	Absolute emissions	SDA	Disclosure, target setting	Although the SDA produces targets in terms of physical intensity, a company's performance to date can be measured in terms of cumulative absolute emissions. This allows for target adjustment based on historical emissions performance. See Annex B for details.
		%	Technology share	TSC	Target setting	Physical emissions intensity and absolute emissions are necessary metrics for scope 1 electric power generation, but not entirely sufficient. The technology share metric provides needed transparency on the decarbonization levers used to reduce the value of the other metrics. This dynamic is illustrated in Figure 4.1.1.
		%	Feedstock share	LAA	Target setting	The feedstock share metric provides additional transparency on the use of power generation feedstocks such as sustainable biomass that supports the adoption timelines within the power sector pathway.

Activity-scope combinations			Target-setting approaches			
Activity	**Scope**	**Activity unit**	**Metric**	**Method**	**Function**	**Justification**
Electricity transmission and distribution	Scope 1	t SF_6	Absolute emissions	N/A	Disclosure	SF_6 has a high GWP value and is commonly used in electrical transmission and distribution equipment (Smith et al., 2021). However, the power sector pathway does not provide sufficiently granular data to set quantitative SF_6 abatement targets. Regardless, due to its high impact, an SF_6 metric is useful for disclosure purposes. Qualitative criteria are provided in the power sector standard to address these emissions.
	Scope 2	t CO_2	Absolute emissions	N/A	Disclosure	Absolute emissions are used for disclosure purposes to satisfy the applicability constraints outlined in the power sector standard.
	Scope 2	%	Share of electricity lost in electricity system (transmission and distribution)	N/A	Disclosure	Emissions associated with electricity losses in transmission and distribution systems are subject to different decarbonization levers than other scope 2 emissions, e.g. improving the efficiency of transmission equipment. As such, they require specific guidance from the power sector standard. Share of electricity lost is an appropriate metric as transmission and distribution system operators are able to increase the efficiency of their systems.
Sale of electricity	Scope 3 Category 3	t CO_2	Absolute emissions	N/A	Disclosure	Absolute emissions are used for disclosure purposes to satisfy the applicability constraints outlined in the power sector standard.

Activity-scope combinations			Target-setting approaches			
Activity	**Scope**	**Activity unit**	**Metric**	**Method**	**Function**	**Justification**
	Scope 3 Category 3	%	Technology share	TSC	Target setting	Emissions from the generation of purchased energy that is sold to end users represents a significant source of CO_2 emissions from the sale of electricity, and should be treated separately from other Scope 3 Category 3 targets. Technology share is an appropriate metric as electricity retail sellers can reduce emissions associated with purchase and resale of electricity by changing trading portfolios.
Storage of electricity	Scope 2	t CO_2	Absolute emissions	N/A	Disclosure	Absolute emissions are used for disclosure purposes to satisfy the applicability constraints outlined in the power sector standard.
	Scope 2	%	Share of electricity lost in electricity system (transmission and distribution)	N/A	Disclosure	Emissions associated with electricity losses in storage systems are subject to different decarbonization levers than other scope 2 emissions, e.g. improving the efficiency of storage equipment. As such, they require specific guidance from the power sector standard. Share of electricity lost is an appropriate metric as storage system operators are able to increase the efficiency of their systems.

6. DISCUSSION AND RECOMMENDATIONS

Establishing SBTs requires a number of design judgements that cover the selection of metrics to track climate performance, the selection of suitable methods for establishing net-zero aligned targets and the design and application of these methods for target setting purposes. This synthesis paper has assessed a range of metrics and target-setting methods proposed for use in the power sector as well as highlighting key implementation challenges. The assessment against SBTi principles and testing of proposed adjustments has enabled proposals for more robust implementation of SBTs. These insights are used to formulate recommendations for SBTi's revision of its power sector standard.

6.1 Metric selection

The SBTi requires that companies in certain sectors - including the power sector - set targets using the SDA. Because of this, weighted average physical emissions intensity has historically been used as the default metric for power sector target setting. The assessment against principles for the selection of metrics conducted in this report determined that physical intensity is appropriate for target setting, but absolute emissions is nevertheless a more robust metric with a direct link to climate performance. As such, both metrics should be used in power sector target setting. Technology share metrics provide useful information regarding a company's progress toward aligning with power sector decarbonization scenarios, and should be used as a complement to target setting with impact metrics.

A key consideration for the power sector is mapping the approved metrics to specific uses for target setting in the sector. Table 6.1.1 demonstrates a framework assigning metrics to specific combinations of activities and emissions scope. In the case of Scope 1 emissions from electricity generation, targets must be set using multiple metrics: physical intensity, absolute emissions, and technology share.

Table 6.1.1. Mapping of metrics proposed for use to power sector activities and emissions scopes.

Metric code	Metric type	Metric category	Scope	Description	Units	Net-zero aligned benchmark value	Reference pathway
Power Generation							
Metric-PS.1	Physical emissions intensity	Impact	Scope 1	Physical intensity of CO_2 emissions from power generation by assets and activities owned or controlled by the entity.	Kilograms of CO_2 per MWh of electricity generated (kg CO_2 / MWh)	1.03	SBTi power sector pathway
Metric-PS.2	Absolute emissions	Impact	Scope 1	Absolute CO_2 emissions from electricity generation by assets or activities owned or controlled by the entity.	Metric tons of CO_2 (t CO_2)	N/A, for disclosure use only	N/A
Metric-PS.3a	Technology share	Outcome	Scope 1	Share of total electricity generation from low carbon electricity generation by assets and activities owned or controlled by the entity.	Percent (%)	99.43%	SBTi Power Sector Pathway
Metric-PS.3b	Technology share	Outcome	Scope 1	Share of total electricity generation from unabated fossil fuel electricity generation by assets and activities owned or controlled by	Percent (%)	0.57%	SBTi Power Sector Pathway

Metric code	Metric type	Metric category	Scope	Description	Units	Net-zero aligned benchmark value	Reference pathway
				the entity.			
Metric-PS.4	Feedstock share	Outcome	Scope 1	Share of biomass sustainably sourced	Percent (%)	100%	IEA NZE
Electricity Transmission and Distribution							
Metric-PS.5a	Absolute emissions	Impact	Scope 1	Absolute SF_6 emissions from electricity transmission and distribution by assets and activities owned or controlled by the entity.	Metric tons of SF_6 (t SF_6)	N/A, appropriate for disclosure use only	N/A, appropriate for disclosure use only
Metric-PS.5b	Share of losses	Outcome	Scope 1	Annual SF_6 leakage rate in electricity transmission and distribution equipment from assets and activities owned or controlled by the entity	Percent (%)	N/A, appropriate for disclosure use only	N/A, appropriate for disclosure use only
Metric-PS.6	Absolute emissions	Impact	Scope 2	Absolute CO_2 emissions from electricity losses in the entity's electricity transmission and distribution activities.	Metric tons of CO_2 (t CO_2)	N/A, appropriate for disclosure use only	N/A, appropriate for disclosure use only
Metric-PS.7	Share of losses	Outcome	Scope 2	Share of electricity lost in electricity network	Percent (%)	**Category A** 2040: 10.8%	N/A, best practice approach not derived

Metric code	Metric type	Metric category	Scope	Description	Units	Net-zero aligned benchmark value	Reference pathway
				(transmission and distribution)		2050: 2.0% **Category B** 2040: 20.1% 2050: 5.7%	from a pathway
Sale of Electricity							
Metric-PS.8	Absolute emissions	Impact	Scope 3 Category 3	Absolute CO_2 emissions from electricity purchased and resold to the end consumer.	Metric tons of CO_2 (t CO_2)	N/A, appropriate for disclosure use only	N/A, appropriate for disclosure use only
Metric-PS.9a	Technology share	Outcome	Scope 3 Category 3	Share of electricity purchased and sold to end user from low-carbon electricity generation.	Percent (%)	99.43%	SBTi Power Sector Pathway
Metric-PS.9b	Technology share	Outcome	Scope 3 Category 3	Share of electricity purchased and sold to end user from unabated fossil fuel electricity generation.		0.57%	SBTi Power Sector Pathway
Storage of Electricity							
Metric-PS.10	Absolute emissions	Impact	Scope 2	Absolute CO_2 emissions from electricity losses in	Metric tons of CO_2	N/A, appropriate for disclosure use	N/A, appropriate for disclosure use only

Metric code	Metric type	Metric category	Scope	Description	Units	Net-zero aligned benchmark value	Reference pathway
				the entity's electricity storage activities.	(t CO_2)	only	
Metric-PS.11	Share of losses	Outcome	Scope 2	Share of electricity lost in electricity storage	Percent (%)	6.46%	SBTi Power Sector Pathway

6.2 Method selection and underlying allocation principles

The quantitative methods assessment included in this report (see Annex A) focused on the Sectoral Decarbonization Approach due to its relevance to the power sector. The assessment was based on the method's ability to conserve the power sector budget, its actionability for users and the SBTi, as well as whether it can incorporate equity considerations. SBTi considers its Ambitious principle to be the paramount objective of any target-setting method. Compliance with this principle drew on insights from Bjørn et al.'s (2022) "Emission Imbalance" assessment to show that the SDA can conserve budgets under certain conditions.

All methods require monitoring over time to ensure that progress against the pathway is conserving the carbon budget, and that inaction between base year and current years is compensated for with increased future target ambition. Methods using physical production allocation require additional monitoring steps given that they rely on activity projections to determine absolute reductions. These intensity methods are prone to increased volatility that results from changing growth projections over the target period. Rekker et al. (2022) showed that targets modeled using the SDA must be continuously "re-aligned" to reflect updated activity growth projections. While a method may rely on physical production to define its target year benchmark, targets should ultimately be set in absolute terms to overcome the issues highlighted with the volatility of intensity metrics and their need for additional monitoring of what is causing changes in the metric.

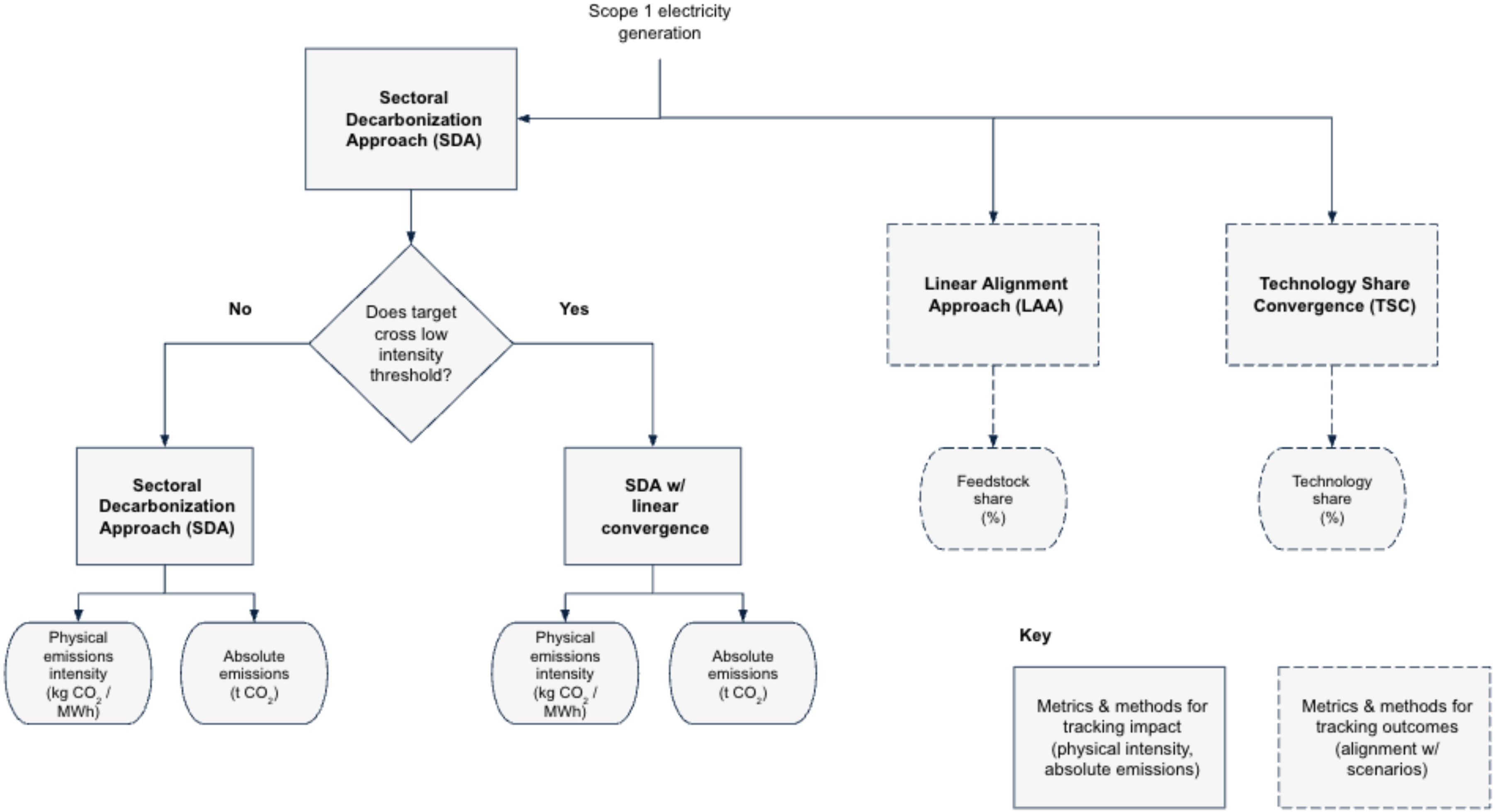
Building on the mapping exercise applied to metrics above, a key consideration for the power sector is the clear and consistent application of the appropriate target-setting method to each sector activity-emissions scope pair. Table 6.2.1 characterizes the methods recommended for use in the power sector and the metric to which they should be applied. In the case of Scope 1 emissions from electricity generation, targets must be set using multiple metrics and methods. Figure 6.2.1 visualizes the process flow for setting targets on scope 1 emissions from electricity generation, including both impact and outcome metrics.

Table 6.2.1. Mapping of target-setting methods applicable to metrics used to track performance in the power sector

Metric-Method Application		**Extrinsic Allocation**		**Intrinsic Allocation**	**Input Variables**
Metric	**Method**	**Formula allocation principles**	**Type of allocation formula**	**Granularity (global, regional, sectoral, other)**	**Company Input variables required in addition to base year, base year emissions, and interim target year**
PS.1	Sectoral Decarbonization Approach (SDA)	• Legacy entitlement • Physical Production	Convergence	Sectoral differentiation	• Base year electricity generation (MWh) • Interim target year electricity generation (MWh)
PS.2	N/A - disclosure only	N/A - disclosure only	N/A - disclosure only	N/A - disclosure only	N/A - disclosure only
PS.3a	Technology Share Convergence (TSC)	• N/A, interim performance values are derived directly from selected pathways	Convergence	Sectoral differentiation	Base year electricity generated from low-carbon sources (MWh)
PS.3b	Technology Share Convergence (TSC)	• N/A, interim performance values are derived directly from selected pathways	Convergence	Sectoral differentiation	Base year electricity generated from unabated fossil fuel sources (MWh)
PS.4	Linear Alignment Approach	• N/A, interim performance values are derived directly from selected pathways	Convergence	Sectoral differentiation	• Base year sustainable biomass sourced (t) • Base year total biomass sourced (t)
PS.5a	N/A - disclosure only	N/A - disclosure only	N/A - disclosure	N/A - disclosure	N/A - disclosure only

Metric-Method Application		Extrinsic Allocation		Intrinsic Allocation	Input Variables
			only	only	
PS.5b	N/A - disclosure only	N/A - disclosure only	N/A - disclosure only	N/A - disclosure only	N/A - disclosure only
PS.6	N/A - disclosure only	N/A - disclosure only	N/A - disclosure only	N/A - disclosure only	N/A - disclosure only
PS.7	N/A - disclosure only	N/A - disclosure only	N/A - disclosure only	N/A - disclosure only	N/A - disclosure only
PS.8	N/A - disclosure only	N/A - disclosure only	N/A - disclosure only	N/A - disclosure only	N/A - disclosure only
PS.9a	Technology Share Convergence (TSC)	N/A, interim performance values are derived directly from selected pathways	Convergence	Sectoral differentiation	Base year electricity purchased and resold from low-carbon sources (MWh)
PS.9b	Technology Share Convergence (TSC)	N/A, interim performance values are derived directly from selected pathways	Convergence	Sectoral differentiation	Base year electricity purchased and resold from unabated fossil fuel sources (MWh)
PS.10	N/A - disclosure only	N/A - disclosure only	N/A - disclosure only	N/A - disclosure only	N/A - disclosure only
PS.11	Index Alignment Approach	N/A, interim performance values are derived directly from selected pathways	Convergence	Sectoral differentiation	Base year share of electricity storage losses (%)

Figure 6.2.1. Scope 1 electricity generation target-setting method process flow



ANNEX A: QUANTITATIVE ASSESSMENT OF METHODS

The quantitative assessment of methods builds on the analysis in Bjørn et al. (2021), assessing a selection of target-setting methods against the principle of carbon budget conservation in scope 1 target setting. The SBTi's updated power sector pathway is used in place of the authors' original global emissions scenario.

This assessment does not include all target-setting methods relevant to the power sector and within the scope of this report. The justifications for this approach are summarized in table A.1.

Table A.1. Methods included and excluded from quantitative assessment.

Method name	Status	Justification
Sectoral Decarbonization Approach (SDA)	Included	Relevant for use in power sector target setting.
Sectoral Decarbonization Approach with cap on the market share parameter removed (SDA_no cap)	Included	Useful addition to assessment as it shows how the SDA behaves without an existing operationalization adjustment, the upper limit of 1 placed on the market share parameter.
Technology Share Convergence (TSC)	Excluded	By definition, alignment metrics and target-setting methods cannot be quantitatively assessed in terms of carbon budget conservation.
Linear Alignment Approach (LAA)	Excluded	By definition, alignment metrics and target-setting methods cannot be quantitatively assessed in terms of carbon budget conservation.

An assessment is conducted using a simplified scenario composed of five archetypal companies (see Table A.2) representing the global power sector and the updated SBTi power sector pathway. Company archetypes are defined by combinations of two key variables: base year physical emissions intensity and projected annual growth in power generation.

Table A.2. Archetypal company definitions.

Code	Description	Base year intensity ($t\ CO_2$ / MWh)	Projected annual power growth (%)
ig	Low base year intensity, low growth rate	0.3078725	2.5%
iG	Low base year intensity, high growth rate	0.3078725	4.0%
Ig	High base year intensity, low growth rate	0.6394275	2.5%
IG	High base year intensity, high growth rate	0.6394275	4.0%
ig*	Low base year intensity, variable growth rate	0.3078725	Variable[1]
Notes 1. Variable growth rate of ig* is used to ensure that the sum of total power generation from all five archetypal companies is equal to total power sector generation, thus enabling assessment using Cumulative Benchmark Divergence.			

Target ambition is modeled for both versions of the SDA in terms of physical emissions intensity (t CO_2/MWh) (see figures A.1 and A.2), as well as absolute emissions (Mt CO_2) and cumulative emissions (Mt CO_2). Two target timeframes are modeled, acting as general proxies for interim and net-zero target setting: 2020-2030 and 2020-2050. Carbon budget maintenance in both timeframes is assessed using the Cumulative Benchmark Divergence (CBD) metric, which measures the cumulative emissions produced by each method relative to the cumulative sector budget derived from the updated power sector pathway (IIGC, 2024). A positive CBD score indicates cumulative emissions in excess of the sector budget, while a negative score indicates cumulative emissions lower than the sector budget.

Figure A.1. Physical intensity targets of archetypal companies modeled using the SDA.

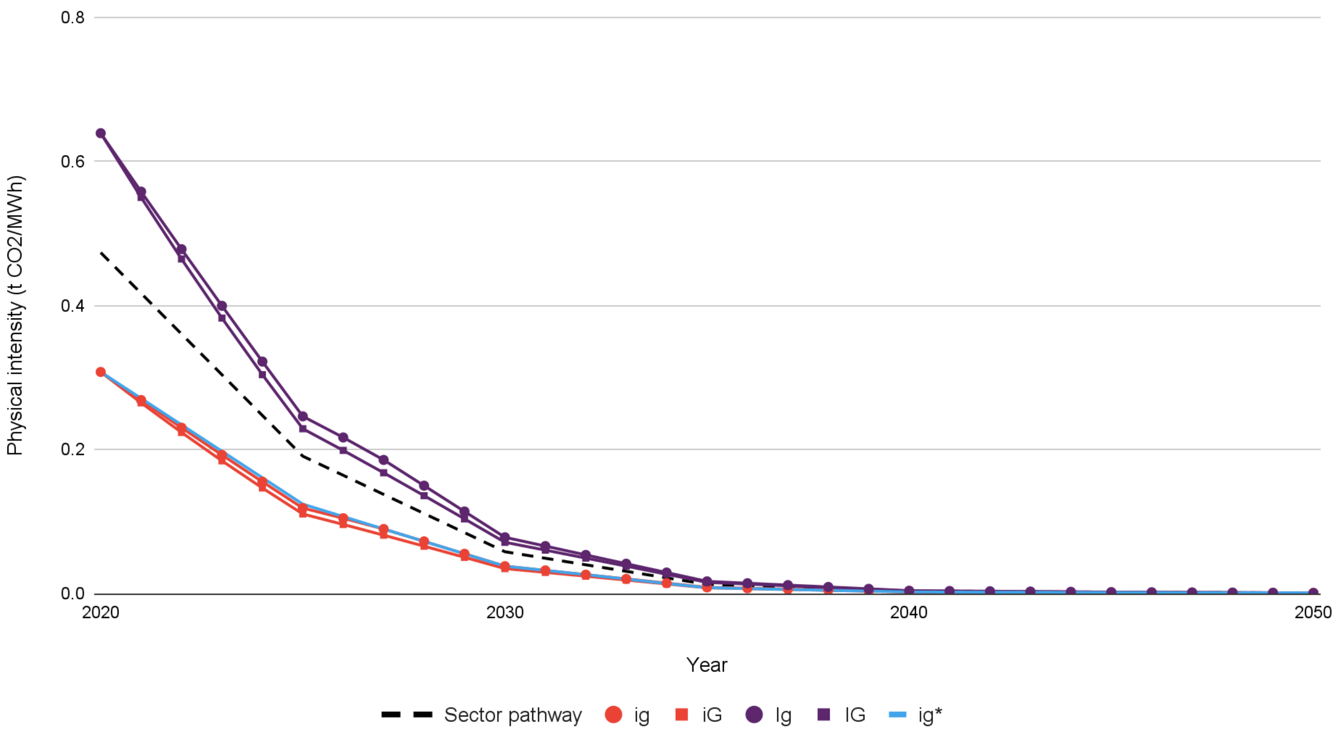
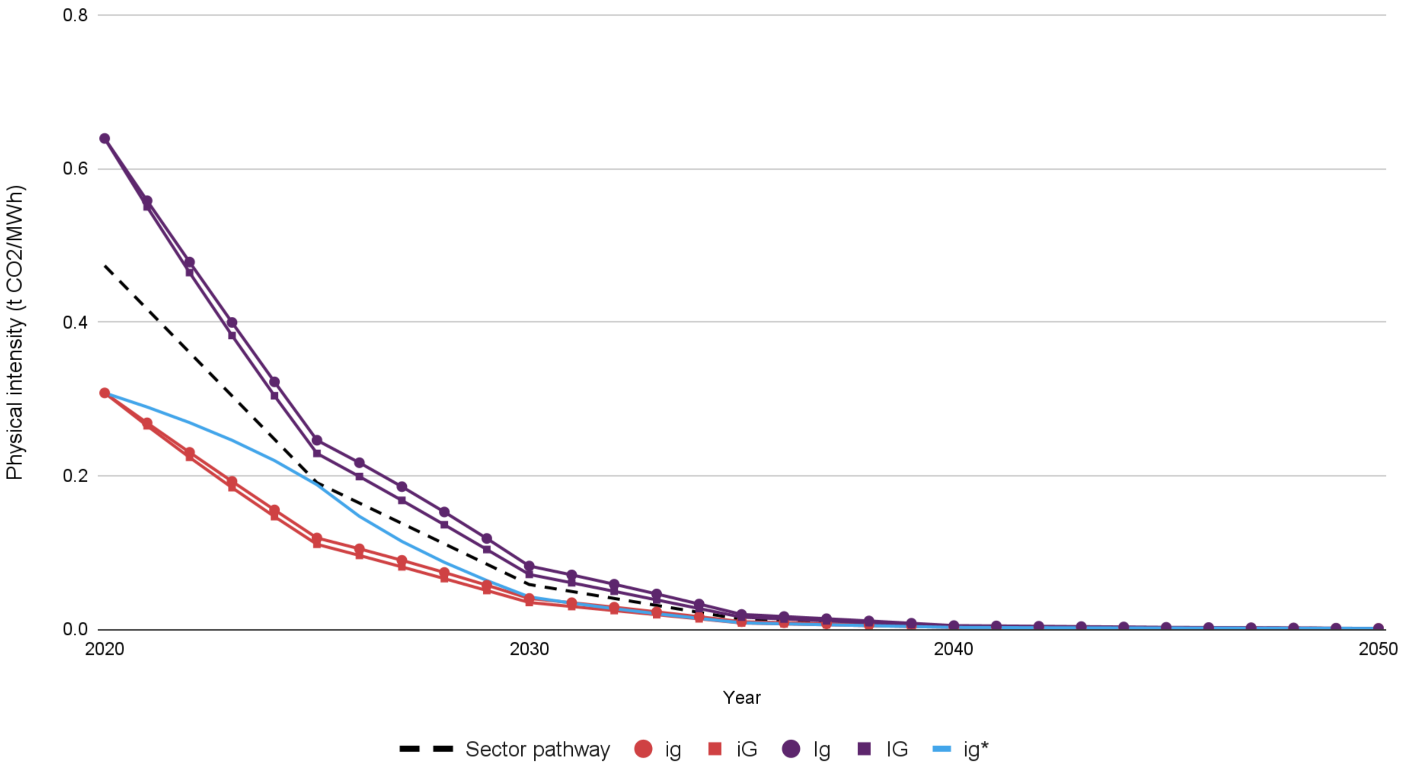


Figure A.2. Physical intensity targets of archetypal companies modeled using the SDA_no cap.



Targets modeled using the SDA and SDA_no cap yield negative CBD scores for the sample set of archetypal companies (Table A.3), indicating that the SDA satisfies the principle of budget conservation whether or not the m-parameter is capped at 1.

Table A.3. Cumulative benchmark divergence scores for the sample set of archetypal companies modeled using the SDA and SDA_no cap methods.

	Interim target timeframe, 2020 - 2030			Net-zero target timeframe, 2020 - 2050		
Method	**Power sector cumulative emissions ($Mt\ CO_2$)**	**Archetypal set cumulative emissions ($Mt\ CO_2$)**	**CBD score (%)**	**Power sector cumulative emissions ($Mt\ CO_2$)**	**Archetypal set cumulative emissions ($Mt\ CO_2$)**	**CBD score (%)**
SDA	74,201.06	68,643.04	-7.49%	83,214.74	77,099.35	-7.35%
SDA_no cap	74,201.06	70,220.63	-5.36%	83,214.74	79,043.68	-5.01%

ANNEX B: SDA CUMULATIVE PERFORMANCE ADJUSTMENT (CPA)

This annex identifies the risks of sector carbon budget overshoot when cumulative performance is not accounted for and describes the methodology used to convert performance to date in terms of cumulative emissions into a physical emissions intensity target adjustment.

A simplified ‘what-if’ scenario analysis is conducted demonstrating possible cumulative emissions generated in the process of achieving minimum target ambition under a point-in-time target-setting approach. In figures B.1 and B.2, ‘Base ambition’ represents the emissions intensity reduction curve generated by the SDA, converted into absolute emissions. The other scenarios represent hypothetical alternate emission curves that converge at the minimum target ambition in the target year, but differ considerably in terms of annual absolute emissions between base and target years. Figure B.1 shows target reduction curves between base and target years in terms of absolute emissions, and figure B.2 shows the cumulative emissions of each scenario between base and target years.

The scenarios in figure B.2 with greater cumulative emissions than the ‘Base ambition’ scenario - Over_a, Over_b, and Over_c - demonstrate that an entity can exceed the cumulative emissions of the ‘Base ambition’ SDA target while still achieving minimum target ambition under a point-in-time target-setting approach

Figure B.1. Absolute emissions produced by SDA target reduction curves with fixed target ambition and variable annual emissions between base and target year.

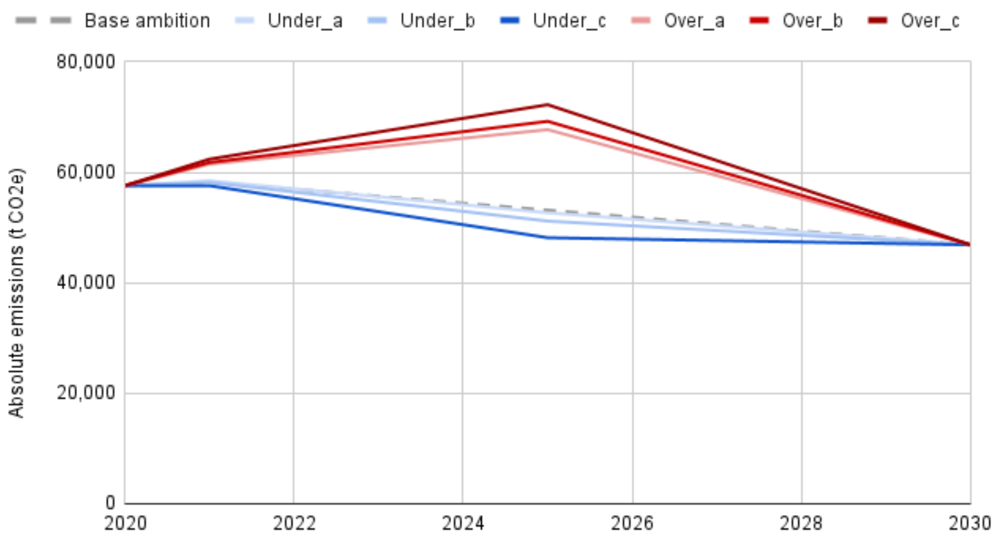
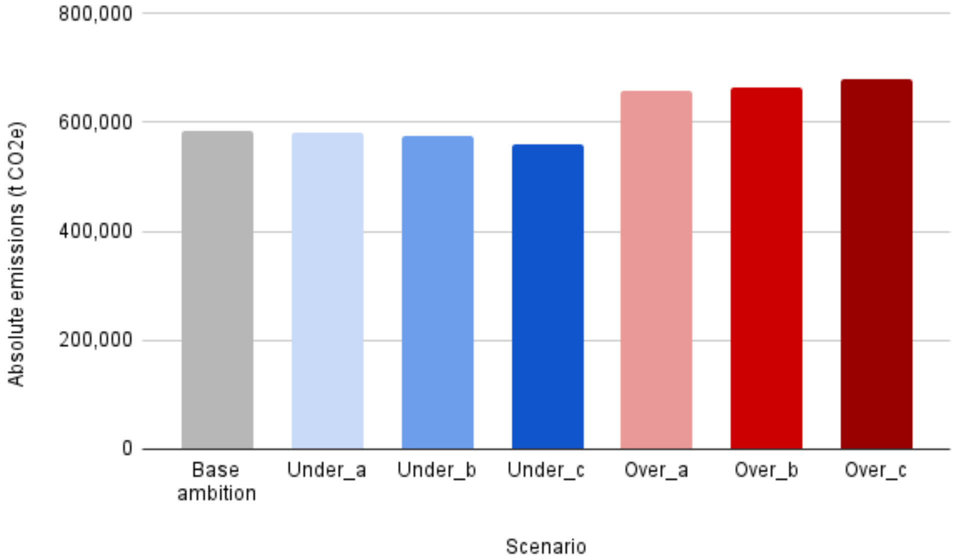


Figure B.2. Cumulative absolute emissions produced by SDA target reduction curves with fixed target ambition and variable annual emissions between base and target year.



This analysis demonstrates the importance of accounting for cumulative performance to date in order to fulfill the Ambitious principle and to ensure carbon budgets are not exceeded. The SDA Cumulative Performance Adjustment (CPA), building on the methodology developed by Rekker et al. (2022), is proposed as a means of satisfying these conditions.

B.1 Method adjustment description

The CPA assesses a company's performance to date in terms of cumulative absolute emissions against the level of ambition defined by the sector pathway. If performance to date has not met this minimum level of ambition, an adjustment is applied to target ambition to enable credible claims of alignment with the sector pathway and the underlying carbon budget.

The SDA is used to model a physical emissions intensity pathway between the reference year and the base year. This is the company's reference pathway, i.e. emissions intensity performance aligned with the sector pathway during that time period. A cumulative emissions budget is derived from the reference pathway using company activity data. The company's performance to date in terms of cumulative absolute emissions during this time period is assessed against this budget. Any budget overshoot revealed by this assessment is accounted for through an adjustment to the physical emissions intensity target in the subsequent target period.

This framework is also extended to subsequent target timeframes, i.e. performance to date between the base year and target year of a company's first target period is accounted for and may result in a CPA applied to its second target period.

Because the SDA requires activity projections, which cannot be reasonably or accurately extended to the net-zero year in 2050, this method adjustment cannot model long-term cumulative targets and can only model interim cumulative targets. Although this is not as comprehensive an approach, it still allows for carbon budget conservation, provided that successive interim targets are updated accordingly. This constraint further underscores the need for progress monitoring and adjusting target ambition at each target milestone year.

Although this adjustment is scientifically robust insofar as it accounts for performance to date and supports carbon budget conservation, it has significant drawbacks in terms of feasibility and ease of implementation. In order to accurately determine performance to date, companies must have access to accurate emissions data prior to the base year. This is not always possible due to data quality issues, lack of reporting schemes in earlier years, and changing operational boundaries. Additionally, the company's budget for each target period is calculated using activity projections, which may be inaccurate, producing a strict budget target that may not accurately reflect the company's actual operations in the target period.

B.2 Method adjustment implementation

The Reference Budget (RB_{by}, Equation B.1) represents the cumulative absolute CO_2 emissions from the reference year - the start year of the sector pathway - to the base year chosen by the company. This can be interpreted as the cumulative historical CO_2 emissions the company would report if its performance had been in alignment with the sector pathway from the reference year until the base year.

Equation B.1. Calculating the Reference Budget

$$\mathbf{RB}_{\mathbf{by}} = \sum_{y = ry}^{by} \mathbf{CI}_{\mathbf{y}} \times \mathbf{CA}_{\mathbf{y}}$$

Where:

RB_{by}	=	Reference Budget between the reference year and the base year in terms of cumulative absolute CO_2 emissions (t CO_2)
y	=	Any year *y* within the target timeframe
ry	=	The reference year, i.e. the pathway start year
by	=	The base year selected by the company
CI_y	=	Projected historical emissions intensity in year *y* calculated using the standard SDA or SDA linear convergence system of equations, given emissions intensity in the reference year (t CO_2 / MWh)
CA_y	=	Company activity in year *y* (MWh)

The company's Historical Emissions (HE_{by}, Equation B.2), its cumulative CO_2 emissions between the reference year and the base year, shall be submitted as part of the validation assessment for comparison against its RB_{by}. If HE_{by} is greater than RB_{by}, the company's historical performance does not meet the minimum ambition set by the reference pathway during that time period. The difference between these two terms is shown in the company's Reference Budget Overshoot (RBO, Equation B.3).

Equation B.2. Calculating the company's Historical Emissions

$$HE_{by} = \sum_{y=ry}^{by} CE_y$$

Where:

HE_{by}	=	Historical Emissions between the reference year and base year in terms of cumulative absolute CO_2 emissions (t CO_2)
y	=	Any year *y* between *ry* and *by*
ry	=	The reference year, i.e. the pathway start year
by	=	The base year selected by the target setter
CE_y	=	Company absolute emissions in any year *y* between the reference year and base year (t CO_2)

Equation B.3. Calculating the company's Reference Budget Overshoot

$$RBO = HE_{by} - RB_{by}$$

Where:

RBO	=	Reference Budget Overshoot in terms of cumulative absolute CO_2 emissions (t CO_2)
HE_{by}	=	Historical Emissions between the reference year and base year in terms of cumulative absolute CO_2 emissions (t CO_2)
RB_{by}	=	Reference Budget between the reference year and the base year in terms of cumulative absolute CO_2 emissions (t CO_2)

A positive RBO value indicates an emissions overshoot between the reference year and the base year. This overshoot is counterbalanced by an adjustment to physical intensity target ambition that is applied to the original SDA target calculation. First, the SDA physical intensity target is converted into absolute emissions terms by calculating the initial Target Budget (TB_i, Equation B.4). The positive RBO is subtracted from TB_i, yielding an adjusted Target Budget (TB_a, Equation B.5). This is then converted back to physical emissions intensity terms via a target adjustment scaling factor (SF, Equation B.6) that yields an adjusted emissions intensity target ($CI_{y,a}$, Equation B.7).

Equation B.4 Calculating the initial Target Budget

$$TB_i = \sum_{y=by}^{ty} CI_y \times CA_y$$

Where:

TB_i	=	Initial target budget between the base year and the target year in terms of cumulative absolute CO_2 emissions (t CO_2)
y	=	Any year *y* within the target timeframe
by	=	The base year selected by the company
ty	=	The interim target year selected by the company
CI_y	=	Emissions intensity in year *y* calculated using the standard SDA or SDA linear convergence system of equations (t CO_2 / MWh)
CA_y	=	Company activity in year *y* (MWh)

Equation B.5 Calculating the adjusted Target Budget

$$TB_a = TB_i - RBO$$

Where:

TB_a	=	Adjusted target budget between the base year and the target year in terms of cumulative absolute CO_2 emissions (t CO_2)
TB_i	=	Initial target budget between the base year and the target year in terms of cumulative absolute CO_2 emissions (t CO_2)
RBO	=	Reference Budget Overshoot in terms of cumulative absolute CO_2 emissions (t CO_2)

Equation B.6. Calculating the target adjustment scaling factor

$$SF = \frac{TB_a - CE_{by}}{TB_i - CE_{by}}$$

Where:

SF	=	Target adjustment scaling factor
TB_a	=	Adjusted target budget between the base year and the target year in terms of cumulative absolute CO_2 emissions (t CO_2)
CE_{by}	=	Company absolute emissions in the base year (t CO_2)
TB_i	=	Initial target budget between the base year and the target year in terms of cumulative absolute CO_2 emissions (t CO_2)

Equation B.7. Calculating the adjusted emissions intensity target

$$CI_{y,a} = SF \times CI_{y,i}$$

Where:

$CI_{y,a}$	=	Adjusted emissions intensity in year *y* (t CO_2 / MWh)
SF	=	Target adjustment scaling factor
$CI_{y,i}$	=	Initial emissions intensity in year *y* calculated using the standard SDA or SDA linear convergence system of equations (t CO_2 / MWh)

Required company input variables

The company shall provide the following input data for the above equations:

- Base year
- Base year CO_2 emissions (t CO_2)
- Base year power generation activity (MWh)
- Interim target year
- Interim target year projected activity (MWh)
- Reference year CO_2 emissions (t CO_2)
- CO_2 emissions for all years between reference year and base year (t CO_2)
- Reference year power generation activity (MWh)
- Power generation activity for all years between reference year and base year (MWh)

ANNEX C: SDA METHOD ADJUSTMENT LINEAR CONVERGENCE (BETA FOR PUBLIC CONSULTATION)

C.1 Method adjustment description

An optional SDA method adjustment using linear convergence is proposed for companies in the power sector with substantially lower power generation intensity than the sector average. The ambitious reductions called for by interim targets are at times challenging or infeasible for companies with low intensity generation activities. This may be due to factors beyond the companies' control, e.g. regulatory requirements for security of supply that may imply a certain minimum level of baseline power generation from fossil fuels.

To provide an alternative solution, the adjustment first establishes an ambitious threshold for low intensity power generation that is derived from the updated SBTi power sector pathway. A simple backcasting methodology uses the power sector pathway curve from 2045-2050 to create a low intensity threshold between 2020 and 2050, visualized in Figure C.1.1. The values of this low intensity threshold at each milestone year are shown in Table C.1.1.

Figure C.1.1. A linear threshold for low intensity power generation derived from the power sector pathway curve between 2045 and 2050.

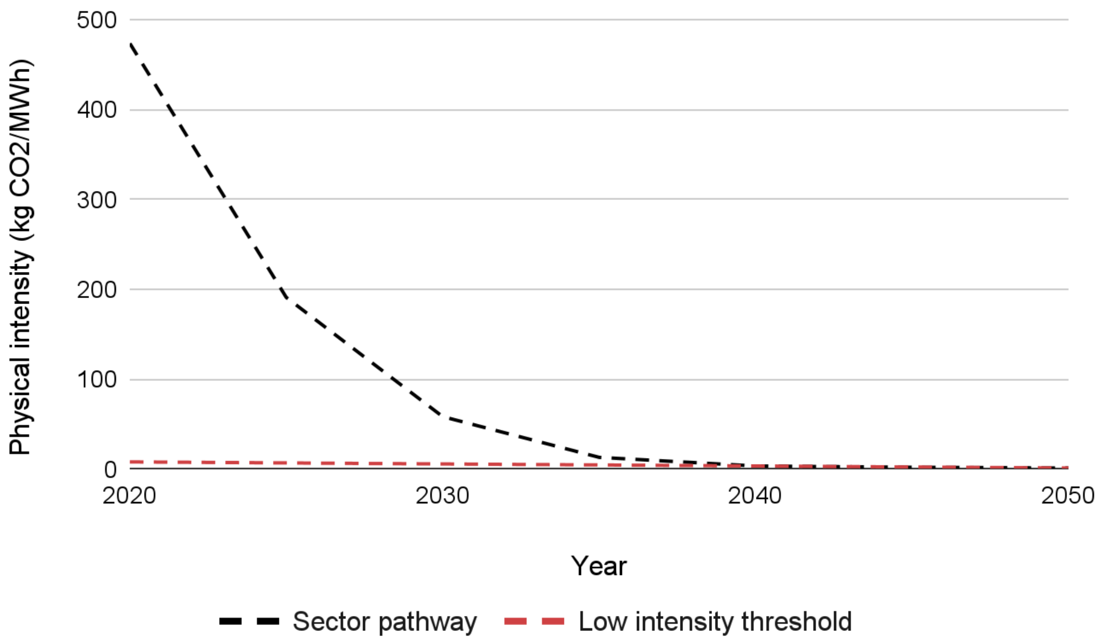


Table C.1.1. Low intensity threshold values used in the SDA linear convergence adjustment.

Milestone year	2020	2025	2030	2035	2040	2045	2050
Low intensity threshold value (kg CO2 / MWh)	6.07	5.23	4.39	3.55	2.71	1.87	1.03

The goal of the low intensity threshold is to establish a cutoff point for physical emissions intensity of power generation that is close to but not yet at the net-zero convergence value. This purposefully establishes a very high level of ambition that power generation activities must achieve in order to trigger the adjustment. A linear backcasting approach was selected in order to provide an intuitive threshold that is simple to communicate and for targets to be measured against. A five-year timeframe of intensity values on the power sector pathway was selected in order to maintain consistency with the target timeframes proposed in the Corporate Net-Zero Standard V2. In addition to the high level of ambition enforced by the 2045-2050 timeframe, all earlier five-year timeframes on the power sector pathway curve yielded a low intensity threshold with values above the sector pathway at some point prior to 2050, which does not align with the intended purpose of the adjustment.

The company's target reduction curve, calculated using the SDA, is compared against this threshold. If the target reduction curve falls below the threshold within the target timeframe, an adjusted target curve is modeled following a linear trajectory to the net-zero benchmark value in 2050 (Figure C.1.2).

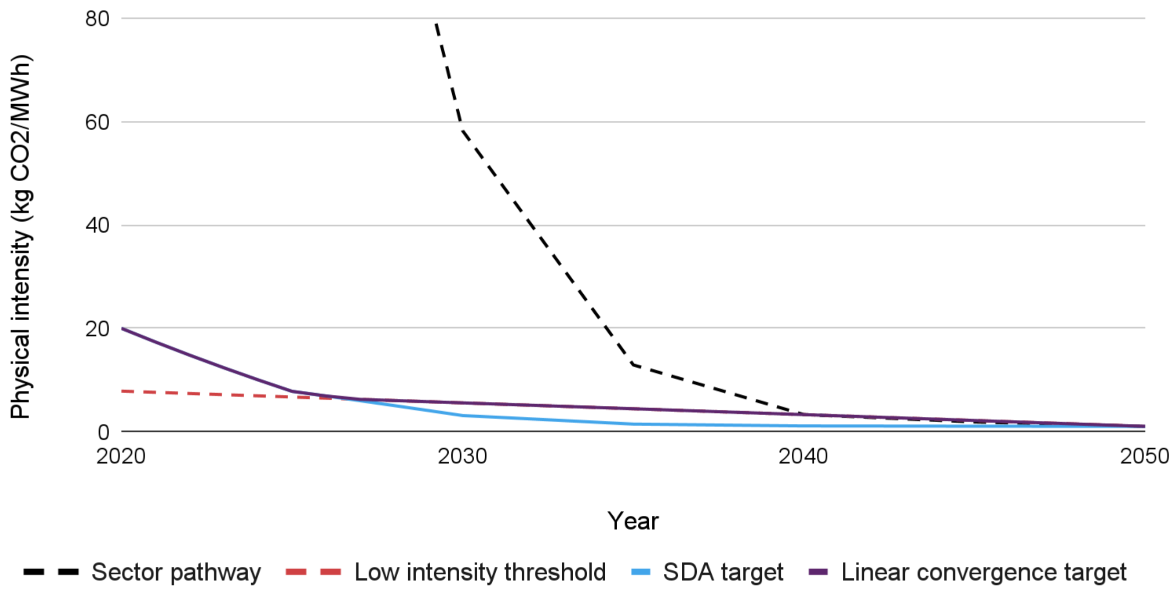


Figure C.1.2.

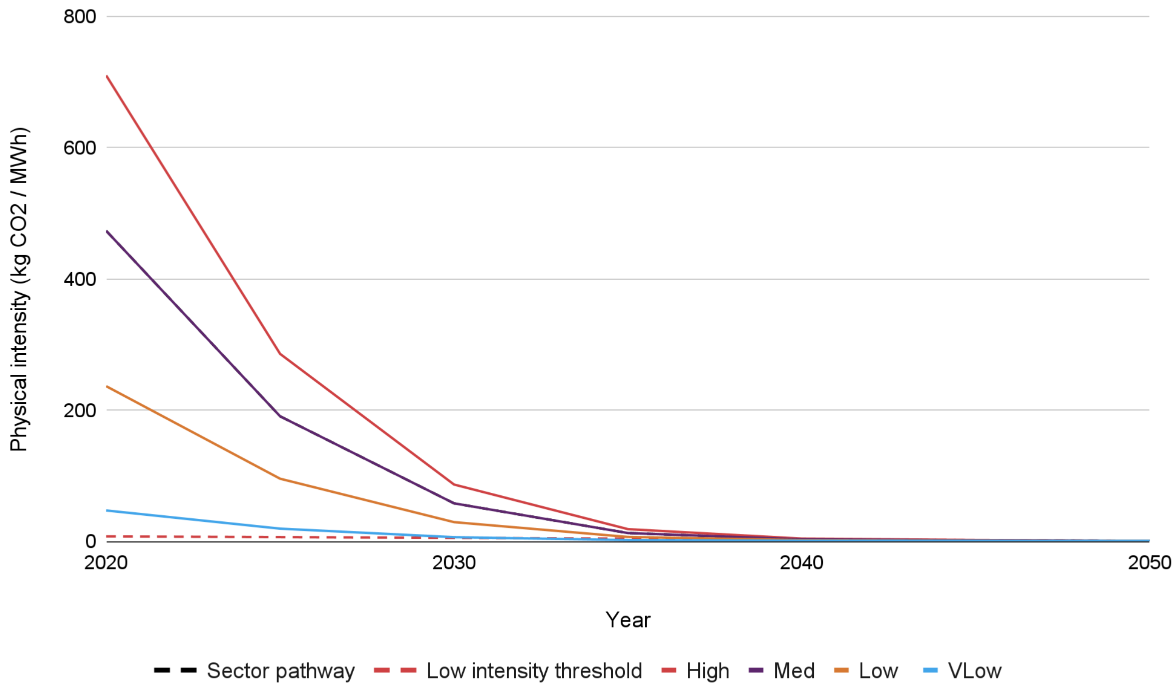
A target pathway that crosses the low intensity threshold and is subsequently altered to a linear trajectory to the net-zero benchmark in 2050. The sector pathway and low intensity threshold curves are the same as in Fig. C.1, with a scaled-down y-axis to provide more visual detail.

This adjustment presents some risk of sector carbon budget overshoot. A worked example is provided to illustrate the potential scope of this risk. A scenario is constructed using four archetypal power generation companies with inputs summarized in Table C.1.1. Activity projections for all company archetypes are based on fixed market share, growing to 27,554 MWh in 2050. Targets are modeled using the SDA and evaluated against the low intensity threshold (see Figures C.1.3.a - b). Cumulative absolute emissions from 2020-2050 are calculated for all companies using both the SDA and the linear convergence adjustment. The results showing the effects in terms of cumulative absolute emissions on applying the linear convergence adjustment are summarized in Table C.1.2.

Table C.1.1. Company archetype input data.

Archetype name	Base year activity (MWh)	Base year emissions (t CO_2)	Base year emissions intensity (t CO_2 / MWh)	Intensity relative to base year sector value (%)
High	10,000	7,104	0.7104	150%
Med	10,000	4,736	0.4736	100%
Low	10,000	2,368	0.2368	50%
VLow	10,000	474	0.0474	10%

Figures C.1.3.a-b. Company archetype targets modeled and plotted against the power sector pathway and the low intensity threshold (a), with a scaled-down y axis to provide more visual detail (b). The Med archetype overlaps with the power sector pathway curve because this archetype has fixed market share activity projections and a base year physical intensity equal to the sector average.



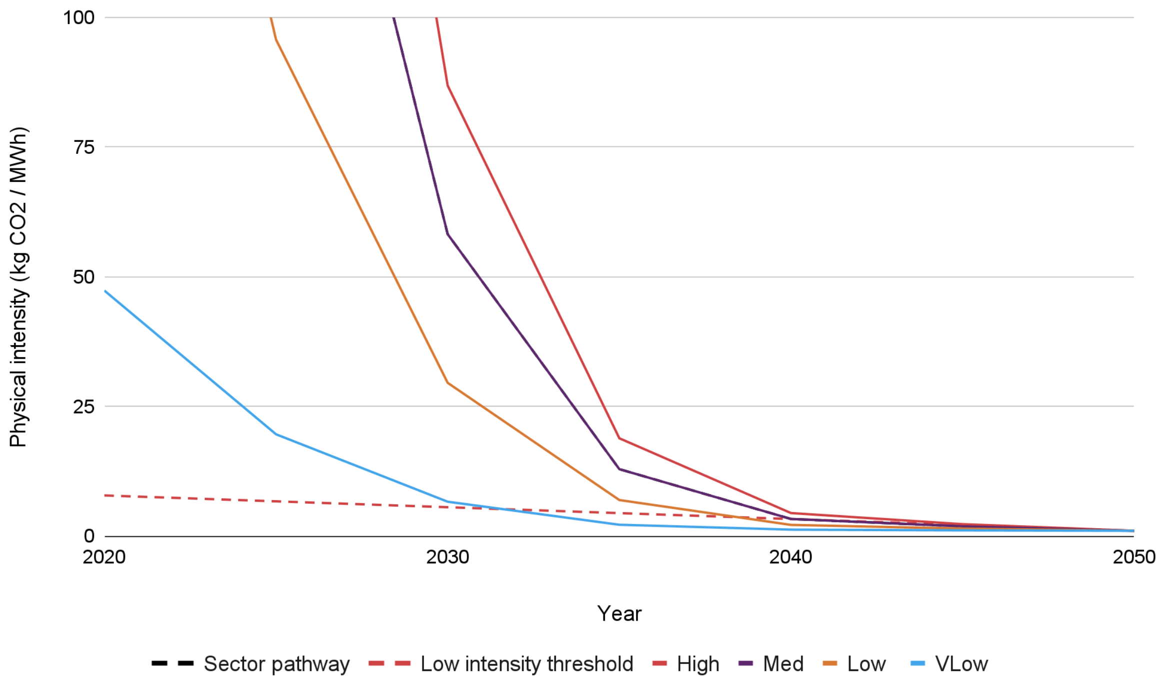


Table C.1.2. Comparison of cumulative emissions from 2020-2050 yielded by SDA and linear convergence adjustment target setting for four company archetypes. ‘Delta’ indicates the excess emissions produced by the linear convergence target compared to the initial SDA target. ‘Adjustment start year’ indicates the year in which the company archetype’s target curve crosses the low intensity threshold and triggers the linear convergence adjustment.

Archetype name	SDA cumulative emissions (t CO_2)	SDA LC cumulative emissions (t CO_2)	Delta (t CO_2)	Delta (%)	Adjustment start year
High	45,895	45,895	0	0.00%	N/A
Med	30,758	30,792	33	0.11%	2041
Low	15,622	15,784	162	1.04%	2039
VLow	3,512	3,998	486	13.84%	2032

All company archetypes except High (150% of sector average emissions intensity in 2020) trigger the linear convergence adjustment. The resulting increase in cumulative absolute emissions for the Med and Low archetypes is relatively low, 0.11% and 1.04% respectively. The VLow archetype (10% of sector average emissions intensity in 2020) sees an increase in cumulative absolute emissions of 13.84%. While this is a substantial portion of the archetype’s total emissions, the resulting overshoot is very small in absolute terms relative to the sector carbon budget. The extent to which this adjustment risks budget overshoot depends largely on the number of power generation companies that are eligible for a target adjustment, and the subset of those that would elect to apply the adjustment based on their legitimate inability to meet their initial SDA target, e.g. due to regulatory requirements.

Further safeguards could be added to the linear convergence adjustment by introducing a point in time after which the adjustment is no longer applicable. For example, in the above case a cutoff point of 2035 would prevent the adjustment from being triggered for all company archetypes except VLow.

C.2 Calculation Methodology

The calculation steps to model an SDA target linear convergence adjustment are as follows:

1. **Model target using the SDA and evaluate against the low intensity threshold**
   A target is modeled using the standard SDA system of equations. If, during the target timeframe, the SDA target reduction curve crosses the low intensity threshold, the adjustment is triggered.
2. **Model linear convergence target**
   An adjusted target is modeled, applicable to the timeframe between the year the SDA target curve crosses the low intensity threshold and the target year.

Equation C.2.1. Calculating an SDA linear convergence adjustment target.

$$SDA\ LC_y = SDA_{y-1} - \frac{(SDA_{y-1} - SI_{nzy})}{(nzy - y - 1)}$$

Where:

$SDA\ LC_y$	=	SDA linear convergence adjustment target in any year *y* (kg CO_2 / MWh)
SDA_{y-1}	=	SDA target in any year *y* - 1 (kg CO_2 / MWh)
SI_{nzy}	=	Sector emissions intensity in the net-zero year (kg CO_2 / MWh)
nzy	=	The net-zero year of the sector pathway
y	=	Any year y in the target timeframe

ANNEX D: TECHNOLOGY SHARE CONVERGENCE (BETA FOR PUBLIC CONSULTATION)

D.1 Method description

The Technology Share Convergence method produces a technology pathway between the base year and the target year representing the company's technology share trajectory to reach the net-zero benchmark by 2050.

The method determines interim performance values for key electricity generating technology categories. Companies can then establish targets that ensure that their technology share meets minimum and maximum thresholds to ensure they converge with the sector technology shares in the net-zero year.

This method can be applied to technology pathways at various levels of granularity. In this beta version for public consultation, a high-level categorization approach is proposed. Power generation technology types are aggregated into two categories: low carbon power generation and unabated fossil fuel power generation. Companies can then set targets to ensure that their technology shares meet minimum (for low carbon electricity) and maximum (for unabated fossil fuel electricity) thresholds and gradually converge with the power sector pathway technology share values in the net-zero year. The generation technologies included in each category are listed in Table D.1, and are defined as follows:

- **Power generation from low carbon sources:** operation of generation facilities that produce electricity from renewable sources (e.g. biofuels, hydropower, on-shore and off-shore wind power, photovoltaic solar energy, thermal solar energy, geothermal energy, green hydrogen-to-power, and tide, wave and ocean energy), nuclear, fossil fuels equipped with carbon capture and storage (Within this Standard, fossil fuel power generation with CCS is considered low-carbon where capture rate is 90-95% at a minimum)
- **Power generation from unabated fossil fuels:** operation of generation facilities that produce electricity from non-renewable sources (e.g. natural gas, coal, fossil-based hydrogen and other fossil fuels, without carbon capture and storage directly applied to the generation plant).

Table D.1. Power generation categories and technologies under the technology category approach.

Category	Power generation technologies included
Low carbon power generation	• Hydro • Nuclear • Solar • Wind • Geothermal • Gas w/CCS • Coal w/CCS • Bioenergy w/CCS

Unabated fossil fuel power generation	• Coal w/o CCS • Gas w/o CCS • Oil

Company targets are set against power sector-wide technology share benchmarks derived from the technology mix in the set of scenarios that inform the power sector pathway. The technology share level of each generation technology category at milestone years is shown in Figure D.1. Further details on the methodology used to derive these technology share benchmarks are available in the Power Sector Pathway Synthesis Report.

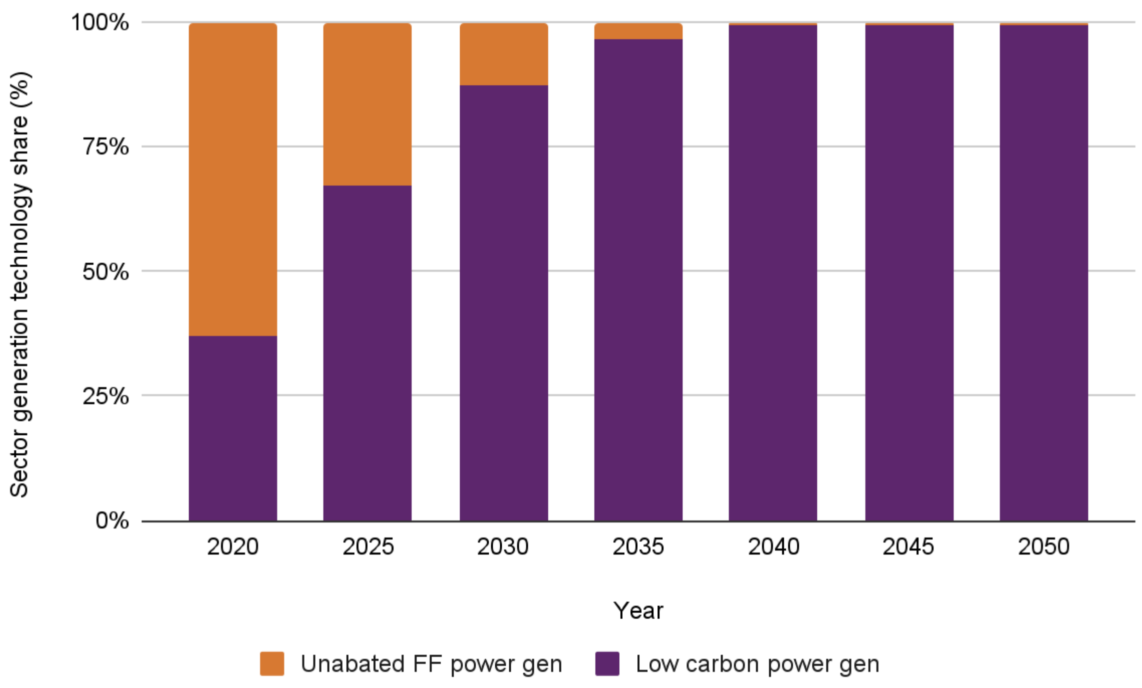


Figure D.1. Sector generation technology share derived from the SBTi power sector pathway. The percent share of each category is used as a benchmark for company-level target setting.

Figure D.2 shows a simplified illustrative example of how the technology share convergence method is implemented under the technology category approach. A company-level target is modeled for each technology category, labeled 'TSC'. For zero-carbon electricity, the target indicates the minimum technology share level, i.e. the share of zero-carbon electricity in the company's generation technology mix must be the value indicated by the target or higher. For abated and unabated fossil fuel electricity, the target indicates the maximum technology share level, i.e. the share of abated and unabated fossil fuel electricity in the company's generation technology mix must be the value indicated by the target or lower.

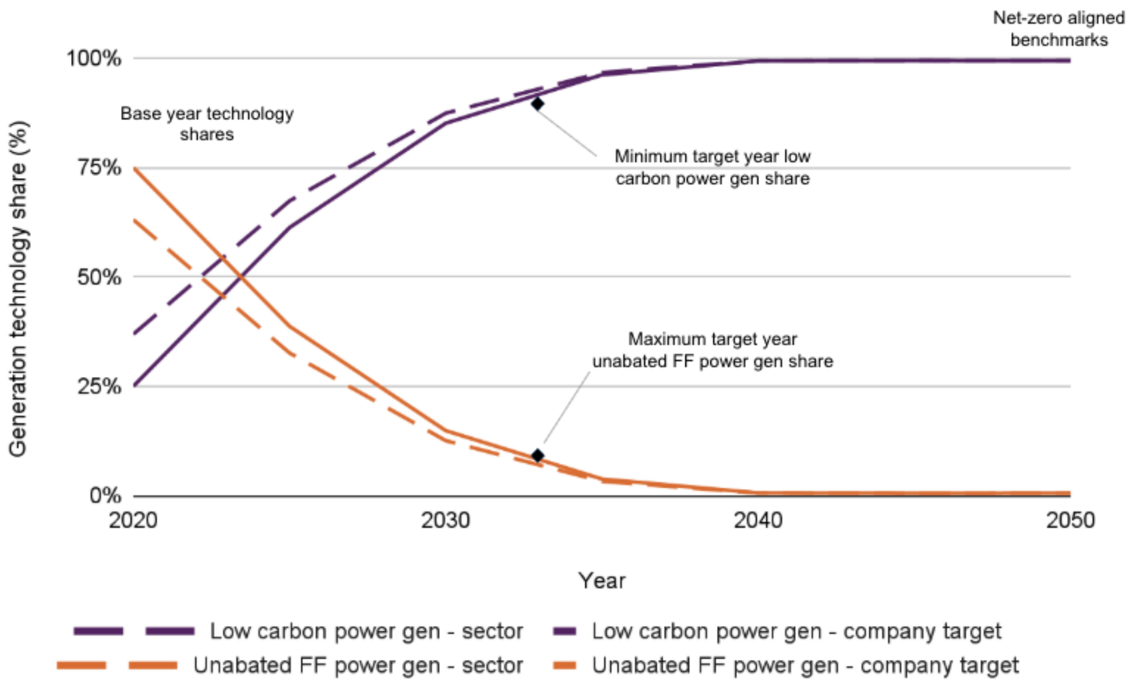


Figure D.2. Illustrative example of the Technology Share Convergence method. Series labeled 'sector' represent the sector technology share of each technology generation category. Series labeled 'TSC' represent a company-level target modeled using the Technology Share Convergence method for each technology generation category.

Metric and target formulation

Targets use a percentage share metric of annual electricity generation. Targets are therefore formulated as the minimum and maximum percentage of total annual generation from different technology categories in the target year e.g. annual low carbon electricity generation will increase from 10% of total annual generation in the base year to 30% in 2030.

Technology phase out

The company's technology exposure pathway implies the phase out of generation technologies by certain points in time that is consistent with the phase out criteria explicitly described in Chapter 1 of the power sector standard. These criteria should be used to determine company decisions regarding phase out dates.

Activity and scope application

This annex broadly refers to use of the TSC in the context of scope 1 emissions from power generation. This reflects the scope 1 decarbonization levers available to companies operating power generation assets: a company with power generation activities reduces emissions associated with those activities by shifting away from fossil fuel electricity generation and toward zero-carbon electricity generation. However, the TSC is not limited exclusively to this activity-scope combination in the context of the power sector standard.

The suitability of a target-setting method to a particular activity-scope combination depends on the decarbonization levers available to actors engaging in the activity. Provided the technology share metric and TSC method appropriately reflect the available decarbonization lever or levers, they may be applied to scope-activity combinations other than scope 1 emissions from power generation. For example, the primary decarbonization lever for Scope 3 Category 3 emissions from the sale of electricity is changes made to the generation portfolio mix of electricity purchased and sold to the end user. In order to be consistent with the emissions reductions prescribed by the power sector pathway, this portfolio mix should align with the generation technology shift inherent to the pathway, i.e. an electricity trader's portfolio should follow the same alignment trajectory as a power generation company.

D.2 Method Implementation

Each generation technology category is benchmarked against a corresponding technology pathway, yielding two TSC targets. The steps and equations outlined below are applied to each category, i.e. discrete TSC targets are calculated for low carbon electricity and unabated fossil fuel electricity.

Step 1: Calculate the initial performance parameter

The initial performance parameter establishes the gap between the current technology share versus the net-zero aligned benchmark value.

Equation D.1. Calculating the initial performance parameter.

$$d = TS_{by} - STS_{nzy}$$

Where:

d	=	Initial performance parameter in the base year relative to the net-zero year sector benchmark value (%)
TS_{by}	=	Technology share in the base year (%)
STS_{nzy}	=	Sector technology share benchmark value in the net-zero year (%)

Step 2: Calculate the sector technology share index

The method assumes that the company's technology share for each generation technology will converge in the net-zero year. This convergence is represented by an index of the sector's technology share being equal to 1 in the base year and 0 in the net-zero year.

Equation D.2. Calculating the sector technology share index.

$$P_y = \frac{STS_y - STS_{nzy}}{STS_{by} - STS_{nzy}}$$

Where:

P_y	=	Sector technology share index in year *y*
STS_y	=	Sector technology share in year *y* (%)
STS_{by}	=	Sector technology share in the base year (%)
STS_{nzy}	=	Sector technology share benchmark value in the net-zero year (%)

Step 3: Calculate the target year technology share

Combining the company's initial performance parameter with the sector technology share index for year *y* results in an equation that provides the company's technology share target for any year *y* between the base year and the target value in the net-zero year.

Equation D.3. Calculating the target year technology share.

$$TS_y = (d \times P_y) + STS_{nzy}$$

Where:

TS_y	=	Company technology share in year *y*
d	=	Initial performance parameter in the base year relative to the net-zero year sector benchmark value (%)
P_y	=	Sector technology share index in year *y*
STS_{nzy}	=	Sector technology share benchmark value in the net-zero year (%)

Required company input variables: Based on the above equations, the company shall provide the following input data:

- Technology share in base year

ANNEX E: LINEAR ALIGNMENT APPROACH

E.1 Method description

The Linear Alignment Approach applies a sector convergence principle that requires all companies to converge to the sector benchmark value in the net-zero year, which is independent of the company's starting point. In the power sector, this method is applied to sustainable biomass sourcing to ensure that companies using biomass for power generation are sourcing 100% sustainable biomass by 2030. This value is targeted regardless of the company's performance in the base year.

The minimum share of biomass from sustainable sources at the interim target year is determined by measuring the base year share of biomass from sustainable sources and applying a linear growth rate consistent with reaching 100% alignment by the benchmark year of 2030.

E.2 Method Implementation

Equation E.1. Calculating base year alignment of sustainable biomass sourcing

$$SSB_{by} = \frac{SB_{by}}{TB_{by}}$$

Where:

SSB_{by}	=	Share of biomass sustainably source in the base year (%)
SB_{by}	=	Sustainable biomass sourced in the base year (t)
TB_{by}	=	Total biomass sourced in the base year (t)

Equation E.2. Calculating interim targets for alignment of sustainable biomass sourcing

$$SSB_{ty} = 100\% - (nzy - ty) \times \left(\frac{100\% \quad SSB_{by}}{nzy - by} \right)$$

Where:

SSB_{ty}	=	Share of biomass sustainably sourced in the target year (%)

nzy	=	The net-zero year
ty	=	The target year
SSB_{by}	=	Share of biomass sustainably sourced in the base year (%)
by	=	The base year

Required company input variables: Based on the above equations, the company shall provide the following input data:

- Sustainable biomass sourced in the base year
- Total biomass sourced in the base year

ANNEX F: METRICS DERIVED FROM THE POWER SECTOR PATHWAY

The power sector standard expands the list of activities relevant to the power sector that are covered by SBTi target-setting guidance. Physical emissions intensity is an appropriate metric for companies engaged in power generation activities, but in order to reflect the decarbonization levers available to companies engaged in other power sector activities novel metrics are proposed for use in target setting.

These metrics are derived from the updated power sector pathway using variables tracked by scenarios within the scenario ensemble used to derive the pathway. The steps used to derive each metric from the power sector pathway and other details are outlined below.

F.1 Transmission and distribution losses

A subset of scenarios was identified in the power sector pathway scenario ensemble that included variables relevant to electric transmission and distribution losses. The median value of these scenarios is used to establish benchmark values for target setting at each milestone year between 2020 and 2050, as shown in Table F.1.1.

Table F.1.1. Milestone year benchmark values for electricity transmission and distribution loss target setting.

Metric	Unit	2020	2025	2030	2035	2040	2045	2050
Electricity transmission and distribution loss	%	13.59%	12.78%	11.67%	10.99%	10.37%	9.83%	9.23%

This derived metric has substantial limitations. Firstly, the variable ‘Secondary Energy|Electricity|Transmission Losses’ excludes losses from the distribution of electricity, and as such does not comprehensively account for this activity. The scenario ensemble used to derive the power sector pathway does not include scenarios that measure a variable for electricity distribution losses, so it is not possible to derive a combined metric from the power sector pathway that comprehensively enables quantitative target setting for this activity. Secondly, the global level of disaggregation in the power sector pathway does not enable the Category A/B company categorization framework as proposed in the Corporate Net-Zero Standard V2. Given the regional variations in efficiency of transmission and distribution networks, especially between developed and developing economies, the net-zero aligned benchmarks of this metric may be overly challenging for some companies to achieve, and overly easy for others. Finally, the level of granularity in the power sector pathway does not allow for targets to account for the differences between technical losses (e.g. resistance in distribution networks) and non-technical losses (e.g. theft). The levers for reducing these losses are different, and it is arguable that the actions to reduce non-technical losses are beyond the scope of SBTi's work as a climate action organization.

In order to produce a practical metric for target setting, a 'best practice approach' is proposed using real world data on transmission and distribution losses (World Bank Group, 2023). Although this approach does not provide a pathway with benchmark values at milestone years, it includes distribution data and enables A/B company categorization. Additionally, this yields more ambitious targets, as the minimum level in each category (2.0 and 5.7) exceeds the ambition of the power-sector derived pathway (9.23).

Table F.1.2. Alternative approach for transmission and distribution loss metric using World Bank/IEA data.

Metric	Unit	Category	Level	Value
Electricity transmission and distribution loss	%	A	Min	2.0
Electricity transmission and distribution loss	%	A	Mean	10.8
Electricity transmission and distribution loss	%	B	Min	5.7
Electricity transmission and distribution loss	%	B	Mean	20.1

F.2 Storage losses

A subset of scenarios was identified in the power sector pathway scenario ensemble that included variables relevant to electric storage losses. The median value of these scenarios is used to establish benchmark values for target setting at each milestone year between 2020 and 2050, as shown in Table F.2.1. Due to the variations in loss rates among different energy storage technologies and the regional limitations in terms of installation (Sahoo & Timman, 2023), this metric may face some applicability constraints that limit its usefulness in target setting. For example, the loss rates projected in the power sector pathway scenario ensemble may apply more to Category A companies than Category B companies under the company categorization framework proposed in the Corporate Net-Zero Standard V2.

Table F.2.1. Milestone year benchmark values for electricity storage loss target setting.

Metric	Unit	2020	2025	2030	2035	2040	2045	2050
Electricity storage loss	%	0.00%	1.58%	4.87%	6.46%	6.47%	6.34%	6.04%

GLOSSARY

Benchmarks: Target-setting benchmarks indicate a desirable level of performance, in terms of a target-setting metric, and serve as a point of reference against which ambition and performance of a target-setting entity is compared.

Metric: A metric is a quantifiable metric to assess, manage, compare, and communicate the past, current, or intended climate-related performance of an organization. Metrics can be expressed in terms of impact (e.g. greenhouse gas emissions released into the atmosphere), outcome (e.g. percentage of electricity sourced from zero-carbon sources), or process (e.g. establishment of a portfolio company engagement strategy).

Scenarios and pathways: A scenario is a plausible description of how the future may develop, based on a coherent and internally consistent set of assumptions about key driving forces (e.g. rate of technological change, prices) and relationships. Scenarios yield pathways, which represent a quantitative trajectory of a climate-relevant metric over time, such as greenhouse gas (GHG) emissions.

Science-based target: A science-based target is a specific greenhouse gas reduction goal whose ambition is consistent with the latest peer-reviewed climate science to limit global warming to temperature goals as set by the Paris Agreement.

Target: A target is a quantity that indicates the rate of change of a metric, in terms of percentage change over time, from benchmark to benchmark to reach long-term net-zero performance.

Target setting: Target setting refers to the process of establishing a target on a given metric that represents the total percentage change that the entity wishes to achieve.

Target-setting method: A target-setting method is a mathematical formula or algorithm that can be used to determine the benchmark, threshold, or desired performance of a counterparty using a relevant metric. These benchmarks serve as a reference for defining criteria and setting targets in SBTi Standards.

Technical foundations: Technical foundations refer to target-setting metrics, target-setting methods, and pathways. They are the foundation of SBTi standards.

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