SMARTargets

A Methodology for Grounded and Actionable Climate Targets Aligned with Global Goals

THE METHODOLOGY

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ACKNOWLEDGMENTS

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- Professor Granger Morgan, Carnegie Mellon University
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The peer reviewer's comments are those of the individual and not their institutions, the institution is noted for information purposes only. The responsibility for integrating feedback and finalizing the methodology rests solely with SMARTargets' principal investigators and should not be interpreted as endorsement by the reviewers or Stakeholder Advisory Group.

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1. EXECUTIVE SUMMARY

This document presents the SMARTargets Methodology—a methodology for grounded, actionable climate targets and strategies aligned with science and international climate goals. The methodology helps companies contribute to the pursuit of international climate aspirations while identifying strategies that account for their actual opportunities and risks.

In the United Nations Framework Convention on Climate Change's 2015 Paris Agreement, the international climate policy community set a goal to limit global average temperature to "well below" 2°C, with an additional aspirational goal to "pursue efforts" to limit global warming to 1.5°C. Companies worldwide are wanting and needing to understand their role in the pursuit of the Paris Agreement goals in terms of potential transitions, opportunities, and risks.

There is also growing interest in companies setting greenhouse gas (GHG) emissions targets that are aligned with the Paris Agreement. This has given rise to proposed GHG target setting and assessment methodologies and benchmarks. However, assessment of the relevant science has found that existing approaches can be misleading with important issues not considered that are essential for informed decision-making and credible targets and strategies.

Alignment with Science and International Goals

Implementing SMARTargets, by design, results in corporate GHG targets and strategies aligned with science and the Paris Agreement. The methodology is based on strong scientific foundations. Scientific and operational requirements for a science-based methodology are first derived from assessment of all the relevant science. The resulting methodology is "based on science" in that it provides (1) science-based alignment with a global temperature goal, and (2) facilitates science-based decision-making. The former recognizes the ranges of pathways consistent with international goals, pathway assumptions and uncertainties, the implications of alternative pathways, and the limitations of global pathways as corporate benchmarks, while the latter is achieved by helping companies consider uncertainty, their unique transition opportunities, decarbonization and other societal priorities, the need for flexibility, and the resiliency of strategies.

The methodology also results in targets and strategies that are comprehensively aligned with both the Paris Agreement's temperature goals and its provisions for achieving those goals, which includes recognition of country differences in opportunities, multiple priorities, and enabling factors.

The Methodology

The SMARTargets Methodology consists of eight standardized steps, with transparent company-specific assessment and communications of company circumstances and transition opportunities and risks a hallmark of the approach. Using tailored transition risk analysis and standardized outputs, companies evaluate, pursue, and communicate aspirational targets based on international goals and qualified targets reflecting the greatest emissions reductions possible while balancing priorities under alternative future conditions. The result is a valuable set of company- and engagement-relevant information on target and transition opportunities, strategies, and risk management, including the identification of opportunities for cooperation and coordination on enabling conditions for greater emissions reductions.

The initial methodology is designed to support utilities worldwide that are providing electric power, electricity transmission and distribution, and natural gas services to communities. The approach, however, generalizes and can be helpful to other industries and companies as a template for evaluating their transition opportunities and risks and pursuing GHG targets.

The Value of SMARTargets

SMARTargets provides significant value to companies and stakeholders. For companies, in addition to helping them pursue ambitious and actionable GHG targets aligned with science and international goals, the methodology facilitates enhanced planning, risk management, and stakeholder engagement with a risk-based approach that helps companies explore a broader set of futures and transition opportunities and typically considered in company planning. The approach also facilitates cross-functional integration across planning, risk management, sustainability, policy, and corporate strategy teams.

For investors, and other stakeholders, SMARTargets not only means a company has science-based targets aligned with international goals, but the grounded, rigorous, well-defined standardized process and outputs provide transparency, comparability, and credibility to the targets and strategies. Furthermore, by identifying enabling conditions, the methodology facilitates constructive dialogue and coordination for greater ambition and progress.

Implementation

Implementing SMARTargets requires planning and coordination with respect to resources, internal collaboration, modeling capabilities (internal or external), and stakeholder engagement. Completing and documenting the analysis requires 6-9 months, with third-party validation an additional activity.

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2. OVERVIEW OF THE METHODOLOGY

The SMARTargets Methodology helps companies contribute to the global pursuit of international climate aspirations while identifying actionable strategies that account for their actual opportunities and risks. The methodology is a systematic, comparable approach for evaluating transition opportunities and risks and developing credible company-level greenhouse (GHG) targets and strategies aligned with science and international goals.

The initial SMARTargets Methodology is designed to support utilities worldwide that are providing electric power, electricity transmission and distribution, and natural gas services to communities. The approach, however, generalizes and can be helpful to other industries and companies as a template for evaluating their transition opportunities and risks and pursuing GHG targets.

Having SMARTargets means:

1. A company has ambitious and actionable GHG targets that are aligned with science and the international climate goals,
2. A company followed a grounded, rigorous, well-defined standardized process (with standardized outputs) that provides transparency and comparability, and
3. The company has created a wealth of company- and engagement-relevant information on decisions and analysis, transition opportunities, targets, strategy, and risk management, including identifying opportunities for cooperation and coordination on enabling conditions for greater emissions reductions.

SMARTargets Methodology steps

The steps associated with implementing the SMARTargets Methodology are depicted in Figure 1. See the methodology section for detailed step guidance, including the outputs required from each step, and see the methodology justification section for the scientific support for the steps and overall design. Accounting for company specific circumstances is critical to identifying real and actionable low-carbon transition opportunities for companies, and for making progress on addressing climate change. The steps below provide companies with the opportunity to pursue global climate objectives while considering their company-specific and regional economy-wide transition opportunities and risks. The resulting information allows for informed dialogue regarding real transitions and opportunities. Here we briefly characterize each step of the methodology:

- ***Step 1: GHG inventories and base year –*** In this step, a company will prepare verified GHG inventories and select a base year. A company will need, as possible given current methods, GHG emissions inventories for each of the categories of emissions relevant to their business. The company will also need to have the inventories verified. This would include verifying the company's base year inventory and most recent year inventory if different from the base year. A company will also need to decide on their emissions reduction base year and apply it consistently. SMARTargets does not mandate a specific base year because there are practical reasons for companies to have different base years and there is no scientific justification for a prescribed base year. See Table 1 for the emissions categories most relevant to utilities.

Figure 1. The SMARTargets Methodology implementation steps

- ***Step 2: Practical issues and climate target groupings –*** In this step, a company will consider company-specific practical issues and identify GHG target groupings. For each emissions category, a company will need to work through a set of questions that facilitate consideration of practical issues that affect a company's ability to set and pursue targets. Among other things, this includes consideration of whether the emissions can be adequately characterized, whether the emissions are material, and whether the emissions are regulated by Paris Agreement aligned policy. For each category, a company will decide whether to (1) set a target; (2) not set a target because the emissions are already covered by a Paris Agreement aligned policy or another company's SMARTargets, or (3) not set a target with justification based on practical considerations. There is a limited set of conditions where not setting a target can be appropriate. In these circumstances, a company will need to document and justify the decision, and, as possible, communicate plans for addressing the issue to facilitate future targets. The company will also communicate how the categories for which they are pursuing targets will be grouped. Targets can be by emissions category, by GHG across categories (e.g., CO_2), or across GHGs and categories.

- ***Step 3: Aspirational climate targets aligned with international goals –*** In this step, a company will select generic aspirational targets aligned with the international goals. Based on the categories for which the company will be setting targets, a company will identify the generic aspirational CO_2, non-CO_2, or CO_2e intermediate and 2050 target levels using global total emissions pathway ranges aligned with the international climate goals. The global pathways help identify aspirational goals and coordinate effort, but they do not provide information about actual individual company opportunities and risks (see Scientific Foundations document). In subsequent steps of the methodology, the company will evaluate their transition opportunities and risks and identify enabling conditions for achieving these aspirational levels. Enabling conditions, such as supportive policies, cooperation with others, and carbon dioxide removals, may be necessary for achieving the aspirational targets while managing the challenges and risks. Such information will inform and facilitate coordination and the development of enabling strategies.

- ***Step 4: Company transition risk analysis of opportunities and risks –*** In this step, a company will perform company-tailored transition risk analysis of aspirational and qualified targets to identify enabling conditions and their transition strategy, including risk management contingency plans. A company will evaluate alternatives for achieving emissions reduction levels—aspirational and other (qualified) levels—based on tailored company transition risk scenario analysis of transition opportunities, enabling conditions, risks, and risk management options. Qualified targets reflect the greatest emissions reductions possible, in terms of managing challenges and risks, under different potential future conditions. The Paris Agreement refers to this as the "highest possible ambition" in reference to considering both emissions reductions and the effort required, which accounts for differences in circumstances and multiple priorities. The transition risk analysis consists of a well-defined process of seven phrases (Figure 2). It starts with defining reference conditions that exist in all plausible futures and itemizing uncertainties for possible evaluation. It also includes an iterative refinement process of risk-based scenario design and evaluation of the potential transition opportunities and risks for potential futures. In the end, a company may have a range of qualified targets, with different qualified reductions consistent with different future conditions.

- ***Step 5: Strategy and qualified target alignment with international goals –*** In this step, a company will evaluate transition strategy and qualified target alignment with the international goals. A company will evaluate *qualitative* alignment of their transition strategy relative to the types of transitions robustly observed in all global pathways consistent with the international goals. The company will also evaluate *quantitative* alignment of their qualified targets with the international goals relative to the pathway ranges consistent with the international goals, but recognizing that this is not a conclusive test due to the limitations of global pathways for representing company opportunities and assessing company alignment (see Scientific Foundations document).

- ***Step 6: Documentation and communication –*** In this step, a company will document and communicate their SMARTargets. Using the SMARTargets Reporting Template, a company will document and communicate their implementation of the SMARTargets Methodology. This includes documenting methodology implementation choices with justification, transition analysis insights, targets, strategies, and milestones.

- ***Step 7: Validation and verification –*** In this step, a company will validate their SMARTargets and verify their progress. Using the SMARTargets Reporting Template, a company can undertake validation and progress verification activities. SMARTargets facilitates internal and third-party validation according to international best practices for validation and verification procedures based on the principles of impartiality, independence, and objectivity. Companies will need to establish internal controls, auditing practices and consider their climate-related risk disclosure needs and regulations. Note that independent third-party validation services for corporate GHG targets will need to develop to provide the appropriately grounded, trained, objective, and independent assurance that investors and other stakeholders require. These services do not currently exist.

- ***Step 8: Monitoring and adjusting –*** In this step, a company will monitor their milestones and adjust their strategy as needed. Periodically, a company will want to assess developments as the future unfolds relative to their milestones to determine if their climate strategy needs adjustment according to their contingency plans. The company will also want to evaluate whether conditions have changed such that the set of potential futures are substantively different than what was analyzed. If so, the company would want to consider refreshing their SMARTargets analysis.

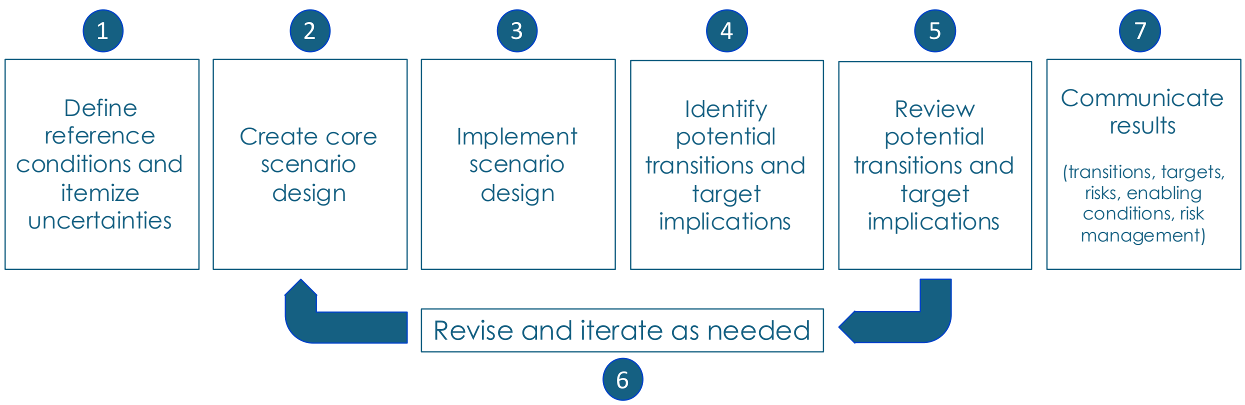

Figure 2. Phases for creating a tailored company-specific low-carbon transition risk scenario analysis and informing the evaluation and pursuit of GHG targets

Emissions categories and targets

In applying the methodology, a utility needs to consider each of the emissions categories shown in Table 1. The categories listed in Table 1 are those from the GHG Protocol that are most relevant for utilities. SMARTargets is not dependent on the GHG Protocol categories. Other GHG accounting approaches could be used to define emissions categories.

As noted above, GHG targets can be set by emissions category, by GHG across categories, or across GHGs and categories. For each category, however, a utility will need to decide whether to (1) set a target; (2) not set a target because the emissions are already covered by a Paris Agreement aligned policy or another company's SMARTargets, or (3) not set a target with justification based on practical considerations.

As noted, there is a limited set of conditions where not setting a target can be appropriate. In these circumstances, a company will need to document and justify the decision and, as possible, communicate plans for addressing the issue(s).

Given resource constraints, a company may also have to set targets progressively, prioritizing targets for the most significant emissions categories and progressively expanding to cover other emissions as resources permit. A company would also document this decision and their plans for future SMARTargets.

Table 1. Emissions categories a utility needs to consider for target setting

Source: EPRI using WRI/WBCSD (2004, 2011).

Scope 1
Direct Emissions from Stationary Combustion
Direct Emissions from Mobile Combustion
Direct Emissions from Process Sources
Direct Emissions from Fugitive Sources
Scope 2
Indirect Emissions from Purchased/Acquired Electricity
Indirect Emissions from Purchased/Acquired Steam
Indirect Emissions from Purchased/Acquired Heating
Indirect Emissions from Purchased/Acquired Cooling
Scope 3
Category 3: Fuel- and energy-related activities (not included in scope 1 or scope 2)
Category 11: Use of sold products

Standardized comparable outputs and insights

Companies will communicate their SMARTargets using the SMARTargets Reporting Template. Specifically, implementing the methodology will produce the following standardized and comparable outputs and insights:

- Aspirational Targets with enabling conditions,
- Qualified Targets and their associated conditions,
- International climate goal alignment of aspirational and qualified targets and company strategies,
- Alternative regional low-carbon transitions and implications insights with respect to multiple priorities, including affordability, reliability, and sustainability,
- Identified risks and strategies (risk management and overall transition strategies), and
- Documentation of the methodology implementation, including GHG inventory for required emissions categories, practical consideration responses and target setting groupings, and transition risk modeling and scenario design details, such as modeling approach, reference conditions and uncertain factors, core scenario design definitions and specifications, and criteria for determining risks and enabling conditions.

Companies are also encouraged to communicate on the SMARTargets Methodology itself and its scientific foundations to help educate audiences and facilitate dialogue.

SMARTargets implementation logistics

Implementing SMARTargets requires coordination and resources—time, human, and analytical resources. To effectively identify and communicate meaningful climate targets and strategies, coordination across corporate business units is recommended. The SMARTargets analysis can be informed by and inform many company business units and teams. Figure 3 illustrates these opportunities for utilities, where there are relationships with planning activities and risk management, as well as other corporate functions. Companies should consider engaging staff related to planning, policy, sustainability, risk management, strategy, and outreach, as well as possibly external experts on transition scenario analysis and modeling.

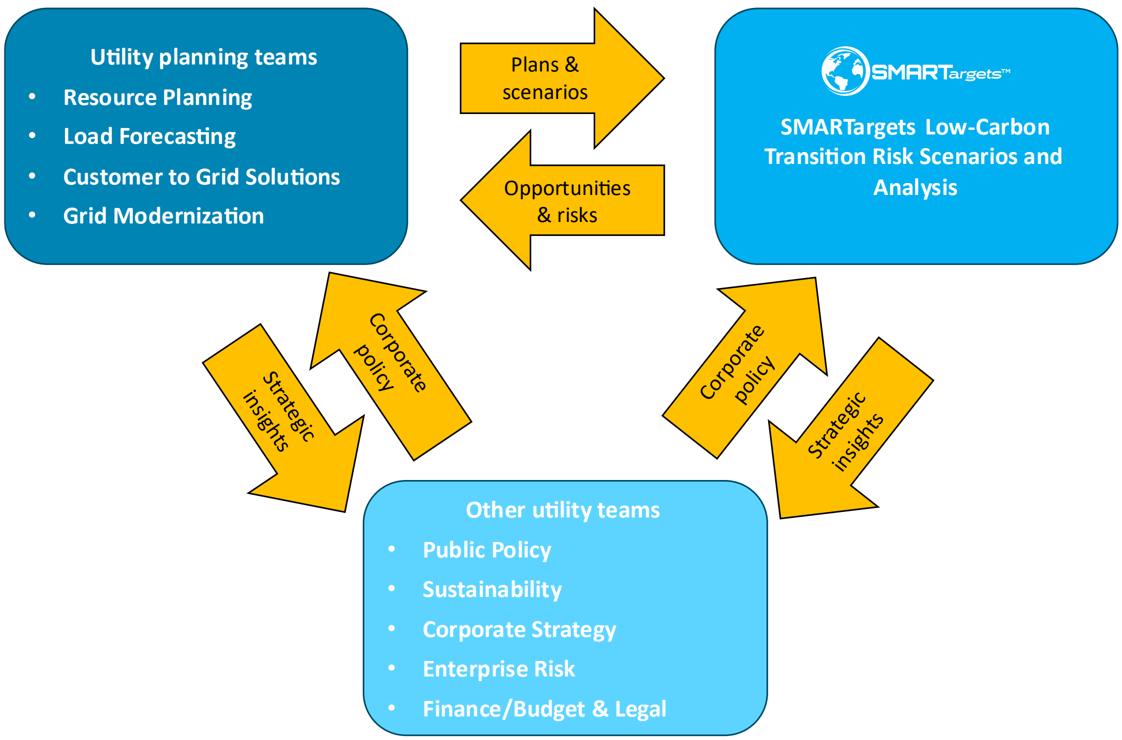

Figure 3. SMARTargets low-carbon transition risk analysis is informed by and informing many utility business units

It is also important to have the appropriate modeling capability (internally or externally) to evaluate the transition opportunities, implications, and risks of alternative regional economy-wide future conditions on company-relevant markets and investment environments. Utilities will need to do either regional economy-wide or enhanced utility planning modeling. Regional (sub-national) economy-wide modeling is recommended but not required. The SMARTargets transition risk analysis does not depend on a particular modeling framework; however, for the insights sought, there are minimum required modeling characteristics (see methodology section). Modeling scope (technology, system, economic, geographic, temporal), dynamics, and even the solution algorithm can affect the types of scenarios and insights produced; thus, communicating the framework used is important. Utility planning modeling that considers alternative economy-wide conditions by varying assumptions can be used. For some utilities, near-term use of current planning modeling capabilities with economy-wide changes considered via exogenous sensitivities may be practical. In the long-run, regional economy-wide modeling is recommended to evaluate potential changes in regional markets, activity, and relationships across sectors and to explicitly identify regional economy-wide transition opportunities and risks.

In addition, there are opportunities along the way for soliciting external input from, for example, a stakeholder advisory group. Implementing the full SMARTargets Methodology—analysis to communications—can take 6-9 months. Third-party validation is an additional activity.

Overall, SMARTargets transition risk analysis is designed to complement and supplement current utility planning analyses and processes—providing broader and longer-term strategic perspectives of potential uncertain factors economy-wide that can affect energy system development, fuel and other commodity markets, and ultimately company transition opportunities and risks. SMARTargets' risk focus is another differentiating feature, with a scenario design explicitly focused on characterizing and evaluating the transition risk decision space. In general, the SMARTargets analysis should be informed by, informing, and even possibly integrating with, utility planning.

"Based on science"

In addition to a new methodology, for more informed dialogue and decision-making, the SMARTargets Initiative is providing a scientific foundation for all corporate GHG target setting and evaluation, and transition planning and evaluation, methodologies. The SMARTargets Scientific Foundations document is a resource for guiding and grounding methodologies and an educational resource for informed dialogue.

The SMARTargets Methodology is "based on science," or more accurately informed by science since the science provides guidance but is not able to tell us exactly what each company should do. The methodology is grounded in and emerges from assessment of all the science relevant to company-level transitions and GHG target setting (see Scientific Foundations document). More specifically, we identify key scientific observations from assessing the science from which we derive the following scientific requirements <u>for any methodology</u> to be "science-based" (Figure 4):

- **The methodology must have science-based alignment with a global temperature.** This entails recognizing the following: there are broad ranges of global and sub-global pathways consistent with a global temperature goal, assumptions matter and are uncertainties that need to be evaluated, the different pathways aligned with a global temperature vary in their implications, and global pathways in general have severe limitations as company benchmarks but the pathways can provide high-level guidance. The limitations of global pathways as benchmarks include that they do not represent individual companies, their markets, or their transition opportunities and the global pathways are missing company-relevant uncertainties, such as policy design and local factors (e.g., market, customer, resource, policy). Global pathways, however, can help identify aspirational goals and coordinate effort even though they do not provide information about actual company opportunities and risks.

- **The methodology must facilitate science-based decision-making.** Insights from the relevant science highlight that science-based decision-making requires consideration of uncertainty regarding potential future conditions; recognition that companies have different transition opportunities due to differences in, among other things, assets, markets, regulatory structure; accounting for and informing the multiple social priorities that a company is responsible for beyond decarbonization, such as affordability and reliability; providing companies with flexibility to respond as the future unfolds; and, supporting company resilience by helping a company identify robust overall strategies to different futures.

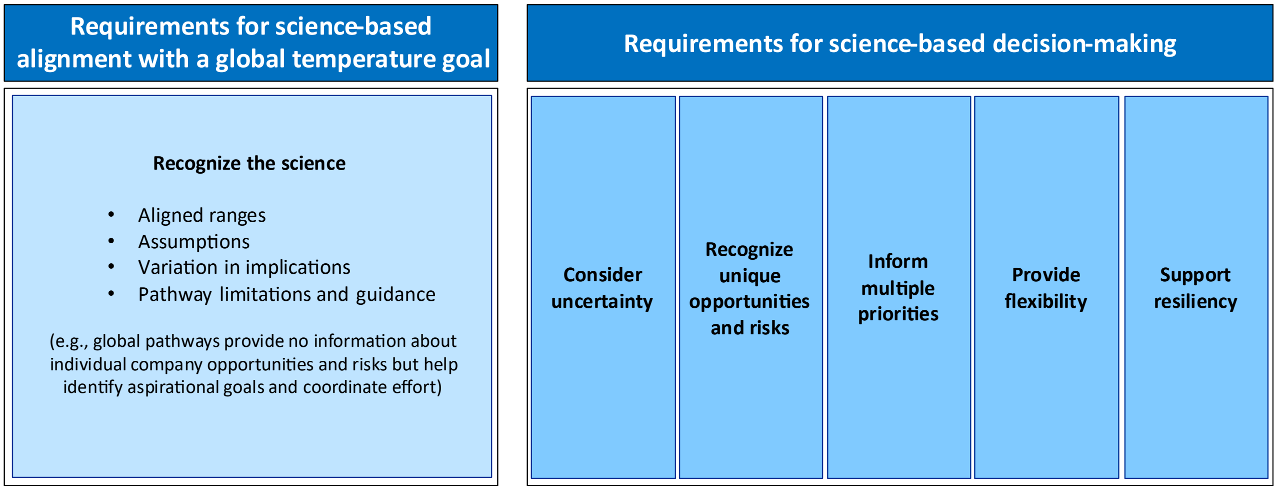

Figure 4. Requirements for a methodology to be "science-based"

Alignment with the Paris Agreement

The SMARTargets Methodology, by design, results in company targets and strategies that align with the Paris Agreement—both its temperature goals and its provisions for achieving those goals. The Paris Agreement calls for "[h]olding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels." The Paris Agreement also includes provisions for achieving the temperature goals, such as recognition of country differences in opportunities, multiple priorities, and enabling factors such as cooperation.

Overall, the SMARTargets Methodology provides alignment with the Paris Agreement in three ways that are consistent with science: quantitative targets aligned with the Paris Agreement temperature goal, qualitative alignment with the Paris Agreement strategies for achieving the temperature goal, and assessment of emission reduction transitions that align with the Paris Agreement and science by recognizing differences in opportunities and enabling conditions. Since alignment with the Paris Agreement and science is by design, a company's resulting SMARTargets targets and strategies will be automatically aligned by implementing the methodology.

Informing stakeholders, serving investor needs, and facilitating economy-wide decarbonization

The SMARTargets Methodology delivers a scientifically grounded, transparent, consistent, and comparable process and outputs that provides users and stakeholders, including investors, with confidence in the approach, results, and insights, as well as, of course, the company's targets and strategy. The approach is a scientifically derived, systematic, in-depth, comparable target setting and low-carbon strategy development process that each company implements. In addition, SMARTargets provides the following standardized outputs using templates for consistent documentation:

- The company's aspirational targets and enabling conditions and qualified targets for other conditions,
- The company's enabling conditions, strategy, risks, risk management, and qualitative Paris Agreement alignment,
- The company's transition risk analysis (the modeling, scenario design and specification, potential quantitative transitions, and insights), and
- The company's implementation of the process, including the portions of the company's GHG inventory that are covered by their targets, regulation, or other company SMARTargets, their practical issues decisions and justifications, and confirmation of their full implementation of the SMARTargets Methodology.

In addition, the SMARTargets transition risk analysis prioritizes economy-wide decarbonization by generating insights regarding interactions and opportunities for cooperation and coordination across the economy that are essential for achieving low-carbon economy-wide transitions.

SMARTargets meets the needs of investors by providing the information sought for credible company low-carbon transition plans, and by transparently informing on company-specific decarbonization opportunities, challenges, enabling conditions, risks, and risk management. Specifically, SMARTargets is aligned with investor needs that have been communicated in various contexts, such as the Net Zero Investment Framework (NZIF), Climate Action 100+, the Transition Plan Taskforce guidance, and TCFD guidance updates.

Methodology development

The SMARTargets Methodology was developed with broad input from stakeholders, industry technical experts, the scientific community, and the general public. The engagement activities included independent scientific peer review, a stakeholder advisory group, utility technical expert consultations, EPRI scientific expert feedback, a public comment process (ongoing), and public and stakeholder outreach throughout development. Details regarding the peer review feedback and the resulting revisions are available on the SMARTargets public comment process website.

Who is EPRI?

EPRI is a non-advocacy, nonprofit, scientific research organization with a public benefit mandate. EPRI strives to advance knowledge and facilitate informed discussion and decision-making. EPRI's Energy Systems and Climate Analysis research group is a long-standing and well-respected member of the research community relevant to this topic. Specifically, EPRI has over fifty years of recognized expertise in, among other things, climate scenarios, climate-related risk assessment, energy and societal transitions, energy technologies and systems, climate impacts, policy evaluation, and sustainability. EPRI also has recognized research community and scientific leadership, producing peer reviewed publications and contributing to scientific assessments and expert panels, including the National Academies of Sciences, Engineering and Medicine, U.S. Environmental Protection Agency's Science Advisory Board, the Intergovernmental Panel on Climate Change (IPCC), the U.S. National Climate Assessment, the scientific steering committee of the Integrated Assessment Modeling Consortium (IAMC), international and national research community studies, and the Task Force on Climate-Related Financial Disclosures (TCFD) Advisory Group for Scenario Guidance.

Assistance with the methodology

For questions or assistance with the methodology, or if you would like an introductory briefing, please contact EPRI's scientific leads: Dr. Steven Rose (srose@epri.com) and Dr. Claudia Octaviano (coctaviano@epri.com).

3. WHY SMARTARGETS?

In the United Nations Framework Convention on Climate Change's 2015 Paris Agreement, the international climate policy community set a goal to limit global average temperature to "well below" 2°C, with an additional aspirational goal to "pursue efforts" to limit global warming to 1.5°C. Companies are eager to understand their role in achieving the Paris Agreement goals in terms of potential low-carbon transitions, opportunities, and risks.

In many countries, decarbonization efforts have begun at national, local, and company levels, and there is growing interest in companies setting greenhouse gas (GHG) emissions targets that are aligned with the Paris Agreement. This has given rise to proposed target setting and assessment methodologies and benchmarks (e.g., SBTi, 2023, 2021; TPI, 2023). However, assessment of the relevant science and additional research has found that there are important issues that are essential to address for companies to identify practical and actionable targets and strategies for achieving outcomes aligned with science and international goals. These include consideration of uncertainty, recognition of differences in decarbonization opportunities and risks, and accounting for multiple societal priorities. While current approaches aim to be "science-based," they tend not to consider these issues and instead opt for "one-size-fits-all" solutions for all companies within a sector worldwide, which contradicts current climate science and sound decision-making. In addition to being informed by science, companies must also consider practical issues such as fiduciary duty, policy and regulatory environments, public perception, and economic implications. Consideration of these issues is essential for identifying actionable targets and strategies.

Overall, considering these issues when setting targets will facilitate progress by producing strategies that are appropriate for a company and their communities because they reflect a company's transition opportunities, including the company's assets, markets, systems, regulatory environment, barriers, risks, and set of societal objectives, such as sustainability, affordability, reliability, and local economic development. In addition, SMARTargets is an opportunity to elevate transition planning and risk management, as well as dialogue with stakeholders.

What is novel about SMARTargets?

The SMARTargets Methodology is designed to help companies contribute to the global pursuit of international climate aspirations while identifying viable transition strategies. The methodology is a systematic, comparable approach for evaluating transition opportunities and risks and developing credible company-level GHG targets and strategies. What specifically is novel about the SMARTargets Methodology?

- **Priorities greater than corporate target setting:** SMARTargets prioritizes transition risk management and economy-wide decarbonization.

- **Scientific alignment:** SMARTargets is aligned with all the science relevant to aligning with international goals and grounded company-level decision-making on targets, strategies, and risk management. Scientific alignment of the methodology was achieved by assessing the relevant science and undertaking a formal, independent scientific peer review.

- **Comprehensive Paris Agreement alignment:** SMARTargets aligns with the Paris Agreement's temperature goals as well as provisions for achieving those goals.

- **Supports good decisions and actionable strategies:** With company-specific transition risk analysis that considers a company's circumstances, opportunities, and uncertainty, SMARTargets generates actionable insights for a company's decarbonization and risk management strategies.

- **Facilitating greater ambition:** SMARTargets identifies enabling conditions for greater emissions reduction ambition that facilitates coordination with customers and policymakers.

- **Facilitating economy-wide decarbonization:** SMARTargets generates insights regarding interactions and opportunities for cooperation and coordination across the economy that are essential for achieving economy-wide decarbonization.

- **Transparency and support for substantive communications and dialogue:** SMARTargets requires companies to be transparent about their transition opportunities and risks, creating critical information for communicating, justifying, and understanding their transition strategies, which is necessary for productive dialogue and progress, as well as cooperation on enabling conditions.

- **Public benefit by enhancing decision-making:** SMARTargets is beneficial to companies, investors, customers, and communities by helping companies develop appropriate viable strategies and consistent targets, properly informing decisions, and avoiding creating risk that can result from imposing abstract and arbitrary benchmarks.

- **Facilitating independent validation:** SMARTargets facilitates internal and third-party validation according to international best practices of impartiality, independence, and objectivity.

SMARTargets supports investor needs

Investors have communicated their needs for credible company low-carbon transition plans through various initiatives. For instance, the Net Zero Investment Framework (NZIF) has identified five key components: comprehensive net-zero aligned emissions targets, a credible strategy for delivering on the targets, engagement to support target achievement, clear climate solution strategies, and emissions and accounting disclosure. Other initiatives, such as Climate Action 100+, the Transition Plan Taskforce guidance, and TCFD guidance updates, have also communicated these requirements. SMARTargets meets these needs and more, providing information for all five requirements as well as transparently and consistently informing investors on company-specific decarbonization opportunities, challenges, enabling conditions, risks, and risk management.

What does it mean to have SMARTargets?

Implementing the SMARTargets Methodology means a company has:

1. Ambitious and actionable GHG targets that are aligned with science and the international climate goals,
2. Followed a grounded, rigorous, well-defined standardized process with standardized outputs that provide transparency and comparability, and

3. A wealth of company- and engagement-relevant information on decisions and analysis, transition opportunities, targets, strategy, and risk management that inform stakeholders, as well as cooperation and coordination.

SMARTargets applicability for utilities and others

The initial SMARTargets Methodology is designed to support utilities worldwide that are providing electric power, electricity transmission and distribution, and natural gas services to communities. The approach, however, generalizes and can be helpful to other industries and companies as a template for evaluating their transition opportunities and risks and pursuing GHG targets. Given differences across sectors in emissions sources, abatement opportunities, markets, policy environments, and uncertainties, the methodology would need to be customized for other sectors.

4. THE SMARTARGETS METHODOLOGY

This section presents the details of the SMARTargets Methodology. The section begins by introducing the methodology structure, discussing how SMARTargets complements current company planning and other activities, and describing methodology implementation requirements. The section then walks through each of the methodology implementation steps in detail.

Introduction

Methodology structure

Implementing the SMARTargets Methodology entails eight steps. Figure 5 provides an overview of the steps and Table 2 provides brief descriptions of each step and its outputs. As shown, each step generates important information that informs the next step. Accounting for company specific circumstances is a key feature of the methodology. Doing so allows a company to identify their transition opportunities and risks, from which they can develop ambitious and actionable climate targets and strategies.

The methodology steps guide utilities through the process required for evaluating, pursuing, communicating, and validating ambitious GHG reduction targets. The initial steps focus on preparing foundational inputs, such as compiling GHG inventories and considering practical issues to determine which emissions to include in company targets. Once emissions categories and target groupings are defined, the company identifies generic aspirational targets aligned with science and the Paris Agreement. These are then evaluated through a company-specific transition risk analysis, which helps identify transition opportunities, risks, and enabling conditions. This analysis also supports the development of qualified targets—actionable goals that reflect the company's highest level of reductions under different conditions. The strategies and qualified targets identified from the analysis are then evaluated for alignment with international goals and science. Subsequent steps provide guidance for documenting, communicating, and validating the SMARTargets, as well as verifying progress over time. The final step emphasizes the importance of monitoring for milestones regarding future conditions and adjusting strategies as needed, and as possible. Together, the set of steps provide a structured, yet flexible, framework that helps companies align their climate targets and strategies with international goals, identify actionable and ambitious targets and strategies, and manage transition risks.

Overall, the methodology provides companies with the opportunity to pursue international climate objectives while recognizing their company-specific and regional economy-wide possibilities. The resulting information allows for informed dialogue regarding real potential transitions and opportunities for working together to achieve global climate outcomes.

Coordinating and integrating SMARTargets with current company activities

The SMARTargets transition risk analysis can be informed by and inform many company business units and teams. Figure 6 illustrates these opportunities for utilities, where there are relationships with planning and risk management activities, as well as other corporate functions.

1. **STEP 1: GHG inventories and base year**
2. **STEP 2: Practical issues and climate target groupings**
3. **STEP 3: Aspirational climate targets aligned with international goals**
4. **STEP 4: Company transition risk analysis of opportunities and risks**
5. **STEP 5: Strategy and qualified target alignment with international goals**
6. **STEP 6: Documentation and communication**
7. **STEP 7: Validation and verification**
8. **STEP 8: Monitoring and adjusting**

Figure 5. The SMARTargets Methodology implementation steps

Table 2. The SMARTargets Methodology implementation steps, short descriptions, and outputs

Implementation step	Short description	Outputs
STEP 1: GHG inventories and base year	Assemble GHG inventories and select a base year	Verified GHG inventory and emissions reductions base year
STEP 2: Practical issues and climate target groupings	Consider company-specific practical issues and identify target groupings	Decisions on practical issues, including emissions categories covered (by regulation or company targets), the categories for which targets are being set, and how these categories are grouped for target evaluation.
STEP 3: Aspirational climate targets aligned with international goals	Select generic aspirational targets aligned with the international goals	Aspirational targets to evaluate
STEP 4: Company transition risk analysis of opportunities and risks	Perform company-tailored regional transition risk analysis of aspirational and qualified targets to identify enabling conditions and transition strategy, including contingency plans	Company regional transition opportunities and risks, aspirational and qualified targets and their enabling conditions, and transition strategies (low-carbon & risk management)
STEP 5: Strategy and qualified target alignment with international goals	Evaluate transition strategy and qualified target alignment with the international goals	International goal alignment assessments of qualified targets and strategies
STEP 6: Documentation and communication	Document and communicate SMARTargets	SMARTargets documentation
STEP 7: Validation and verification	Validate SMARTargets and verify progress	Validated SMARTargets and verified progress
STEP 8: Monitoring and adjusting	Monitor milestones and adjust strategy as needed	Periodic milestone assessment and, as needed, strategy adjustment and/or SMARTargets refresh

SMARTargets transition risk analysis complements current utility planning analyses and processes, providing broader and longer-term strategic perspectives of potential uncertain factors economy-wide that can affect energy system development, fuel and other commodity markets, and ultimately company transition opportunities and risks. SMARTargets' risk focus is another differentiating feature, with a scenario design explicitly focused on characterizing and evaluating the transition risk decision space. In general, the SMARTargets analysis should be informed by, informing, and even possibly integrating with, utility planning.

For instance, the transition risk analysis should be informed by utility planning such as considering current resource retirement and additions plans, load forecasts, grid modernization plans, customer initiatives, and planning uncertainties. Similarly, the transition risk analysis should be informing planning by elucidating economy-wide opportunities and risks for potential planning consideration and providing alternative boundary conditions and inputs to resource planning.

SMARTargets evaluates factors and identifies opportunities and risks typically beyond utility planning analysis, such as the potential decarbonization implications for fuel markets (prices, quantities, composition), end use demand levels, responses, and technology adoption, energy demand drivers outside the power sector, inter-regional transmission, and potential policies and uncertainties in other sectors and regions. SMARTargets can also help define alternative exogenous inputs to planning (e.g., fuel prices; load levels and composition; inter-regional power flows). Finally, the SMARTargets transition risk analysis could eventually be integrated with planning analyses. There is the potential for explicit coordination and linking to generate complementary sets of market and company system transition results.

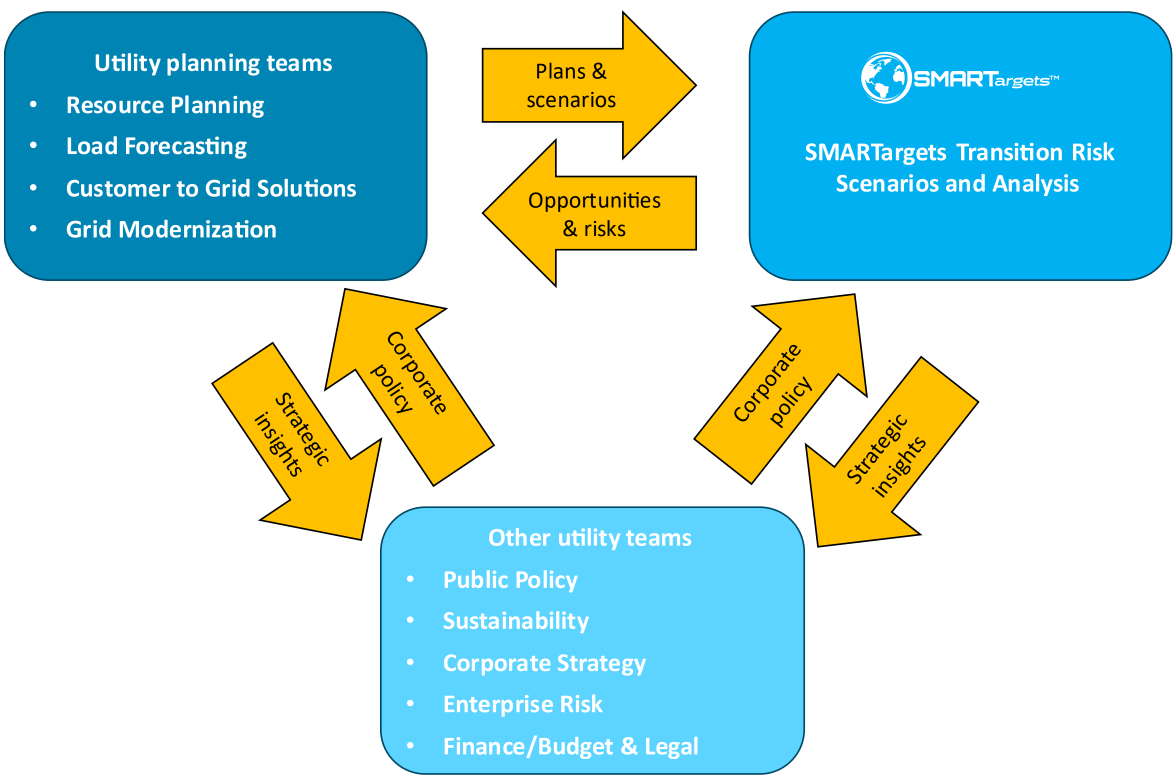

Figure 6. SMARTargets low-carbon transition risk analysis is informed by and informing many utility business units

SMARTargets coordination and resource requirements

Coordination and resources in general

Implementing SMARTargets requires coordination and resources. As illustrated above, SMARTargets' decisions and analysis can be informed by and inform many existing company business units and teams (Figure 6). To effectively identify and communicate meaningful climate targets and strategies, coordination across corporate business units is recommended.

Resources are also required for implementing the methodology. These include people, time, and modeling resources. Companies should consider engaging staff related to planning, policy, sustainability, risk management, strategy, and outreach, as well as possibly external experts on transition scenario analysis and modeling.

In addition, there are opportunities along the way for soliciting external input from, for example, a stakeholder advisory group. These are educational opportunities, as well as opportunities for feedback on a company's planned analysis and, eventually, their transition insights and proposed strategy. Finally, implementing the methodology—from analysis to communications—can take 6-9 months, with third-party validation an additional activity beyond that timeframe.

Modeling resources and capability

For the company-tailored transition risk analysis (Step 4 in Figure 5), it is important to have the appropriate modeling capability (internally or externally). The SMARTargets Methodology, however, is model agnostic. It does not require use of a specific model, but it does have minimum modeling capability requirements.

The SMARTargets' transition risk analysis is designed to provide high-level strategic risk insights and guidance. It is not designed for individual asset operations planning. The transition risk scenarios discussed in the methodology steps below are crafted to characterize future potential regional markets, looking beyond company systems to economy and sector transitions. Note that a company may need to evaluate multiple regions if they operate in more than one and the markets are unique.

The methodology recommends that utilities use either regional economy-wide or enhanced utility system planning modeling, with regional (sub-national) economy-wide modeling preferrable. In the near-term, however, using existing planning modeling may be practical for some companies. If so, the company should consider capturing economy-wide changes via alternative assumption sensitivities (discussed below). In the longer-run, we encourage companies to use regional economy-wide modeling to explicitly account for sector linkages and evaluate economy-wide opportunities, risks, and risk management strategies.

Transition risk analysis for some categories of utility GHG emissions will require the modeling of potential transitions of full systems—sectors, energy, or economy. For instance, evaluating transition opportunities and risks for stationary combustion CO_2 from electricity generation, natural gas related methane (CH_4) fugitive emissions, or downstream gas consumption CO_2 emissions requires supply and demand system modeling to evaluate future potential market conditions—market size and composition. However, some emissions do not require such complex modeling and can be evaluated using simpler abatement cost techniques (e.g., employee commuting emissions, business travel emissions). Methodologically, similar conceptual steps (Figure 5) will still be needed to evaluate uncertainty in emissions reduction opportunities, but the process can be simplified and streamlined. Note that the discussion below focuses on transition risk analysis based on system modeling.

While the transition risk analysis steps do not depend on a particular modeling framework, modeling scope (technology, system, economic, geographic, temporal), dynamics, and even the solution algorithm can affect the types of scenarios and insights that can be produced. Note that creative scenario designs and specifications can be used to circumvent some model scope limitations, such as varying market condition assumptions.

To evaluate and select a modeling framework, a company will need to understand their current modeling resources and capability related to each GHG emissions category and the transition opportunity and risk insights sought. A company may need to collaborate with others who can provide the modeling framework needed. For instance, companies may want to model demand response and/or fuel market size and composition. Also, modeling economy-wide decarbonization transitions and their implications across sectors requires economy-wide modeling. Below we discuss both types of modeling frameworks—economy-wide and planning—and minimum capability requirements for each. Going forward, there will be opportunities for partnerships to advance utility modeling tools to generate additional insights, as well as opportunities for development of tools for SMARTargets applications for other sectors.

Regional economy-wide modeling

SMARTargets recommends scenarios and modeling designed to provide companies with a strategic picture of regional economy-wide transitions and decarbonization opportunities and risks. With economy-wide decarbonization being sought by stakeholders, the methodology is designed to explore what economy-wide decarbonization might look like and take.

Economy-wide modeling tends to have a broader scope (economic, system, and temporal) than company planning modeling, and be less inhibited by policy or process restrictions and, therefore, able to explore a wider set of "what if" transition possibilities. State/region economy-wide modeling elucidates potential supply and demand market changes and provides strategic insights regarding future market and system conditions important to planning and overall corporate strategy.

Valuable economy-wide modeling insights include regional power sector transitions, sector interactions (e.g., end-use electrification, incentives to use low-carbon electricity, electrolytic hydrogen supply and demand), economy-wide renewable fuel opportunities, gas market size and fuel composition, potential fuel price changes, and opportunities for inter-regional transmission and low-carbon power trading (e.g., EPRI, 2023; Blanford et al, 2023; Cheng et al, 2023; Ueckerdt et al, 2021; Luderer et al, 2021).

For a SMARTargets implementation, a *regional economy-wide modeling framework* should have the following minimum characteristics:

- Sub-national regional resolution,
- Economy-wide economic resolution,
- 2050+ modeling horizon,
- 10-year or less time steps (to, at a minimum, model 2030, 2040, and 2050 emissions),
- The ability to evaluate GHG emissions constraints and identify cost-minimizing transitions,

- The ability to derive market equilibrium energy prices and quantities,
- The ability to derive energy supply and demand technology choices,
- The ability to estimate changes in inter-regional energy markets, and
- Dynamic optimization to capture expectation implications for investments. (preferred, not required)

The last item, dynamic optimization, is not required; however, it is the recommended solution algorithm for accounting for market expectation effects on investment choices. Numerous country-specific models with the above capabilities exist. For instance, for the U.S., EPRI's US-REGEN (Blanford et al, 2023), NREL's ReEDS, PNNL's GCAM-USA, and MIT's USREP (Yuan et al, 2019) are examples.[1]

Utility planning modeling

If a company is unable to do economy-wide modeling, they should do utility planning modeling and clearly communicate what they are capturing and not capturing with their framework. The company should also use external information to approximate and evaluate alternative broader economy-wide conditions. Specifically, the company should design scenarios considering alternative input assumptions regarding sector and economy-wide conditions that could affect planning modeling solutions. For instance, using external economy-wide results to guide scaling up and down of electrification trends, proxy increases in low-carbon electricity demand and/or the availability of renewable fuels due to end-use decarbonization policies, proxy data center/AI growth implications on electricity load, proxy low-carbon electricity inter-regional export/import opportunities, or proxy variation in the size of the gas market.

EPRI or other experts can support this need with insights and recommendations for data sources and alternative condition specifications from the scientific literature. For example, US economy-wide decarbonization studies have found that end-use decarbonization policies could result in electrification increase of 60-75%. Similarly, recent studies have suggested 6-18% data center/AI load growth nationally from 2023 to 2030 and regional growth up to 150% from 2020 to 2040. In addition, US regional analysis has projected the possibility of significant changes in inter-regional power trading associated with economy-wide decarbonization. For a SMARTargets implementation, a utility planning modeling framework should have the following minimum characteristics:

- Sub-national regional resolution,
- 2050+ modeling horizon,
- 5-year or less time steps,
- The ability to evaluate system and GHG emissions transitions (i.e., comparing emissions outcomes to constraints or identifying cost-minimizing transitions),
- The ability to inform affordability discussions with price and/or cost results, and
- The ability to derive energy supply technology choices.

[1] EPRI US-REGEN: https://us-regen-docs.epri.com/. NREL ReEDS: https://www.nrel.gov/analysis/reeds/. PNNL's GCAM-USA: https://im3.pnnl.gov/model?model=GCAM-USA. MIT's USREP: https://globalchange.mit.edu/publication/17331.

Numerous models with the above capabilities exist. For instance, there are common system planning models, such as Plexos, Encompass, PowerSIMM™, and Aurora.[2] There are also national electric sector models, such as, for the U.S., EPRI's US-REGEN electric sector version (Merrick et al, 2024), NREL's ReEDs, and ICF's IPM.[3]

Integrated modeling

In the future, a company may want to consider integrated, or coupled, economy-wide and utility planning modeling that provides a complementary and integrated set of market and system specific transition results. For now, the processes should be informing each other, with SMARTargets providing big-picture strategic insights regarding potential economy-wide and sector markets, transitions, and risks, as well as planning analysis sensitivity ideas and inputs. The modeling could eventually be more intimately integrated, or even mathematically coupled. Note, however, that some current utility planning analyses are constrained by regulatory and other processes that could impact what can be done in terms of integrating the modeling. This would be an important consideration.

Technology agnostic

It is important to note that SMARTargets is ***technology agnostic***. The methodology does not favor or preclude any technology *a priori*. Instead, the methodology encourages companies to utilize modeling that allows them to evaluate having and not having options so that they understand the implications and trade-offs for their targets and strategy and can share that information with others and inform dialogue.

Step 1. GHG Inventories and Base Year

Step 1 Outputs: Verified GHG inventory and emissions reductions base year.

The first step towards setting GHG reduction targets is for a company to assemble their GHG inventory and select a base year. A company will need GHG emissions accounts for each of the categories of emissions relevant to their business. A company will also need to decide on their emissions reduction base year and apply it consistently. Finally, the company will need to have the inventories verified. This would include verifying the company's base year inventory and most recent year inventory if different from the base year. The inventory, understanding and documentation of methods, and the base year inform subsequent steps in the methodology.

Specifically, Step 1 includes:

- Assembling the GHG inventory, including characterizing trends,
- Selecting an appropriate base year, and
- Documenting inventory methods, inventory verification, and identifying gaps and limitations.

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[2] Energy Exemplar Plexos: https://www.energyexemplar.com/plexos. Yes Energy Encompass: https://www.yesenergy.com/encompass. Ascend Analytics PowerSIMM™: https://www.ascendanalytics.com/solutions/planner. Energy Exemplar Aurora: https://www.energyexemplar.com/aurora.

[3] EPRI US-REGEN: https://us-regen-docs.epri.com/. NREL ReDS: https://www.nrel.gov/analysis/reeds/. ICF IPM (used by USEPA): https://www.epa.gov/power-sector-modeling.

Assembling the GHG inventory, including characterizing trends

A corporate greenhouse gas (GHG) inventory is a comprehensive and systematic accounting of all GHG emissions and removals associated with a company's operations over a defined period—typically one year. It forms the foundation for understanding a company's emissions profile and is necessary for developing emissions reduction strategies.

There are several methodologies available for developing a corporate greenhouse gas (GHG) inventory, such as the GHG Protocol and ISO 14064. Companies should select and clearly document the methodology or protocol they use to prepare their inventory. The SMARTargets Methodology is designed to be inventory methodology agnostic and does not rely on any specific approach. However, it requires companies to consider all emissions categories listed in Table 3. While these categories reference those defined by the GHG Protocol, using the GHG Protocol itself is not mandatory. Appendix A provides a mapping of key emission sources to each category and scope specifically tailored for electric and gas utilities to assist in identifying relevant sources when using an alternative methodology. For instance, combustion emissions from electricity generation must always be reported, regardless of the chosen protocol.

In addition to identifying current emissions based on the most recent verified inventory, it is important to understand historical trends by analyzing emissions data across as many years as a company has consistent records. This information is useful to communicate and informs base year selection. Visualizing this data through graphs can illustrate trends and highlight emissions increases or reductions.

Table 3. Emissions categories your company needs to consider for target setting

Source: EPRI using WRI/WBCSD (2004, 2011)

Scope 1
Direct Emissions from Stationary Combustion Direct Emissions from Mobile Combustion Direct Emissions from Process Sources Direct Emissions from Fugitive Sources
Scope 2
Indirect Emissions from Purchased/Acquired Electricity Indirect Emissions from Purchased/Acquired Steam Indirect Emissions from Purchased/Acquired Heating Indirect Emissions from Purchased/Acquired Cooling
Scope 3
Category 3: Fuel- and energy-related activities (not included in scope 1 or scope 2)
Category 11: Use of sold products

Selecting a base year

Once a company has a clear understanding of their emissions inventory and trends, they can proceed to selecting a base year. A base year is the specific year against which a company's GHG emissions are compared when measuring progress toward emissions reduction targets. It serves as a reference point for tracking emissions reductions over time.

SMARTargets does not mandate a specific base year. Companies should consider the following in selecting their base year:

- **Communications of progress.** A company should consider a base year that would capture their historical emissions changes. In particular, a company should choose a base year that allows the company to communicate progress to date and the additional planned abatement action.

- **Availability of reliable, verifiable, and consistent emissions data.** The selected base year must be supported by high-quality data. A third-party verified emissions inventory with, at a minimum, a limited level of assurance for the selected base year is required to ensure the credibility and the integrity of future comparisons.

- **Local, regional or national policy base years.** Where appropriate, companies may choose to align their base year with relevant policies—such as the base year used in their country's Nationally Determined Contribution (NDC), state decarbonization targets, or regulatory requirements. While not required, this alignment can help clarify how the company's targets relate to broader climate goals and may enhance stakeholder understanding, particularly in policy or investor communications.

Why not standardize the base year across all companies?

SMARTargets does not mandate a specific base year because there is no scientific justification for a particular year. However, there are practical reasons for companies to have different base years.

At the international negotiation level, as well as corporate level, there have been discussions about what base year should be used for computing percent reductions in emissions and communicating targets. This includes discussion about whether the base year should be updated and if all countries or companies should use the same base year. For example, the current U.S. NDC emissions reduction pledge has a 2005 base year. From a company point of view, revising the base year can have the unintended consequence of not acknowledging emissions reductions to date. Updating the base year can affect perceptions regarding effort and progress. Thus, a company should consider a base year that would capture their historical emissions changes.

On its own, there is no scientific argument for revising the base year. It is simply redefining the reference point. As a matter of fact, the current focus on 2015, as seen in IPCC reports and elsewhere, is in large part an artifact of science community data reporting. Databases, such as associated with the IPCC's latest assessment report (Byers et al, 2022; Riahi et al, 2022) or the IEA's latest net-zero scenario (IEA, 2023) no longer include standardized reporting of earlier historical years, such as 1990 and 2005. The shift to 2015 in part simply reflects changes in data availability rather than a scientific rationale for redefining the base year.

The key issue here is that changing global conditions are making limiting warming to the Paris Agreement goals more challenging. Specifically, global emissions continue to rise and global emissions pathways for limiting warming to the Paris Agreement goals are therefore becoming even more ambitious. Together, this implies higher percent reductions as the percent reductions for achieving a similar 2050 outcome are now based on today's higher starting point, compared to a decade ago. However, the global emissions trend may be inconsistent with the company's emissions trend. If a company has declining emissions over the same period that global emissions are increasing there is yet another disconnect between company and global transitions that should be recognized.

Thus, the SMARTargets base year recommendations for a company setting a target are to:

- Use the latest global emissions pathways to inform the aspirational targets the company evaluates (Step 3),
- Choose a base year that allows the company to communicate their progress to date and the additional abatement action planned,
- Ensure that the same base year is used in communicating the company's target, their transition risk pathways, and the global pathways, and
- Quantitatively communicate the global and company emissions trends to help stakeholders understand how each has progressed and to contextualize the company's role within the broader climate transition.

As indicated above, companies should use the same base year in communicating their targets, their transition risk pathways, and the global pathways used when communicating alignment with international goals (see illustrative examples in Appendix B). It is straightforward to re-scale global pathway percent reduction ranges to different base years.[4]

Updating the base year

In some circumstances, it is appropriate for a company to consider updating their base year. In particular, companies that undergo structural changes might need to revise their base year to more clearly communicate their emissions trends and benchmarks. For example, a company might consider revising their base year following the purchase or sale of assets that redefine a company's emissions sources and GHG inventory (GHG Protocol, 2005; EPRI, forthcoming). If this is the case, that factors motivating the revision should be clearly communicated.

It is also a good practice to develop a clear corporate policy that sets conditions for considering a base year update. If a company's base year recalculation policy is triggered, the company may also need to revisit their SMARTargets and they will want to inform the public and provide justification.[5] See the GHG Protocol for guidance on base year recalculation and EPRI's Technical Note on this topic (GHG Protocol, 2005; EPRI, forthcoming).

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[4] Companies can choose the base year but need to ensure consistency with the base year used for deriving the global pathway percent reduction ranges and then determining the midpoints for each year pre-2050 and in 2050 associated with Figure 7 and

Table 6. EPRI will provide the data needed so that companies can estimate the required reduction percentages based on their chosen base year.

[5] This update will trigger the need to revalidate your target, but an expedited process can be designed to facilitate target validation under these specific circumstances.

Documenting inventory methods, inventory verification, and identifying gaps and limitations

Document methods

A company needs to document the protocols or methodologies used to prepare its GHG emissions inventory. While SMARTargets does not mandate the use of specific methodologies, it does require them to be documented.

The company will also need to justify the selected base year. It is recommended that companies follow reasonable criteria (e.g. that provided by the GHG Protocol), such as choosing a base year for which verifiable emissions data are available and ensuring it represents typical business operations (avoiding atypical high or low-emission years). Companies should also ensure that the base year selection has properly considered any material structural changes in the company and that it represents an accurate datum for benchmarking the company's emissions reductions. The base year should also relate to the company's business goals and context, such as capturing business strategies or aligning with mandatory reporting requirements in their jurisdiction. Additionally, as discussed, companies should select a base year that facilitates communication of historical emissions trends, highlighting past achievements and demonstrating planned additional reductions going forward.

The company should also document inventory verification activities, including the inventory years verified and their justification for verification gaps or delays, especially if the inventory is more than five years old.

Finally, as mentioned, the validation of SMARTargets requires a third-party verified GHG inventory. This verification must be conducted by an accredited Validation and Verification Body (VVB) and must meet, at least, a limited level of assurance for accuracy and completeness.

Gaps and limitations

Companies are required to transparently document gaps or limitations in estimating GHG emissions for the categories listed in Table 3. These gaps may include issues such as incomplete or unreliable activity data, outdated or uncertain emission factors, or missing data for specific sources. In addition to identifying these limitations, companies should assess how they may affect the accuracy of emissions tracking and target-setting and outline any plans or strategies in place to address them over time.

It is important to recognize that GHG accounting is a rapidly evolving field. New methodologies are continually being developed, and existing protocols are regularly updated to reflect advances in science, data availability, and policy needs. For example, the GHG Protocol is currently undergoing a major revision that may influence how emissions are categorized and reported under frameworks like SMARTargets. Companies are encouraged to stay informed about these developments and to understand the limitations of the methodologies they currently use.

As highlighted by Kaplan and Ramanna (2021), one significant limitation of current corporate GHG accounting practices—particularly those based on the GHG Protocol—is the systematic double counting of indirect (Scope 3) emissions across value chains. This can obscure accountability and complicate efforts to manage climate-related risks. In response, alternative approaches such as the e-liability method are being developed to provide more precise, auditable, and transaction-level emissions tracking (Heller, T. and Seiger, A, 2021; Seiger and Roston, 2022; Ronston et al 2023, Ronston et al 2024a, Ronston et al

2024b). These methods aim to improve transparency and better support climate risk management, especially for companies with complex supply chains and potential exposure to climate-related financial risks. Importantly, regardless of whether the GHG Protocol, e-liability, or another GHG accounting approach is used, companies will still want to assess their transition opportunities and risks and identify climate and risk management strategies by following the remaining SMARTargets steps.

Transitioning to a new accounting framework like e-liability could be a significant undertaking. As such, it will be important for companies to understand the potential benefits of emerging alternatives to be able to make informed decisions and to respond to stakeholders.

Step 2. Practical Issues and Climate Target Groupings

Step 2 Outputs: Decisions on practical issues, including emissions categories covered (by regulation or company targets), the categories for which targets are being set, and how these categories are grouped for target evaluation.

In this step, a company will consider company-specific practical issues and identify GHG target groupings. This step helps companies assess practical considerations that may influence their ability to set and achieve GHG emissions targets and inform their evaluation of targets (in Step 4). For each emissions category in Table 3, a utility will need to work through a set of questions that facilitate consideration of practical issues that can affect the company's ability to set and pursue targets.

There is a limited set of conditions where not setting a target can be appropriate. In these circumstances, a company will need to document and justify the decision, and, as possible, communicate plans for addressing the issue to facilitate future targets. The company will also communicate how the categories for which they are pursuing targets will be grouped. Targets can be by emissions category, by GHG across categories, or across GHGs and categories.

For each category, a company will decide whether to:

1. Set a target (using the subsequent SMARTargets steps);
2. Not set a target because the emissions are already covered by a Paris Agreement aligned policy or another company's Paris Agreement aligned targets,
3. Not set a target with justification based on practical considerations that currently preclude target setting, or
4. Not set a target because the category is not relevant to their business.

As indicated by the choices, a company's emissions could be covered by Paris Agreement-aligned strategies in more than one way: their own derived SMARTargets, Paris Agreement-aligned regulation, and other's Paris Agreement aligned targets (SMARTargets or otherwise).

Target setting practical considerations

Drawing on insights from the science (see Scientific Foundations), the following are questions a company should address for each emissions category the company is considering for targets:

1. Is the emissions category adequately estimated and reported?
2. Are the emissions material to the company's overall GHG inventory?
3. Are the emissions already regulated by a Paris Agreement-aligned policy?

4. Has another company in the value chain already set Paris Agreement-aligned targets for this source? *(Applicable only to indirect emission sources)*
5. Does the company have control or influence over the emissions?

Table 4 helps guide the company's responses to the questions. Note that while the table is structured as Yes/No answers, the company is required to provide justification for each of their responses in Table 5 and the SMARTargets Reporting Template. The questions help identify target setting opportunities and uncertainties, as well as specific situations where it may currently be impractical or inefficient for a company to set targets.

The Scientific Foundations document discusses each of the above practical issues. For instance, a GHG inventory is a pre-requisite for setting a target, but for some emissions categories the level of detail in the inventory might be insufficient to set and track progress for a target. In addition, it might be impractical to set targets for relatively minor emissions categories, such as categories representing less than 5% of your total emissions.[6] In this case, while target setting may be precluded by the inventory, you should communicate your strategy for addressing the inventory issue as possible. Similarly, setting targets for emissions that are either already managed by Paris Agreement aligned strategies via regulation, or with other company's targets aligned with the Paris Agreement and science (SMARTargets or otherwise), can be economically inefficient and unnecessarily constrain regulatory compliance or affect the other company's targets strategy respectively. Paris Agreement alignment of regulations or another company's targets can be determined using the Step 5 approach for SMARTargets. A company may still choose to set targets in these cases. If they do, their targets should be consistent with regulatory compliance or the source's targets respectively.

When to consider setting a target

Given the questions above, a company should consider setting a target for an emissions category if:

- The emissions can be adequately estimated and reported,
- The emissions are material to the company's GHG accounts,
- The emissions are not already regulated to a Paris Agreement-aligned level, **and**
- Another company in the value chain has not already set Paris Agreement-aligned targets (SMARTargets or another type of science-based target aligned with the Paris Agreement) for the same emissions (applies to indirect emissions only).

When target setting may be impractical

Alternatively, there is a narrow set of circumstances under which setting a target may not be practical or necessary:

- The emissions cannot be adequately estimated or reported,
- The emissions are not material to the company's GHG accounts,
- The emissions are already regulated to a Paris Agreement-aligned level, **or**

[6] A Company should use the same materiality threshold used in GHG inventory verification and they should report this threshold in the SMARTargets Reporting Template. If they have not identified a materiality threshold, they should use 5% based on the GHG Protocol Corporate Standard (WRI/WBCSD, 2004, p. 69).

- Paris Agreement-aligned targets have already been set for these emissions by another company in the value chain (applies to indirect emissions only).

Limited Control or Influence

Limited or partial control or influence over an emissions category is not, by itself, a reason to exclude the category from target setting consideration. However, it can make achieving a target more difficult and less economically efficient than direct management of the emissions at the source (Scientific Foundations). As such, a company should consider their control/influence for each emissions category. When possible, it should be considered in the form of uncertainties that are evaluated in Step 4 when analyzing transition opportunities and challenges for reducing the category's emissions. For instance, the implications of a lack of control/influence can be evaluated by analyzing uncertainties in the drivers that impact things like generation dispatch, load growth, gas market size, or customer energy and technology choices. In addition to evaluating the implications, the analysis can help identify opportunities for influence and collaboration that could facilitate emissions reductions.

Summarize and document decisions

After considering each of the practical issues questions above, a company will designate each of the emissions categories as one of the following:

1. Covered by their SMARTarget derived targets,
2. Covered by Paris Agreement-aligned regulation,
3. Covered by Paris Agreement-aligned targets from a company in their value chain,
4. Not setting a target due to practical considerations, or
5. Not setting a target because not relevant to their business.

The company will need to communicate and summarize their designation decisions using Table 5 (which is in the SMARTargets Reporting Template). This is essential for transparency, validation, and informing both internal and external stakeholders. Furthermore, for categories where targets are being pursued, the company will conduct transition risk analysis (Step 4) on the target groupings they have chosen to evaluate the opportunities and risks associated with the targets and to inform the company's climate and risk management strategies.

Table 5 also helps a company transparently communicate what emissions are covered and how, as well as help document progressive target setting (discussed below).

Target groupings

Targets can be set by emissions category, by greenhouse gas (GHG) across categories, or across both GHGs and categories. A company should use Table 5 to communicate how their emissions categories map to their target groupings (category, GHG, or GHG & category). If a company uses a modeling framework capable of integrating different emissions categories and/or GHGs, they should consider setting targets that encompass those categories and gases. This approach is preferable, as it enables the identification of cost-effective abatement opportunities across emissions categories. If the framework accounts for multiple GHGs, targets can be expressed in carbon dioxide equivalents (CO_2e). However, if integration across categories and/or gases is not feasible within the current modeling framework, it is acceptable to model and evaluate targets separately by category.

Progressive target setting

The emissions categories (and groupings) for which a company intends to set targets is also a list of categories (and groupings) for which the company intends to do Step 4 transition analysis to identify opportunities and risks for achieving the targets. These analyses require resources to complete—staff time and financial resources. If completing all the analyses at once is not feasible due to resource constraints, a company is encouraged to adopt a progressive target-setting approach. This involves prioritizing Scope 1 and Scope 2 categories and setting targets now for those categories the company is currently able to evaluate, while clearly communicating their plans to assess and set targets for other categories over time. This information should also be included in Table 5. Even if resource constraints prevent a company from evaluating and setting targets for some categories now, it is valuable to communicate their intentions to set targets for these categories in the future.

Table 4. Practical considerations for target setting

Question	Yes	No
Is the emissions category adequately estimated and reported?	Continue considering setting a target.	Consider not setting a target that includes this emissions category; and, consider and communicate measures to estimate and report this category in the future.
Are the emissions material om the GHG accounts (e.g. above 5% of total emissions or another defined materiality threshold)?	Continue considering setting a target.	Consider not setting a target that includes this emissions category.
Are the category's emissions regulated by a Paris Agreement aligned policy?	Consider not setting a target that includes this category to avoid economic inefficiencies and compliance complications. If you determine that a target is necessary, consider how to mitigate any potential inefficiencies or compliance challenges that may arise. *Note: Determine Paris Agreement alignment using the "Well-below 2°C" ranges used in Step 5 of the SMARTargets Methodology.*	Continue considering setting a target that includes this emissions category. However, it is important to also consider whether regulatory approval for pursing greater reductions is needed and will be granted.
Does the source have Paris Agreement-aligned targets (SMARTargets or equivalent) set by another company in the value chain?	Follow the steps below to consider not setting a target that includes this category to avoid economic inefficiencies and complications for another company´s target strategy; or, set the other company's target as your company target. <u>Steps</u> 1. Communicate the source's target set by another company in your value chain, 2. Determine Paris Agreement alignment of the target using the SMARTargets Step 5, 3. Determine whether the target is aligned with science (i.e., it meets the scientific requirements, such as considering uncertainty, unique opportunities, and multiple objectives), 4. Determine whether to set a target using the guidance below to derive a response. • *If it is a SMARTarget* – no need to set a target; or, if still wanting to consider a target, use the source's SMARTarget as the target • *If not a SMARTarget but aligned with the Paris Agreement and science* – no need to set a target; or, if still wanting to consider a target, use the source's target set by another company in your value chain as the target • *If not a SMARTarget and not aligned with the Paris Agreement and/or science* – consider asking the company in your value chain that controls the source to set a SMARTarget or consider setting a SMARTarget taking into account the source's target	Continue considering setting a target.
Is there control or influence over the emissions?	Continue considering setting a target.	Document the control issues and use the insights from the discussion to inform the transition uncertainties in Step 4.

Table 5. Emissions category targets

Table note: Emissions categories are those from Table 3.

Emissions category	GHG total ($MtCO_2e$ or NA if not relevant to business)	Currently covered				To be covered by future Company SMARTargets ($MtCO_2e$)	Not Covered ($MtCO_2e$)	Justification (and, as relevant, plans for not covered emissions and future targets)
		By Our Current Company SMARTargets (MtCO2e)	SMARTarget type (indicate if target for category, GHG, or CO_2e)	By Paris Agreement Aligned Regulation ($MtCO_2e$)	By Another Company's Paris Agreement Aligned Targets ($MtCO_2e$)			
Scope 1. Direct Emissions from Stationary Combustion								
Scope 1. Direct Emissions from Mobile Combustion								
Scope 1. Direct Emissions from Process Sources								
Scope 1. Direct Emissions from Fugitive Sources								
Scope 2. Indirect Emissions from Purchased/Acquired Electricity								
Scope 2. Indirect Emissions from Purchased/Acquired Steam								
Scope 2. Indirect Emissions from Purchased/Acquired Heating								
Scope 2. Indirect Emissions from Purchased/Acquired Cooling								
Scope 3. Fuel- and energy-related activities (not included in scope 1 or 2)								
Scope 3. Use of sold products								

Step 3: Aspirational Climate Targets Aligned with International Goals

Step 3 Outputs: Aspirational targets that will be evaluated in the Step 4 transition risk analysis.

In this step, a company will select generic aspirational targets aligned with the international goals. Based on the Step 2 emissions categories the company identified for evaluating and pursuing targets, and the target groupings they defined (by category, by GHG, or across GHGs). A company will then need to identify for each target grouping aspirational intermediate and 2050 target levels. These are referred to as the Aspirational Targets (ATs) throughout the methodology.

Aspirational and qualified targets

Within the methodology, a company will evaluate and pursue Aspirational and Qualified Targets (QTs). ATs are derived from global emissions pathways aligned with international temperature goals. The ATs are used to encourage ambition and help identify enabling conditions for being more ambitious. Given the limitations of global emissions pathways (see Scientific Foundations); in particular, that they do not represent individual company transition opportunities or differences in opportunities across companies, it is not expected that ATs will be attainable by all companies without enabling conditions, such as carbon dioxide removal (CDR) offsets and/or supportive policies. This is why the ATs are referred to as "aspirational." The ATs are also aspirational because the international climate goals themselves are aspirational, with global emissions pathways consistent with the goals exhibiting ambitious emissions declines and, given current policy trends and the continued rise in global emissions, optimistic assumptions (e.g., global coverage and cooperation, emissions peaking before today).

Evaluating ATs creates the information needed for informed dialogue regarding challenges, risks, enabling conditions, and opportunities for pursuing these kinds of emissions outcomes. SMARTargets encourages companies to evaluate what achieving these targets would entail, identify the conditions needed to support them, and take proactive steps towards creating those conditions. This approach helps companies pursue greater ambition while remaining grounded in practical, risk-informed planning.

QTs, on the other hand, reflect the greatest emissions reductions possible for a company under different potential future conditions. They reflect the maximum emissions reductions a company can pursue under certain conditions while effectively managing challenges and risks. QTs are identified through the company's Step 4 transition risk analysis, which evaluates alternative plausible future conditions. Depending on the conditions, QTs may be more or less ambitious than ATs. Furthermore, a company can have multiple QTs and pathways with each associated with different future conditions. Note that, QTs are optional if a company determines that they can manage the challenges and risks of ATs under the range of future conditions they are required to evaluate in Step 4.

The two types of reductions—ATs and QTs—emerge as a pragmatic approach for pursuing the international temperature goals: evaluating the unique opportunities and challenges for individual companies to pursue ATs, informing stakeholders and their expectations regarding AT levels of reductions, and helping companies identify QT reductions and strategies that make progress under different conditions. Both ATs and QTs provide information that can be readily communicated and pursued in collaboration with customers, policymakers, and others.

Figure 7 and Table 6 describe the annual ATs companies should evaluate and pursue based on their Step 2 target grouping decisions. The specific evaluation requirements are discussed further below. The reductions in Figure 7 and Table 6 are the midpoints of the global emissions pathways ranges consistent with limiting global average warming to 1.5°C. The reduction levels are scientifically consistent with achieving 1.5°C and of interest to stakeholders, as well as accepted as aligned with the Paris Agreement, such as net-zero CO_2 by 2050.

The Figure 7 and Table 6 reductions are ambitious and they will be challenging for many companies, which is why SMARTargets also requires companies to identify enabling conditions and evaluate the highest possible ambition under other conditions (the QTs). Generally, enabling conditions include things like facilitating climate policies, technology availability and lower costs, facilitating infrastructure siting and permitting processes, and favorable market conditions and customer preferences.

For each target grouping, a company is required to evaluate a 2030 or 2035 interim emission reduction AT and a 2050 AT. The ATs should be *at least* as ambitious as those in Figure 7 and Table 6. Companies are welcome to evaluate additional interim targets, but it is not required.

For utilities, the primary GHGs in their inventories are CO_2, methane (CH_4), and sulfur hexafluoride (SF_6). For each emissions category, the company would set aspirational targets based on the GHG produced from that category using Table 6. For example, for CO_2, the company would set ATs of at least -56% or -82% for 2030 or 2035 respectively and -100% (net-zero) for 2050 relative to 2015. For CH_4 and SF_6, the 2050 ATs are -47% and -52% reductions respectively relative to 2015.

The ATs are by GHG because of the different roles each type of GHG plays in global emission pathways that are limiting global average warming to 1.5°C. The different roles of the GHGs are due to differences in how the climate responds to the different gases, as well as the differences in emissions sources and abatement options. In addition, from a company GHG reduction strategy point of view, the GHGs also differ in their uncertainties, risk management opportunities, and transition risk assessment methodological needs. Some companies may prefer to set an aspirational target across categories by gas (e.g., across all CO_2 categories) or across GHGs (e.g., across CO_2 and CH_4 categories). If the latter, they should set the target pathway according to the CO_2e reductions in Table 6.

Note that Figure 7 and Table 6 show required reductions relative to 2015. As noted in Step 1, SMARTargets does not mandate a specific base year for emissions reduction rates. However, a company's base year should be clearly communicated and the global emissions pathway ranges generating the required targets in Table 6 should be adjusted to the same base year for consistency. This adjustment is straightforward—using the ratio of historical emissions for the years of interest—and EPRI can assist as needed. For instance, the 2030, 2040, and 2050 net CO_2 reductions from a 2005 base year are -48%, -85%, and -99% respectively (versus the -56%, -88%, and -100% reductions from a 2015 base year shown in Table 6).

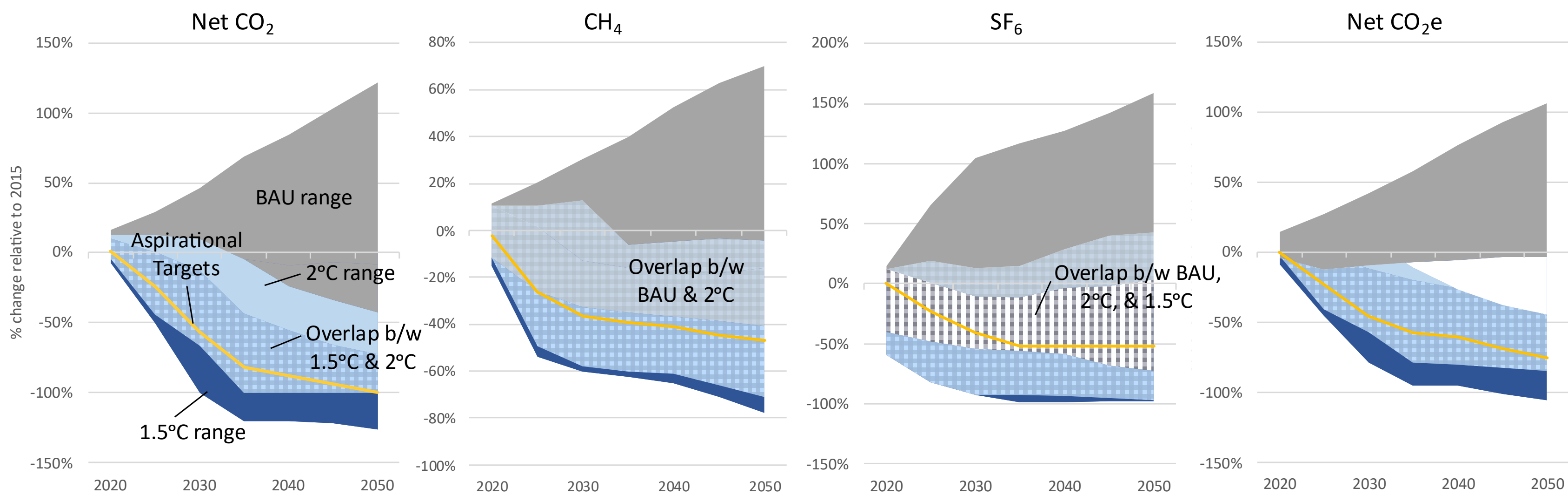

Figure 7. SMARTargets Aspirational Targets and 1.5°C, 2°C, and business as usual (BAU) pathway ranges for global total net CO_2, CH_4, SF_6, and net CO_2e

Source: Developed from the IPCC's Sixth Assessment Report (Byers et al, 2022; Riahi et al, 2022), IEA Net Zero by 2050 (IEA, 2023, 2021), TPI (2023), and PRI (2021) global emissions pathways (EPRI, forthcoming).

Figure note: Each set of targets are the midpoints over time from the respective latest global total emissions percent reduction range consistent with limiting global average temperature to 1.5°C with a 50% likelihood. The 2°C ranges are for global pathways with a 67% likelihood of limiting global average temperature to 2°C. See discussion in the main text for justification and discussion on how the 1.5°C consistent global and sub-global emissions pathway ranges are considered by the methodology. The SF_6 midpoint pathway was modified to be monotonically decreasing. The actual SF_6 midpoints increase post-2030 to -47% in 2050 based on their cost-effectiveness in global pathway solutions. The percent reductions are changes relative to 2015 emissions levels. Companies can choose a different base year that better represents their historical emissions, but they need to adjust the global pathways to derive midpoint target levels consistent with that base year.

Table 6. SMARTargets Aspirational Targets (ATs) for net CO_2, CH_4, SF_6, and net CO_2e and 1.5°C and well-below 2°C global pathway ranges

Source: See Figure 7

Table note: See Figure 7. The well-below 2°C ranges reflects the combined range associated with the latest 1.5°C (50% likelihood) and 2°C (67% likelihood) global pathways.

	Aspirational Targets				*1.5°C Ranges*				*Well-below 2°C Ranges*			
	Net CO_2	*CH_4*	*SF_6*	*Net CO_2e*	*Net CO_2*	*CH_4*	*SF_6*	*Net CO_2e*	*Net CO_2*	*CH_4*	*SF_6*	*Net CO_2e*
2030	*-56%*	*-37%*	*-52%*	*-45%*	*-13% to -100%*	*-13% to -60%*	*-11% to -92%*	*-11% to -79%*	*10% to -100%*	*13% to -60%*	*13% to -92%*	*9% to -79%*
2035	*-82%*	*-39%*	*-52%*	*-57%*	*-43% to -121%*	*-16% to -63%*	*-11% to -93%*	*-20% to -95%*	*-4% to -121%*	*-6% to -63%*	*15% to -98%*	*-11% to -95%*
2040	*-88%*	*-41%*	*-52%*	*-60%*	*-55% to -121%*	*-17% to -65%*	*-3% to -93%*	*-26% to -95%*	*-24% to -121%*	*-5% to -65%*	*29% to -98%*	*-26% to -80%*
2045	*-94%*	*-45%*	*-52%*	*-68%*	*-66% to -122%*	*-18% to -71%*	*-2% to -95%*	*-35% to -102%*	*-33% to -122%*	*-3% to -71%*	*40% to -98%*	*-35% to -102%*
2050	*-100%*	*-47%*	*-52%*	*-75%*	*-73% to -126%*	*-16% to -78%*	*3% to -96%*	*-45% to -106%*	*-43% to -126%*	*-4% to -78%*	*43% to -98%*	*-44% to -106%*

The ATs are based on global total emissions pathways, instead of sub-global pathways, such as sectoral or regional pathways, like global electric sector emission intensity as is used by some existing methodologies (e.g., SBTi). Total global emissions are used because they have the strongest alignment relationship with global average temperature since they are constrained by the physical dynamics of the climate system. Sub-global results, on the other hand, are contingent on policy and non-policy assumptions that result in an allocation of effort across countries and sectors. However, these assumptions are highly uncertain and country-sector allocation of effort is very sensitive to alternative plausible assumptions. With many sub-global transitions found to be consistent with any global emissions transition, companies need to evaluate these uncertainties, instead of compare themselves to results that are dependent on one alternative. Most importantly, companies need to evaluate their unique transition opportunities and risks. Step 4 of the SMARTargets Methodology requires this essential analysis.

The global emissions pathway ranges are used to derive the ATs because all of the pathways represented within the range are equally credible global transitions and all have been found to be consistent with the global temperature outcome (see Scientific Foundations). The midpoints of the ranges are used for the ATs simply because they are reasonable representative emissions transitions for the set of transitions associated with the ranges.

Finally, to create information on the transition challenges associated with pursuing the Paris Agreement's 1.5°C aspirational goal, the emissions pathway ranges consistent with 1.5°C are used for the ATs instead of broader "well-below 2°C" pathway ranges. The methodology aims at providing insights for the highest ambition goal of the Paris Agreement, and thus ATs are set considering the ranges consistent with 1.5°C. It should be noted, however, that current assessment of global emissions pathways indicates that 1.5°C is likely to be exceeded with important implications for global efforts to pursue this goal. This approach can be revisited as international climate policy evolves. The SMARTargets Methodology conceptual approach itself is not dependent on a particular temperature objective. It can be easily adapted for future developments. See the methodology justification section and Scientific Foundations for additional discussion and insights regarding 1.5°C and "well-below" 2°C global emissions pathways.

Intensity targets

Intensity targets focus on emissions rates—such as CO_2 per unit of electricity generated or fugitive CH_4/SF_6 emissions per unit of gas or electricity transmitted respectively. When there is significant uncertainty regarding the activity levels associated with emissions (e.g., electricity load growth, gas market size, or transmission and distribution volumes), and that activity is out of the company's control, intensity targets are frequently considered. This approach allows the company to focus on an aspect of the emissions they can more readily manage—the emissions rate.

However, aligning intensity targets with the Paris Agreement is more challenging than with level (or mass) targets. Doing so requires translating global emissions pathways into sub-global or sector-specific benchmarks, which depend on uncertain, and frequently unrealistic, assumptions (see Scientific Foundations). Given these limitations, the absolute emissions percent reduction target approach above is used for SMARTargets, along with recommending evaluation of activity level uncertainty. The Step 4 transition risk analysis allows a company to explicitly evaluate and communicate on their activity uncertainty, risk implications, and enabling conditions for achieving targets.

In addition, SMARTargets recommends that a company report emissions intensity changes for the transitions identified in their transition risk analysis. This information helps communicate how the structure of systems might transition with different potential future conditions and activity levels. This information will also help a company currently using intensity targets. The company will be able to connect their current intensity targets to the transitions they are evaluating, which will help identify whether revisions to their intensity targets and strategies might be merited.

Step 4: Company Transition Risk Analysis of Opportunities and Risks

Step 4 Outputs: Company regional transition opportunities and risks, evaluation of aspirational and qualified targets and their enabling conditions, and transition strategies (low-carbon & risk management).

In Step 4, a company will perform tailored transition risk analysis of aspirational and qualified targets (ATs and QTs respectively) to identify enabling conditions and their transition strategy, including risk management contingency plans. If, based on Step 2, a company has decided to evaluate and pursue targets, for an emissions category or across categories, they need to undertake transition risk analysis to identify their opportunities, risks, and risk management strategies for pursuing ATs and QTs.

This approach supports decision-making under uncertainty, which is prudent (see Scientific Foundations). For each target grouping identified in Step 2, the company will undertake transition risk analysis. Note that the same analysis can inform evaluation of target opportunities and risks for more than one grouping. For instance, as shown below, the same core scenarios required for evaluating targets for electricity generation supply emissions provide the uncertainty information needed for evaluating potential gas and T&D targets.

There are seven phases associated with creating the tailored company-specific transition risk scenario analysis (Figure 8):

- *Phase 1: Define reference conditions and itemize uncertainties* – define conditions common to all potential futures and itemize planning uncertainties for consideration in scenarios,
- *Phase 2: Create core scenario design* – combine uncertainties to define a scenario design of plausible extreme sets of future transition conditions,
- *Phase 3: Implement scenario design* – specify assumptions for the alternative future conditions in the scenario design for modeling,
- *Phase 4: Identify potential transitions and target implications* – run the model to identify transition opportunities and risks*,*
- *Phase 5: Review potential transitions and target implications – review transition results and insights with company decision-makers,*
- *Phase 6: Revise and iterate as needed* – revise scenario design, implementation, and model results as needed until comfortable with results and insights*,* and
- *Phase 7: Communicate results* – document targets, transitions, risks, enabling conditions, and risk management strategies.

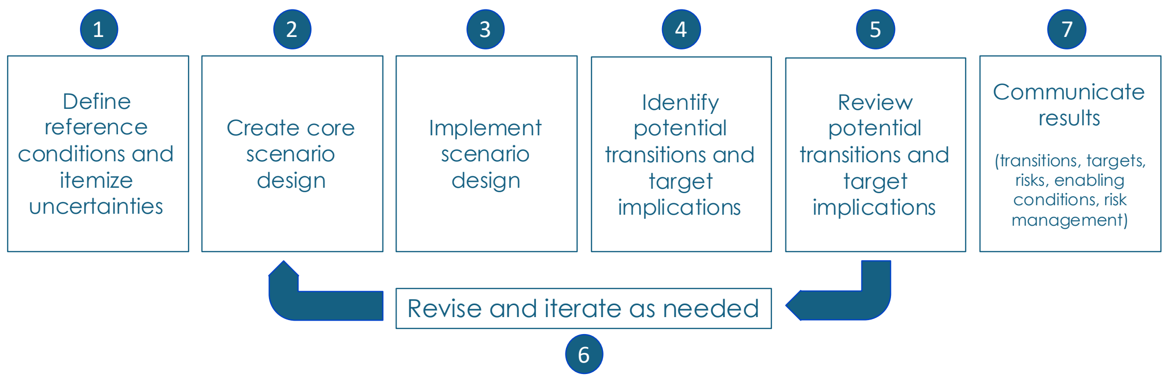

Figure 8. Phases for creating a tailored company-specific transition risk scenario analysis and evaluating GHG targets

This section introduces the SMARTargets scenario design concept and then lays out in detail the required phases, outputs, and decisions associated with implementing the company transition risk analysis. Full analysis implementation examples are provided in Appendix B. In this section, we use electricity supply utility emissions reduction analysis results as our primary examples to illustrate the phases. See Appendix B for implementation examples for target evaluation for utilities providing electricity, gas, and transmission and distribution services.

General approach

The SMARTargets approach uses scenario analysis to inform decision-making under uncertainty. The scenario results identify potential future states and transitions. The results will also inform decision-maker beliefs about the likelihood of possible transitions, which will help them develop hedging strategies. In the future, companies may want to entertain more advanced computational techniques such as stochastic modeling that explicitly introduces probabilities (e.g., Webster et al, 2022; Zhao et al, 2021).

A well-designed company transition risk scenario analysis can identify the potential future transition and emissions reduction conditions for a company to identify opportunities and risks and to characterize their decision-making space. It requires company-level thinking to identify company-relevant uncertainties and company-relevant future conditions.

Transition risk analysis is a valuable tool for exploring possibilities. It is not a forecast, or prescription. It is intended to explore “what if” possibilities. For instance, what if there is low versus high demand for goods and services? What if there are economy-wide versus sector specific decarbonization transitions? What if carbon dioxide removal (CDR) is allowed versus not allowed as a decarbonization option?

As laid out in Step 3, the SMARTargets Methodology requires evaluation of ATs and QTs for each emissions target grouping. For the ATs, a company will want to evaluate alternative transition strategies and the implications, uncertainties, risks, and risk management options. Identifying the QTs requires exploring different reduction levels to evaluate the incremental implications, challenges, and trade-offs associated with increasing reduction effort. For instance, a company will want to know, and be able to communicate, the incremental implications for economic variables, like investments, prices, and costs, as well as for physical capital and system variables related to new infrastructure and operations.

The details of transition risk assessments will vary with company type, due to differences in emissions sources and abatement strategies. For instance, electric power utilities, gas utilities, and transmission and distribution (T&D) utilities have different sets of emissions sources, and therefore different uncertainties that require variation in approaches for assessing relevant potential emissions, transitions, and abatement opportunities and risks. Furthermore, what variables are most important to decision-making will vary by company.

SMARTargets scenario design concept

A good scenario design can meaningfully explore company transition possibilities, differences, trade-offs, and risk. The challenge, however, is to package the uncertainties into a meaningful but modest number of scenarios to evaluate potential transitions, targets, and risks that can be communicated readily. SMARTargets uses a parsimonious 2-by-2 scenario design logic as a starting point to organize and focus thinking (Table 7). The goals being to define the plausible decarbonization transition space and reasonably bound the risk decision-making space.

Table 7. EPRI 2-by-2 transition risk scenario design concept

		Uncertain Other Conditions *(demand, technology, etc.)*	
		Facilitating	***Challenging***
Uncertain Decarbonization Incentives and Options Conditions	***Narrower***	Narrower & Facilitating	Narrower & Challenging
	Broader	Broader & Facilitating	Broader & Challenging

The basic concept illustrated by Table 7 is that there are two categories of uncertainties—those associated with decarbonization incentives and options and those associated with other conditions unrelated to decarbonization. Decarbonization incentives and options uncertainty includes uncertainties in decarbonization incentives within and across sectors of the economy and uncertainties about the available and eligible decarbonization options. Other uncertainty includes uncertainties about future goods and services demands, technology costs, new infrastructure constraints, and fuel markets.

This 2-by-2 scenario design concept has been used successfully to evaluate regional low-carbon transition opportunities and risks for utilities (e.g., Alliant Energy, 2023; WEC Energy, 2022). See also EPRI (2022a) for a similar simple scenario approach based on a precursor to the 2-by-2 scenario design. In each case, applying this heuristic method has led to simple, impactful scenario insights with uncertainties determined by the user based on their needs and their unique circumstances that define their decarbonization opportunities.

The simple 2-by-2 construct provides a useful overarching concept, or logic, for conversation, scenario construction, and the grouping of uncertainties, while minimizing the number of scenarios, which facilitates communications and understanding. In transition risk analysis, we are interested in learning about potential risk; therefore, the objective is to define extreme alternative conditions that will elucidate risks. These can be low-likelihood futures, but they should be plausible so that they provide meaningful insights and guidance. The futures should also be meaningfully unique, providing new information, helping define the boundaries of the risk decision space, contributing to a full, and realistic, characterization of potential transitions and risks, and providing substantive insights regarding differences and similarities.

This scenario logic can be a departure from typical company planning processes that tend to focus more on middle-of-road or likely futures. To identify risk, however, exploring the boundaries is needed. Note that, in this plausible extreme scenario design environment, companies are not being asked to pick between extreme decarbonization futures. Instead, they are evaluating the tails of potential future conditions to elucidate risks. If desired, a company can choose an in-between path using the robust strategies and risk management options identified from the analysis.

Broader and Narrower conditions related to decarbonization incentives and options

Table 7 is valuable for, among other things, facilitating important initial internal conversations within a company on potential sets of decarbonization incentives and options and other conditions. The Broader and Narrower terms in Table 7 refer to broader or narrower scope and flexibility respectively in terms of decarbonization. For instance, Broader might be defined as an economy-wide decarbonization incentive with a fuller decarbonization options portfolio, while Narrower might be defined as a power-sector-only decarbonization incentive with a more limited decarbonization options portfolio. The specific incentives and options of Broader and Narrower will depend on a company's constraints and conditions, such as whether a company's state, provincial, or regional government prohibits or promotes particular technologies. The steps and examples discussed below illustrate these points.

Facilitating and Challenging Other Conditions

For the uncertain other conditions, the terms Facilitating and Challenging are used in Table 7 to represent conditions that facilitate or challenge the transition to a decarbonized economy. For example, the Facilitating specification could be defined as slower economic growth, lower low-carbon technology costs, no additional barriers to new infrastructure, and lower input prices, while Challenging could be defined as greater economic growth, higher low-carbon technology costs, constraints on new infrastructure, and higher input prices. Like with Broader and Narrower, the specific elements of Facilitating and Challenging used by a company will depend on their constraints and context, such as local siting and permitting processes and public sentiment. The phases and examples below discuss different types of uncertainties and help illustrate these points.

Expanded scenario design

We can also build off the 2-by-2 concept, adding dimensionality to separate categories of uncertainty. Specifically, for SMARTargets, we separate uncertainty regarding decarbonization incentives and options to explore their implications independently. Table 8 is an expanded version of the 2-by-2 table. In Table 8, we have identified the SMARTargets' priority scenarios that are required to characterize the range of possible transitions (in green). They represent "best" and "worst" case transition conditions for each decarbonization incentive environment. The other scenarios in Table 8 are recommended, but not required, to flesh out the space for all the uncertainty combinations. In addition to the required and recommended scenarios, there is also the opportunity for optional sensitivity scenarios to explore within the space, as well as beyond it, by varying individual or subsets of assumptions for more refined insights regarding specific uncertainties or topics. See below for more discussion of optional sensitivity scenarios and examples.

Regional focus

In general, to capture differences in regional transition opportunities, SMARTargets recommends modeling regional (e.g., sub-national, provincial, state) transitions with regional reductions targets to create insights regarding potential overall system and market transitions. It is important to look beyond company systems to economy-wide transitions to gain insights into potential new markets and investment opportunities and risks. Note that, as discussed in the methodology introduction, if a company is not running a regional economy-wide model, they should run economy-wide-like scenarios by varying exogenous assumptions that proxy economy-wide effects, such as changes in market size and composition.

Table 8. SMARTargets scenario design concept for required (green) and additional recommended scenarios (blue)

	Decarbonization Incentive	Decarbonization Options	Uncertain Other Conditions (demand, technology, etc.)	
			Facilitating	***Challenging***
Uncertain Decarbonization Incentives and Options Conditions	***Narrower***	***Broader***	Narrower incentives / Broader options / Facilitating other	Narrower incentives / Broader options / Challenging other
	Narrower	***Narrower***	Narrower incentives / Narrower options / Facilitating other	Narrower incentives / Narrower options / Challenging other
	Broader	***Broader***	Broader incentives / Broader options / Facilitating other	Broader incentives / Broader options / Challenging other
	Broader	***Narrower***	Broader incentives / Narrower options / Facilitating other	Broader incentives / Narrower options / Challenging other

The seven phases of transition risk analysis

As indicated in Figure 8, there are seven phases associated with the company-specific transition risk analysis. Each phase and its requirements are discussed below, including who should be involved. In addition, there are opportunities for soliciting external input from, for example, a stakeholder advisory group. These opportunities are identified as well.

Phase 1: Define reference conditions and itemize uncertainties – identify conditions common to all futures and itemize planning uncertainties

- *Phase inputs: Previous company planning, strategy, analysis, and risk management experience; and, Step 2 insights regarding activity level uncertainties impacting emissions.*
- *Phase outputs: Scenario analysis reference conditions and list of uncertain factors to consider in scenario design.*
- *Who should be involved: Staff related to planning, policy, sustainability, risk management, strategy, and outreach, as well as possibly external experts on scenario analysis and modeling.*

- *Documentation: SMARTargets Reporting Template entries summarizing reference conditions and uncertain transition factors for scenario design consideration.*

A critical first conversation is to discuss reference conditions. These are conditions that are not uncertain and that the company sees as a part of all potential futures. For instance, this could be federal or local policies and regulations related to emissions, land use, or economic development that the company expects to be in place in every possible future. It might also be company or regional plans for specific assets that are already in motion, such as projects underway or planned retirements. If, however, there is uncertainty about these, the company would want to include them in their uncertain factors discussion for potentially inclusion in their scenario design in Phase 2.

A second conversation is to discuss and itemize the uncertain factors that are important to the company. Some will be uncertainties the company already considers in their planning processes, such as uncertainties regarding future demand and input markets. Some will have emerged from Step 2 emissions control discussions of activity level uncertainties and factors, such as uncertainties about the size of the gas market or end-use technology adoption. Others will be newer, and the company may not know whether they are important yet. The company will want to catalogue this latter type of uncertainty as well so that they can consider exploring their importance in the next phase.

Table 9 lists examples of low-carbon transition uncertainties based on EPRI's research, literature assessments, and applied work with companies. These are uncertainties that have been found to be impactful on utility transitions or uncertainties companies have found to be important based on their experience. Uncertain decarbonization incentives and options for evaluation include uncertainty regarding low-carbon transition incentive coverage (e.g., economy-wide, power sector only, technology specific) and the eligible low-carbon options (e.g., CCS, CDR, low-carbon power imports, and/or bioenergy). Other uncertainties include uncertainties regarding other factors, such as load (demand for electricity—clean or otherwise); fuel markets; technology costs; planning, permitting and construction; and not-in-my-backyard constraint uncertainties.

Table 9 is not meant to be exhaustive or prescriptive. Table 9 does, however, identify uncertainty categories that SMARTargets requires be considered (in green). Utilities must consider uncertainty regarding decarbonization incentives, decarbonization options, demand, energy supply and demand technologies, supporting infrastructure, and energy markets. The scientific literature to date has found emissions pathways and decarbonization strategies to be sensitive to these uncertainties; and, therefore, relevant to company risk assessment and planning (see Scientific Foundations).

Keep in mind that some high-level uncertainties can represent a variety of uncertain factors. For example, uncertainty regarding infrastructure additions can represent a combination of uncertainties regarding technology development and commercialization, permitting and siting, local policy, supply chain, not-in-my-backyard (NIMBY) public sentiment, and resource procurement that alone or together could contribute to uncertainty regarding opportunities for new infrastructure. In general, Table 9 is meant to provide ideas to facilitate conversation within a company regarding potential uncertainties to consider in their transition risk scenario design.

Note that, at this point the objective is to identify relevant uncertainties. Model capability and implementation will be considered later, as we do not want modeling capability to constrain the discussion. In Phase 2, the company will discuss alternatives for representing each uncertainty in their modeling. For models that cannot explicitly represent an uncertainty, there are creative approaches for capturing alternative conditions and sets of conditions.

At the end of Phase 1, the company will document their reference conditions and itemize the identified uncertain factors in the SMARTargets Reporting Template. The template requires consideration of the minimum sets of reference conditions and uncertain factor categories discussed above, and allows for additional conditions and categories to be added. For each of the required uncertainties, the company should document if and how they are being considered. Note that, the company is not required to include all of them, but they are required to consider each and decide on whether to include them.

Table 9. Examples of transition uncertainties

Table note: Required categories in green.

- **Decarbonization incentives & options uncertainties**
  - **Incentive**
    - Economic coverage – e.g., power sector, non-electric sectors, economy-wide
    - Geographical coverage – e.g., isolated, regional, or national
    - Timing and stringency
  - **Options**
    - Technology eligibility (nuclear, natural gas, CCS, etc, power imports, allowance markets, offsets, fossil reserve capacity eligibility)
  - **Neighbor's policies** (incentives and options)
- **Other uncertainties**
  - **Markets**
    - Load – e.g., population, AI/data centers, EVs, buildings, DERs, changing industry structure, etc.
    - Inputs – e.g., fuel prices, workforce, other supply chain
  - **Technology**
    - Energy supply – e.g., costs and performance and availability (solar, wind, advanced nuclear, storage, CCS, etc.), water scarcity, additions constraints
    - Energy demand – e.g., cost, performance, adoption rates, and consumer preferences
  - **Supporting infrastructure**
    - T&D, pipelines, EV chargers, filling stations, etc. – e.g., cost, additions constraints
  - **Non-climate policy**
    - Permitting, clearances, zoning
    - State and local development plans, resource and transmission planning requirements, DER policy, etc.
  - **Public perception** – e.g., NIMBY, fossil resource opposition

Phase 2: Create core scenario design – define plausible extreme alternative future conditions

- *Phase inputs: Phase 1 scenario analysis reference conditions and list of uncertain factors to consider in scenario design.*
- *Phase outputs: The company's core scenario design for the required SMARTargets scenarios.*
- *Who should be involved: Staff related to planning, policy, sustainability, risk management, strategy, and outreach, as well as possibly external experts on scenario analysis and modeling.*
- *Documentation after iterations: SMARTargets Reporting Template entries summarizing the core scenario design.*

Core scenarios

As discussed, the methodology requires companies to evaluate the ATs (

Table 6) and QTs and their conditions. Thus, the scenario design needs to facilitate identification of enabling conditions by evaluating the range of possible transition conditions for the company and providing information regarding trade-offs and risks that are relevant to company decision-making. This phase creates the company's scenario design from their Phase 1 reference conditions and itemized uncertain factors using the SMARTargets' risk-based scenario design logic (Table 7). Specifically, in this phase the company will combine the uncertain factors into plausible, but more extreme, alternative sets of decarbonization conditions for evaluating potential transitions. First, we present the SMARTargets scenario structure for evaluating the ATs and identifying the QTs and then we discuss the details the company needs to define to tailor the scenario design to evaluate their transition possibilities, risks, enabling conditions, and potential risk management strategies.

Scenarios for Electricity Supply Utility Emissions Targets

Table 10 lists the core scenarios required by SMARTargets for evaluating ATs and QTs for companies wanting to set CO_2 targets for electricity supply emissions. Further below we discuss the core scenarios for targets for gas and T&D related emissions. The set of scenarios in Table 10 allow the utility to evaluate the implications of the three priority categories of uncertainties. The scenarios explore the net-zero by 2050 CO_2 AT transition implications for two types of decarbonization incentives (sector specific versus economy-wide net-zero CO_2 by 2050 transitions), two types of decarbonization options (*Fuller* versus *More Limited* sets of options), and two types of other conditions (*Facilitating* versus *Challenging* decarbonization conditions). Discussion of how to define Fuller/More Limited and Facilitating/Challenging is provided below.

Utilities setting targets for electricity supply emissions are required to run reference and AT scenarios. The first two scenarios evaluate reference conditions without emissions constraints to elucidate the implications of the Facilitating and Challenging conditions. The next two AT scenarios evaluate a regional power sector only transition to the net-zero AT in 2050 under alternative combinations of decarbonization options and other conditions. The next two AT scenarios evaluate a regional economy-wide transition to a net-zero AT in 2050 under the alternative decarbonization options and other conditions.

The scenarios in Table 10 may look different from typical utility planning scenarios. This is because the emissions constrained scenarios in Table 10 are intentionally designed to explore risk and evaluate overall decarbonization transitions in the sector and full economy to generate the needed insights regarding opportunities and risks for decarbonizing whole energy systems and economies.

Table 10. Required scenarios for evaluating reductions in electricity supply CO_2 emissions

Target type being evaluated	Target pathway	Economy-wide transition to net-zero in 2050	Decarbonization options	Other conditions
Reference	Reference (without CO_2 constraint)	No	N/A	Facilitating
	Reference (without CO_2 constraint)	No	N/A	Challenging
Aspirational Targets (net CO_2 ATs and QTs > ATs)	Power sector transition to net-zero CO_2 in 2050	No	Fuller	Facilitating
	Power sector transition to net-zero CO_2 in 2050	No	More Limited	Challenging
	Power sector transition to net-zero CO_2 in 2050	Yes	Fuller	Facilitating
	Power sector transition to net-zero CO_2 in 2050	Yes	More Limited	Challenging
Qualified Targets (net CO_2 QTs < ATs)	Power sector net CO_2 transition to X, Y, and Z% in 2050	No	Fuller	Facilitating
	Power sector net CO_2 transition to X, Y, and Z% in 2050	No	More Limited	Challenging

The economy-wide scenarios will help the company and their stakeholders understand how decarbonization incentives outside the company's sector can impact their transition and decarbonization opportunities. As discussed in the Scientific Foundations document, most low-carbon transition pathways in the literature, and used by stakeholders, assume economy-wide decarbonization incentives, which is not the actual policy context for most companies. However, these policy assumptions have been found to have significant implications for transitions, facilitating more rapid electric sector decarbonization and use of low-carbon electricity and fuels to decarbonize the economy. Different decarbonization incentives will result in different practical decarbonization transitions; and, thus, uncertainty regarding incentives is important to evaluate. The scenarios in Table 10 facilitate this evaluation.

Table 10 also shows the QT scenarios the utility should consider to evaluate the implications of varying levels of emissions reductions for the regional power sector. These scenarios provide insights regarding the potential incremental implications of increasing the level of reductions. To evaluate and identify the companies QTs, a company should run scenarios evaluating a range of reduction targets by 2050 under the Fuller/More Limited and Facilitating/Challenging transition combinations of conditions. For instance, the company could evaluate CO_2 reduction pathways to 30%, 50%, and 80% below 2015 in 2050.

Note that the reference scenarios will help the company identify a reasonable lower bound reduction rate. For instance, if the reference scenarios result in 35% reductions by 2050 without an emission reduction requirement, the company might evaluate a 40% reduction in 2050 with their lowest incremental reduction scenario. Exploring a range of increasingly more ambitious reductions up to the AT levels will create the information needed to understand the incremental implications of pursuing more ambitious reductions. Figure 9 illustrates conceptually how the results across scenarios with increasing reduction levels can be combined to generate incremental insights on costs, prices, investments, new builds, or system variables related to operations. Note that the company may want to revise their incremental reduction levels after seeing the preliminary modeling results to properly identify the reduction levels they can achieve in some conditions while balancing trade-offs and managing risks. Additional scenarios assuming an economy-wide decarbonization are not needed here. The economy-wide decarbonization scenarios already run for the ATs provide the information needed for evaluating the power sector and energy system implications.

Table 11 lists the additional recommended scenarios for fully fleshing out the possible AT and QT transitions for all the combinations of uncertainties. Table 11 also lists optional sensitivity scenarios for exploring topics of interest further once a company has seen the other results. This is a conversation for Phase 5 of the transition risk analysis.

To implement the scenarios in Table 10 (and Table 11), the company needs to define the Fuller/More Limited decarbonization options and Facilitating/Challenging other conditions. Table 12 provides an example of potential definitions. For the alternative decarbonization option conditions, Fuller/More Limited, the company should define a relatively optimistic set of options for "Fuller" and a relatively pessimistic set of options for "More Limited." Both sets should be plausible, both should be relevant to policy and stakeholder conversations, and both should be relatively extreme. In Table 12, for instance, Fuller includes a broad portfolio of electric and non-electric sector decarbonization options, including renewables, storage, fossil energy with and without CCS, new nuclear generation, CDR, biopower, hydrogen, other renewable fuel, and low-carbon imported power. Fuller also allows for fossil resources to meet capacity reserve requirements.

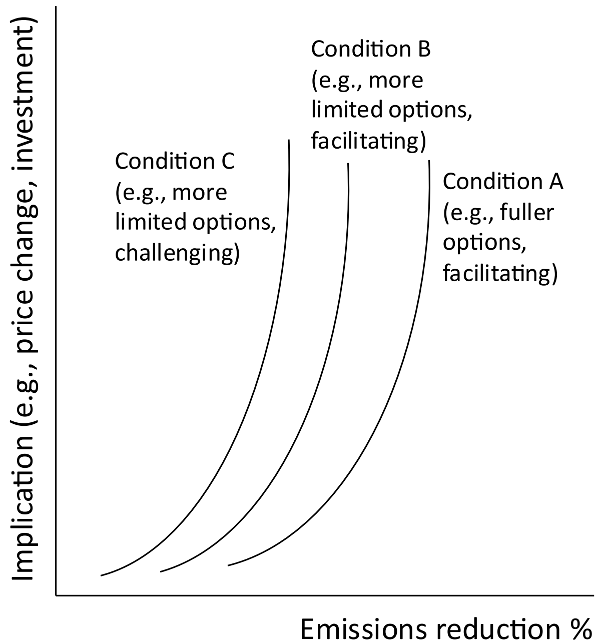

Figure 9. Companies need to develop incremental implications information to evaluate trade-offs and identify their qualified targets

Table 11. Additional recommended and optional sensitivity scenarios for evaluating reductions in electricity supply CO_2 emissions

Required, recommended, optional?	Target type being evaluated	Target pathway	Economy-wide transition to net-zero in 2050	Decarbonization options	Other conditions
Additional recommended	Aspirational Targets (net CO_2 ATs and QTs > ATs)	Power sector transition to net-zero CO_2 in 2050	No	Fuller	Challenging
		Power sector transition to net-zero CO_2 in 2050	No	More Limited	Facilitating
		Power sector transition to net-zero CO_2 in 2050	Yes	Fuller	Challenging
		Power sector transition to net-zero CO_2 in 2050	Yes	More Limited	Facilitating
	Qualified Targets (net CO_2 QTs < ATs)	Power sector net CO_2 transition to X, Y, and Z% in 2050	No	Fuller	Challenging
		Power sector net CO_2 transition to X, Y, and Z% in 2050	No	More Limited	Facilitating
Optional sensitivities	At company discretion based on insights from other results				

Alternatively, More Limited includes a very narrow portfolio of options, including renewables, existing nuclear generation, storage, electrolytic hydrogen, and declining eligibility of fossil resources for capacity reserves. The company should define Fuller and More Limited as is appropriate to them. Decarbonization technology options will likely vary between companies due to differences in local circumstances, such as local policy. For instance, a company should leave out options that are implausible in all their potential futures. The Fuller/More Limited definitions might also consider other types of emissions offsets (e.g., forestry, agriculture) or a supply of emissions allowances.

It is important to keep in mind that SMARTargets is technology agnostic. The methodology does not favor or preclude any technology *a priori*. Instead, the methodology encourages companies to evaluate having and not having options so that they understand the implications and trade-offs for their targets and strategy and can share that information with others. Thus, companies should default to including options and letting the analysis identify some of the opportunities and risks.

For the alternative other conditions, Facilitating/Challenging, the company should define a set of market, technology, supporting infrastructure, etc. conditions, that could facilitate relatively less and more challenging transitions respectively. Again, both should be plausible, both should be relevant to policy and stakeholder conversations, and both should be relatively extreme. In Table 12, for instance, the illustrative Facilitating conditions include reference electricity load growth, faster cost improvements for generation technologies, lower barriers for new capacity and transmission additions, lower fuel prices, and faster cost improvements for end-use electric technologies. Challenging is just the opposite of each of these. Note that, at this stage, the alternative conditions are only specified in qualitative terms (e.g., faster/slower, lower/higher). In Phase 3, the company will need to quantitatively specify these conditions so that they can be modeled and analyzed (e.g., x% slower, y% higher).

Table 12. Illustrative Fuller/More Limited and Facilitating/Challenging decarbonization condition definitions

Illustrative FULLER decarbonization option set	Illustrative MORE LIMITED decarbonization option set
Renewables (wind, solar, bio, hydro)	Renewables (wind, solar, bio, hydro)
Nuclear (extensions)	Nuclear (extensions only)
Advanced nuclear (additions)	Storage
Fossil	Electrolytic Hydrogen only
Fossil w/CCS	Other renewable fuels (w/ and w/o CCS)
CDR (biopower w/ CCS & direct air capture (DAC))	Fossil capacity reserve eligibility declines to zero in 2050
Storage	Demand conservation and energy efficiency
Hydrogen	
Biopower carbon neutrality	
Other renewable fuels (w/ and w/o CCS)	
Low-carbon power imports	
Fossil capacity reserves permitted (within emissions constraint)	
Demand conservation and energy efficiency	

Illustrative FACILITATING other conditions	Illustrative CHALLENGING other conditions
Reference electricity load growth	**Faster** electricity load growth
Faster electricity generation cost improvements,	**Slower** electricity generation cost improvements,
Economic electricity capacity additions,	**Constrained** electricity capacity additions,
Economic electricity transmission additions,	**Constrained** electricity transmission additions,
Lower fossil fuel prices,	**Higher** fossil fuel prices,
Faster electric technology cost improvements	**Slower** electric technology cost improvements

Scenarios for T&D and gas utility emissions targets

Because T&D and gas utility GHG emissions are a function of the size and composition of the electricity and gas markets, the scenarios required are focused on evaluating the potential future size and composition of these regional markets. This information is an essential input to evaluating opportunities for reducing fugitive SF_6 and gas system CH_4 emissions, CO_2 from line losses, and upstream and downstream CO_2 and fugitive CH_4 gas consumption and development emissions. See Table 13 and Table 14 for the T&D utility and gas utility required scenarios respectively. From Step 3, the AT for SF_6 in 2050 is a reduction of at least 52% (from 2015); and, for methane, the AT in 2050 is a reduction of at least 47% (from 2015).

Table 13. Required scenarios for evaluating reductions in T&D utility SF_6 and CO_2 emissions

Target pathway type being evaluated	2050 targets for pathways	Electric sector transition	Economy-wide transition to net-zero in 2050	Decarbonization options	Other conditions
Aspirational Targets (SF_6 & net CO_2 ATs and QT > ATs)	SF_6 52% & net CO_2 100%	Reference (without CO_2 constraint)	No	N/A	Facilitating
		Reference (without CO_2 constraining)	No	N/A	Challenging
		Transition to net-zero CO_2 in 2050	No	Fuller	Facilitating
		Transition to net-zero CO_2 in 2050	No	More Limited	Challenging
		Transition to net-zero CO_2 in 2050	Yes	Fuller	Facilitating
		Transition to net-zero CO_2 in 2050	Yes	More Limited	Challenging
Qualified Targets (SF_6 & net CO_2 QTs < ATs)	SF_6 A, B, C% & net CO_2 X, Y, Z%	Reference (without CO_2 constraint)	No	N/A	Facilitating
		Reference (without CO_2 constraining)	No	N/A	Challenging
		Transition to net-zero CO_2 in 2050	No	Fuller	Facilitating
		Transition to net-zero CO_2 in 2050	No	More Limited	Challenging
		Transition to net-zero CO_2 in 2050	Yes	Fuller	Facilitating
		Transition to net-zero CO_2 in 2050	Yes	More Limited	Challenging

Table 14. Required scenarios for evaluating reductions in gas utility CH_4 and CO_2 emissions

Target pathway type being evaluated	2050 targets for pathways	Electric sector transition	Economy-wide transition to net-zero in 2050	Decarbonization options	Other conditions
Aspirational Targets (CH_4 & net CO_2 ATs and QTs > ATs)	CH_4 47% & net CO_2 100%	Reference (without CO_2 constraint)	No	N/A	Facilitating
		Reference (without CO_2 constraint)	No	N/A	Challenging
		Transition to net-zero CO_2 in 2050	No	Fuller	Facilitating
		Transition to net-zero CO_2 in 2050	No	More Limited	Challenging
		Transition to net-zero CO_2 in 2050	Yes	Fuller	Facilitating
		Transition to net-zero CO_2 in 2050	Yes	More Limited	Challenging
Qualified Targets (CH_4 & net CO_2 QTs < ATs)	CH_4 A, B, C% & net CO_2 X, Y, Z%	Reference (without CO_2 constraint)	No	N/A	Facilitating
		Reference (without CO_2 constraint)	No	N/A	Challenging
		Transition to net-zero CO_2 in 2050	No	Fuller	Facilitating
		Transition to net-zero CO_2 in 2050	No	More Limited	Challenging
		Transition to net-zero CO_2 in 2050	Yes	Fuller	Facilitating
		Transition to net-zero CO_2 in 2050	Yes	More Limited	Challenging

For evaluating reductions for T&D and gas utility emissions, the required core scenarios include scenarios to evaluate the electricity and gas markets without and with power sector or economy-wide decarbonization transitions. These scenarios help T&D and gas utilities evaluate GHG reductions when there may or may not be electric sector or economy-wide decarbonization transitions. Both types of futures are part of the plausible transition space for T&D and gas utilities and therefore need to be evaluated. See Appendix B for illustrative T&D and gas utility examples using these scenarios.

Table 15 and Table 16 list the additional recommended scenarios for T&D and gas utilities respectively for more fully fleshing out the possible AT and QT transitions for all the combinations of uncertainties. The tables also note the possibility of optional sensitivity scenarios for exploring individual uncertainties of interest once the company has seen the other results.

Table 15. Additional recommended and optional sensitivity scenarios for evaluating reductions in T&D utility SF_6 and CO_2 emissions

Required, recommended, optional?	Target pathway type being evaluated	2050 targets for pathways	Electric sector transition	Economy-wide transition to net-zero in 2050	Decarbonization options	Other conditions
Additional recommended	Aspirational Targets (SF_6 & net CO_2 ATs and QT > ATs)	SF_6 52% & net CO_2 100%	Transition to net-zero CO_2 in 2050	No	Fuller	Challenging
			Transition to net-zero CO_2 in 2050	No	More Limited	Facilitating
			Transition to net-zero CO_2 in 2050	Yes	Fuller	Challenging
			Transition to net-zero CO_2 in 2050	Yes	More Limited	Facilitating
	Qualified Targets (SF_6 & net CO_2 QTs < ATs)	SF_6 A, B, C% & net CO_2 X, Y, Z%	Transition to net-zero CO_2 in 2050	No	Fuller	Challenging
			Transition to net-zero CO_2 in 2050	No	More Limited	Facilitating
			Transition to net-zero CO_2 in 2050	Yes	Fuller	Challenging
			Transition to net-zero CO_2 in 2050	Yes	More Limited	Facilitating
Optional sensitivities	At company discretion based on insights from other results					

Table 16. Additional recommended and optional sensitivity scenarios for evaluating reductions in gas utility CH_4 and CO_2 emissions

Required, recommended, optional?	Target pathway type being evaluated	2050 targets for pathways	Electric sector transition	Economy-wide transition to net-zero in 2050	Decarbonization options	Other conditions
Additional recommended	Aspirational Targets (CH_4 & net CO_2 ATs and QTs > ATs)	CH_4 47% & net CO_2 100%	Transition to net-zero CO_2 in 2050	No	Fuller	Challenging
			Transition to net-zero CO_2 in 2050	No	More Limited	Facilitating
			Transition to net-zero CO_2 in 2050	Yes	Fuller	Challenging
			Transition to net-zero CO_2 in 2050	Yes	More Limited	Facilitating
	Qualified Targets (CH_4 & net CO_2 QTs < ATs)	CH_4 A, B, C% & net CO_2 X, Y, Z%	Transition to net-zero CO_2 in 2050	No	Fuller	Challenging
			Transition to net-zero CO_2 in 2050	No	More Limited	Facilitating
			Transition to net-zero CO_2 in 2050	Yes	Fuller	Challenging
			Transition to net-zero CO_2 in 2050	Yes	More Limited	Facilitating
Optional sensitivities	At company discretion based on insights from other results					

Optional additional sensitivity scenarios

The required scenarios for electric supply, T&D, and gas utility emissions reductions will generate valuable insights regarding a wide range of potential future conditions and possible transitions for ATs and QTs; and, the additional recommended scenarios will flesh out the space of potential transitions further. A company may also want to evaluate additional possibilities between or beyond the required and recommended conditions. Targeted sensitivity scenarios can help a company more concretely characterize a risk or enabling condition. For instance, the company may want to evaluate a decarbonization options set between Fuller and More Limited, or other conditions between Facilitating and Challenging. This might simply entail switching one or two assumptions to define a new potential condition for evaluation. For instance, a company could evaluate a future with More Limited conditions but CDR available, or they might evaluate a future with the Challenging conditions but lower barriers for capacity and transmission additions.

Furthermore, a company might want to consider an "expected" set of conditions as a sensitivity to evaluate what they consider to be a most likely future condition. Caution is merited here from a communications point of view. This scenario should not be regarded as a forecast or risk management strategy and the company does not want to distract from the risk insights provided by the other futures that are, by design, teasing out the range of transition opportunities and risks. As such, the company will want to think carefully about how best to communicate an "expected" scenario to avoid misunderstandings.

At the end of Phase 2, the company should document their definitions of Fuller/More Limited and Facilitating/Challenging using the SMARTargets Reporting Template. The template lists the uncertainties that must be considered and some other common possibilities that the company can indicate as being included or excluded. It also provides space for additional possibilities to be added.

Phase 3: Implement scenario design – specify assumptions for scenario modeling

- *Phase inputs: The company's Phase 2 core scenario design for the required SMARTargets scenarios.*
- *Phase outputs: Specification of core scenario design for the company's modeling framework.*
- *Who should be involved: Staff related to planning, sustainability, policy, and strategy, as well as external experts on scenario analysis, modeling, and alternative assumptions.*
- *Stakeholder engagement: This is a good time to seek external stakeholder feedback.*
- *Documentation after iterations: SMARTargets Reporting Template entries summarizing the core scenario design specification.*

To evaluate the scenario design created in Phase 2, the company will now need to translate the alternative conditions into modeling assumptions. For instance, what specific decarbonization technology cost and performance specifications does the company want to include for the options in their Fuller and More Limited sets? Similarly, if the company is evaluating technology cost uncertainty, they will need to decide what specific alternative technology cost improvements over time they want to assume and for which technologies. If they are evaluating uncertainty regarding new infrastructure development, how do they want to specify less and more constrained conditions for adding new infrastructure? One option here would be to define two types of futures: one that allows new infrastructure based on costs, and another that does not allow new infrastructure at all. Alternatively, instead of precluding new infrastructure entirely, the second type of future could take a more nuanced approach and constrain annual future infrastructure additions informed by, but not necessarily limited to, historical rates of additions or increases in deployment costs.

Table 17 and Table 18 provide example specifications for the Fuller/More Limited and Facilitating/Challenging conditions for the scenario designs from Phase 2. Table 17 documents some possible sources for technology cost and performance assumptions. Other reputable sources could also be used (e.g., NREL, 2020). Table 18 documents illustrative specifications for the alternative assumptions for Facilitating and Challenging.

When making specification choices, it is important to keep in mind the overarching objective to identify risk and the scenario design logic of defining plausible extremes. Thus, the two specifications for an individual uncertainty should intentionally be extreme, but plausible, alternatives. It is also important to have grounded specifications with documentation of and justification for the choices. For instance, a company can use studies of future technology cost and performance to inform alternative technology improvement specifications; and, use historical information to ground projections for new infrastructure timing and levels, keeping in mind the need to be intentionally optimistic and pessimistic.

Defining emissions constraints: The company will also need to define the emissions constraint pathways they will be imposing on the model. These constraints will constrain the model to producing no more than the emissions reductions specified (though the model could produce emissions below the constraints, as we show in the examples in Appendix B). The model will identify the least-cost transitions and implications associated with achieving the required reductions in each of the alternative futures.[7] For evaluating the required ATs, we recommend piece-wise linear constraints between the target years. Specifically, we recommend using emissions constraints that are linear from today to the 2030 or 2035 intermediate target, linear from there to any other intermediate target, and then linear beyond that to the 2050 target. For evaluating the incremental reductions associated with identifying QTs, we recommend a set of piece-wise linear constraints that are incrementally below the ATs pathway (Table 6) but follow its shape and lead to the lower 2050 reduction levels.

The outputs from this phase are the specifications for each of the alternative scenarios in the modeling framework. The company will be ready to run their model at this point, which is Phase 4.

Finally, Phase 3 is a good time for external stakeholder feedback on the company's initial scenario design and specification. It is an opportunity to discuss the preliminary futures being considered as well as SMARTargets in general and the planned transition risk analysis.

At the end of Phase 3, the company should document their specifications for their Fuller and More Limited decarbonization options and their Facilitating and Challenging conditions in the SMARTargets Reporting Template.

[7] Note that, some models may be simulation models, instead of optimization models that find the cost-minimizing strategy. Simulation models identify emissions and cost outcomes for assumed transition portfolios. In this case, for futures and portfolios where the GHG targets are not met, the company would need to evaluate the implications of the additional abatement required to meet the targets.

Table 17. Illustrative summary of energy technology assumptions

Decarbonization technology cost and performance	Comment/description	Reference
Renewables (wind, solar, bio, hydro), nuclear, advanced nuclear, coal, coal w/ CCS, gas, gas w/ CCS, CDR (biopower w/ CCS, DAC), storage, hydrogen	Engineering-based cost and performance specifications with gradual improvement over time	EPRI (2022b)
Biomass carbon neutrality	Carbon neutral assumption based on analysis of net land use and GHG changes associated with increasing biomass supplies	Blanford et al (2022)
Other renewable fuels	Renewable liquid and gas fuels, including renewable gasoline, diesel, and jet fuel, renewable natural gas, and synthetic natural gas produce with renewable energy	Blanford et al (2022)
Low-carbon power imports	Low-carbon electricity can be exported to other regions via intra-regional transmission	EPRI (2023)
Fossil capacity reserves permitted (within emissions constraint)	Fossil generation capacity can be used to meet capacity reserve requirements but declining emissions constraints over time apply to any generation from that capacity	EPRI (2022b)
Demand conservation and energy efficiency	End-use sectors can reduce emissions through technology and fuel substitution that increases efficiency, as well as reductions in overall use	Blanford et al (2022)

Table 18. Illustrative specifications for Facilitating and Challenging other condition assumptions

Other conditions	Facilitating	Challenging
Electricity load growth	Reference = load growth due to reference economic and population growth assumptions and electrification due to electric technology relative cost improvements	Faster = reference load growth conditions plus additional data center load growth based on recent trends resulting in 12% greater total load by 2030 (EPRI, 2024)
Electricity generation cost improvements	Faster = default cost projections and reference learning curve for battery cost improvements over time	Slower = higher cost projections by technology and slower learning curve for battery cost improvements over time
Electricity capacity additions	Economic = allows for all economically viable electric capacity to be built	Constrained = limits the building of economically viable electric capacity to historical build rates
Electricity transmission additions	Economic = allows for all economically viable interregional transmission to be built	Constrained = limits the building of economically viable interregional transmission based on historical transmission build rates
Fossil fuel prices*	Lower = No additional supply costs for fossil fuel production beyond the equilibrium cost determined by the energy economy model's balance of supply and demand for each fuel	Higher = Additional supply costs added to fossil fuel production modeling low resource availability or pipeline expansion
Electric technology cost improvements	Faster = Default cost reductions in EV & heat pump components, faster EV adoption reflective of less range anxiety and greater availability of new electric technologies	Slower = Higher component costs for EV & heat pumps, slower EV adoption representative of more range anxiety and less availability of new electric technologies

* The fossil fuel price assumptions in the table reflect the US-REGEN modeling structure. Other economy-wide frameworks might have fixed assumed (i.e., exogenous) energy prices. For instance, they might be based on lower/higher U.S. Department of Energy Annual Energy Outlook fuel price projections.

Phase 4: Identify potential transitions and target implications

- *Phase inputs: Phase 3 specification of core scenario design for implementation in the company's modeling framework.*
- *Phase outputs: Preliminary transition analysis pathways and insights.*
- *Who should be involved: Staff and external experts running the model and processing outputs.*
- *Documentation: None. This is an intermediate phase. Phase 7 documents the final modeling results and insights once iterations are complete.*

This phase creates preliminary transition results, running the company's modeling framework with the scenario specification implementation and generating initial potential transition pathway model results. The modeling provides information regarding the alternative potential transitions, implications, trade-offs, risks, enabling conditions, robust strategies, contingencies, and more. As the company attempts to run each of the scenarios in the design, they may have to revise their scenario specification implementation if the model is not solving or it is producing strange or unintuitive results.

In addition to running the scenarios, the company will want to develop preliminary graphics—figures and tables—and identify preliminary insights for review. In particular, the company will want to evaluate differences and similarities in transition results between scenarios. For instance, utilities would likely be interested in the alternative potential transitions for, among other things, electricity capacity and generation mixes, electricity demand, gas consumption and composition, power transmission, emissions, costs, and prices.

A sample of the types of results that can be produced with the core scenarios (Table 10) are provided in the figures and table below. They illustrate potential transitions for electricity generation and load, electricity generation capacity, new capacity investments and retirements, gas consumption, and power sector emissions respectively for a U.S. Midwestern region. They also provide examples of transition uncertainty ranges as well as riskier outcomes for this region. For instance, Figure 10, Figure 11, and Figure 12 illustrate the possibility of very different plausible electricity generation, capacity, and demand (load) transitions due to the different conditions—sector versus economy-wide decarbonization, decarbonization options, and the other conditions.

Figures like Figure 10, Figure 11, and Figure 12 and also help identify robust strategies and investment and operations uncertainty. For instance, load increases, wind, solar, nuclear, and storage are key features in all four AT decarbonization transitions, as well as reference futures. As such, they would be robust strategies. Figure 12, in particular, illustrates that additions of wind, solar, and storage are consistent elements of all four decarbonized futures, as is retirements of coal. However, we also see in Figure 12 notable variation in the additions by 2035 and 2050, especially for solar, storage, and wind; and, mixed results for addition and retirement opportunities for gas, nuclear, and hydrogen, with only some conditions conducive to those investments. Overall, the cumulative capacity changes associated with all four futures are substantial but with large variation. By 2035, we find additions of approximately 100 to 195 GW and retirements of approximately 30 to 40 GW. By 2050, the additions and retirements are approximately 2080 to 380 GW and 65 to 80 GW respectively. For comparison, in 2024, there was 60 GW of new capacity additions planned across the entire U.S., and 7.5 GW of capacity retirements planned (EIA, 2024). The reference futures alone suggest a good deal of cost-effective additions and retirements, with gas, wind, and hydrogen the primary capacity additions and coal the primary retired capacity (Figure 12). Note that fossil related resources are providing notable generation and/or capacity to 2050 in all the net-zero decarbonization futures, with the role and the magnitude varying with the different conditions. Figure 13 illustrates transition uncertainty that may exist for gas markets. We observe the possibility of increasing or decreasing gas consumption, with natural gas still being consumed across the economy in 2050 in all the transitions. The key uncertainty for the gas market is whether there is an economy-wide, an electric sector, or no decarbonization transition. We also see that in the economy-wide decarbonization futures, the gas market in 2050 is largest with Fuller decarbonization options and Facilitating conditions (versus More Limited and Challenging conditions). This is primarily due to the availability of CDR and the lower price of gas in the Fuller-Facilitating future.

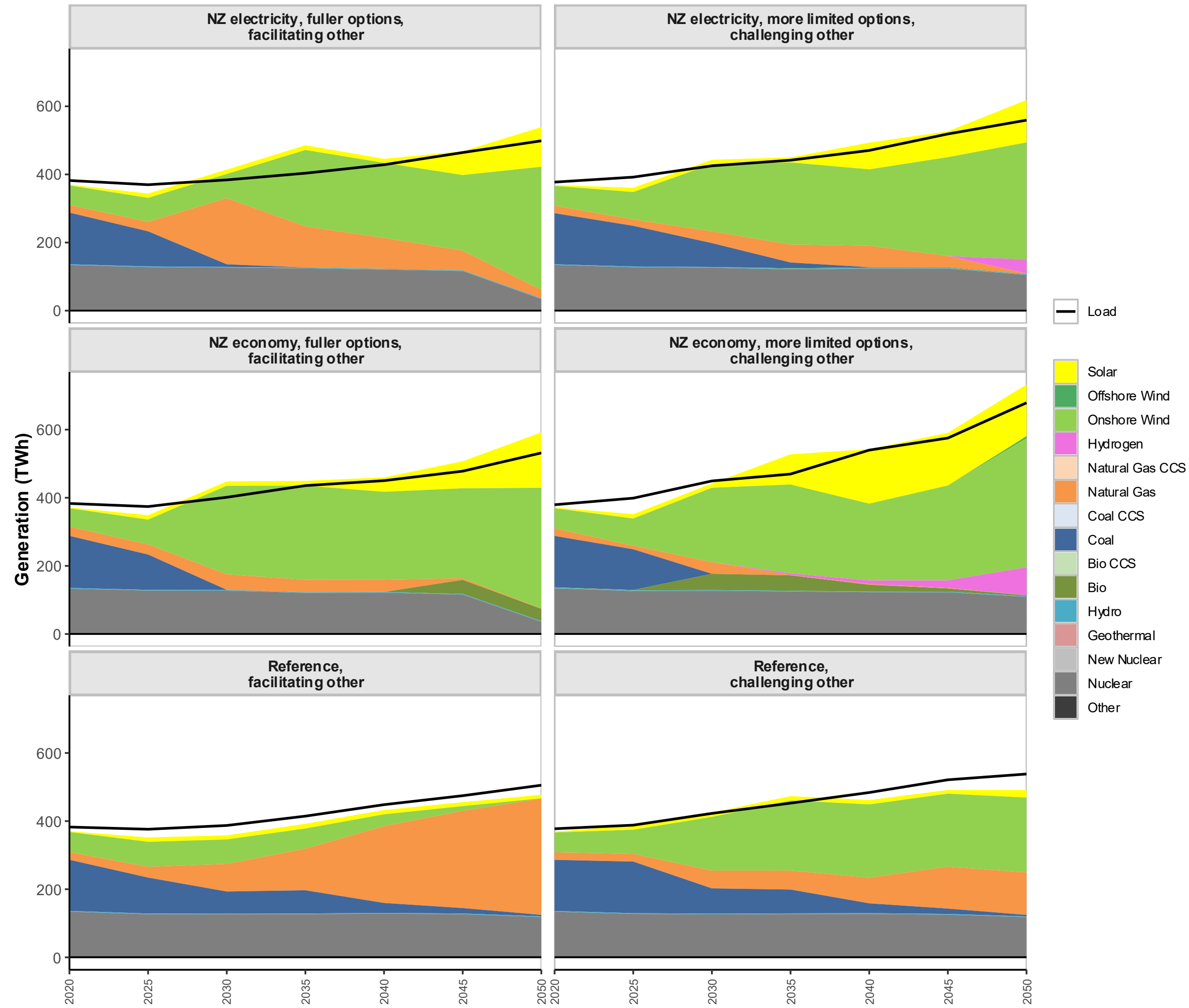

Figure 10. Illustrative regional electricity generation and load transitions for the required electricity supply emissions Aspirational Target scenarios

Figure note: Illustrative results for a Midwest region of the U.S. and for the illustrative scenario design and specification. Results will vary by region of the world and scenario design and specification. Top row results associated with net-zero CO_2 by 2050 power sector transitions with Fuller and More Limited decarbonization options available and Facilitating and Challenging market and technology conditions. Middle row results associated with net-zero CO_2 by 2050 economy-wide transitions with Fuller and More Limited decarbonization options available and Facilitating and Challenging market and technology conditions. Bottom row results associated with reference economy-wide transitions with Facilitating and Challenging market and technology conditions. Natural gas includes a mix of renewable and synthetic natural gas, and dual fuel capacity includes capacity using mixes of fossil and renewable fuels (gas and liquid).

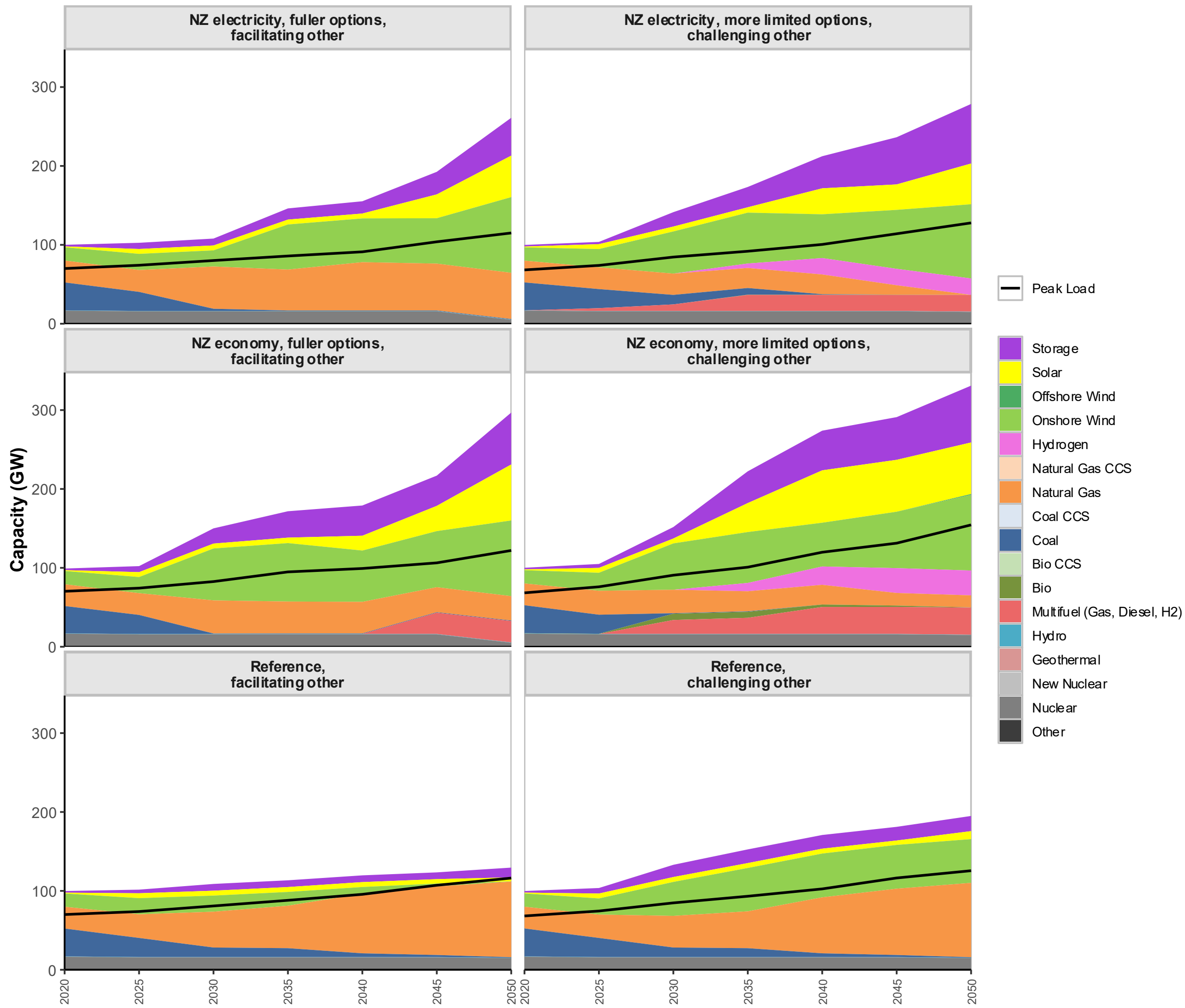

Figure 11. Illustrative regional electricity generation capacity transitions for the required electricity supply emissions Aspirational Target scenarios

Figure note: Figure 11 note.

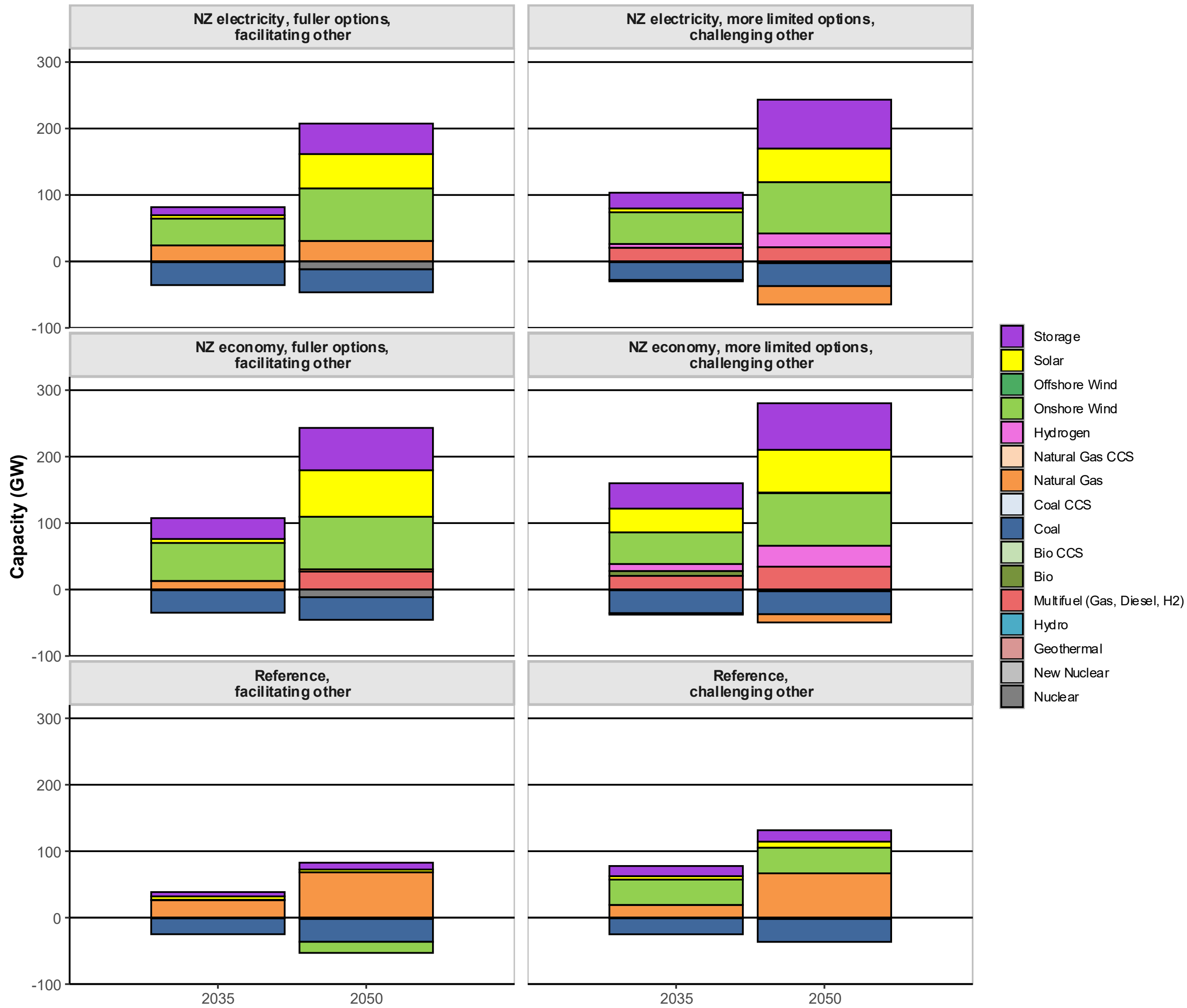

Figure 12. Illustrative regional electricity generation capacity cumulative additions and retirements by 2035 and 2050 for the required electricity supply emissions Aspirational Target scenarios

Figure note: Cumulative capacity additions and retirements are positive and negative respectively. Illustrative results for a Midwest region of the U.S. and for the illustrative scenario design and specification. Results will vary by region of the world and scenario design and specification. Natural gas includes a mix of renewable and synthetic natural gas, and dual fuel capacity includes capacity using mixes of fossil and renewable fuels (gas and liquid).

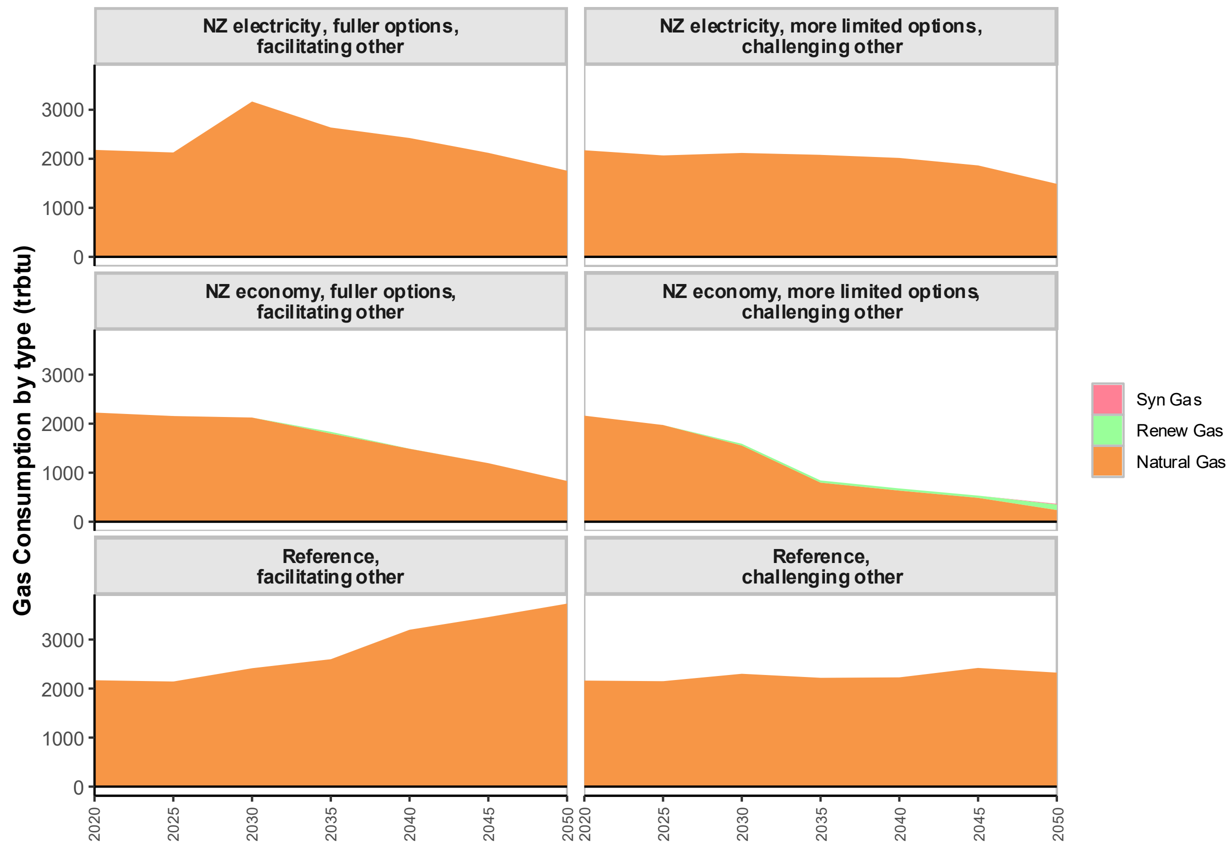

Figure 13. Illustrative regional gas consumption transitions for required gas utility emissions Aspirational Target scenarios

Figure note: Illustrative results for a Midwest region of the U.S. and for the illustrative scenario design and specification. Results will vary by region of the world and scenario design and specification.

Figure 14 illustrates how the power sector decarbonization transition could be much quicker when there is an economy-wide versus power sector only decarbonization incentive. This is an example of an enabling condition and is an important result discussed more in Appendix B. It is also an example of QTs with reductions greater than the ATs. In this context, the economy-wide constraint on emissions requires decarbonization of the end-use sectors as well, such as transportation, buildings, and industry. Forcing decarbonization of end-use activities creates incentives to use low-carbon options, including low-carbon electricity, which incentivizes faster adoption of low-carbon generation capacity in the power sector (Figure 12) and faster reductions in power sector emissions (Figure 14). As reflected in the load results in Figure 11, the economy-wide end-use decarbonization pressure is creating a market for low-carbon electricity and that demand is financially supporting faster decarbonization of the power sector.

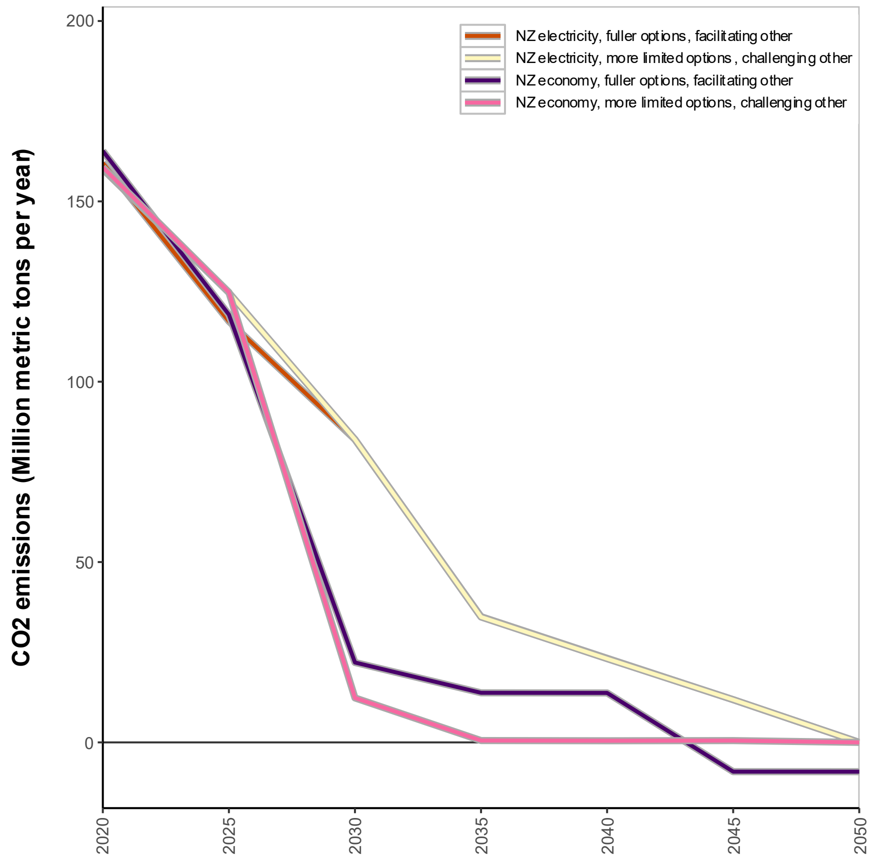

Figure 14. Illustrative regional power sector net CO_2 emissions transitions for the required electricity supply emissions Aspirational Target scenarios

Figure note: Illustrative results for a Midwest region of the U.S. and for the illustrative scenario design and specification. Results will vary by region of the world and scenario design and specification.

Figure 15 provides an example of an incremental implications result from the QT (< AT) scenarios. The incremental reduction scenarios help inform identification of the QTs possible under different conditions, especially when enabling conditions are unavailable. In this case, Figure 15 presents incremental discounted gross electric sector costs through 2035 and 2050 for increasing levels of 2050 power sector emissions reduction ambition (30%, 50%, 80%, and 100%). The 100% results come from the required AT scenarios. Figure 15, we see, in general, increasing discounted costs with larger emissions reductions due to greater generation capacity and transmission additions, O&M costs and power imports. We also see the impact of the Facilitating versus Challenging conditions, where the former is resulting in substantially lower costs of 22-33% and 21-30% by 2035 and 2050 respectively due to the Facilitating environment's lower load growth, lower technology and fuel costs, and reduced barriers for new infrastructure additions.

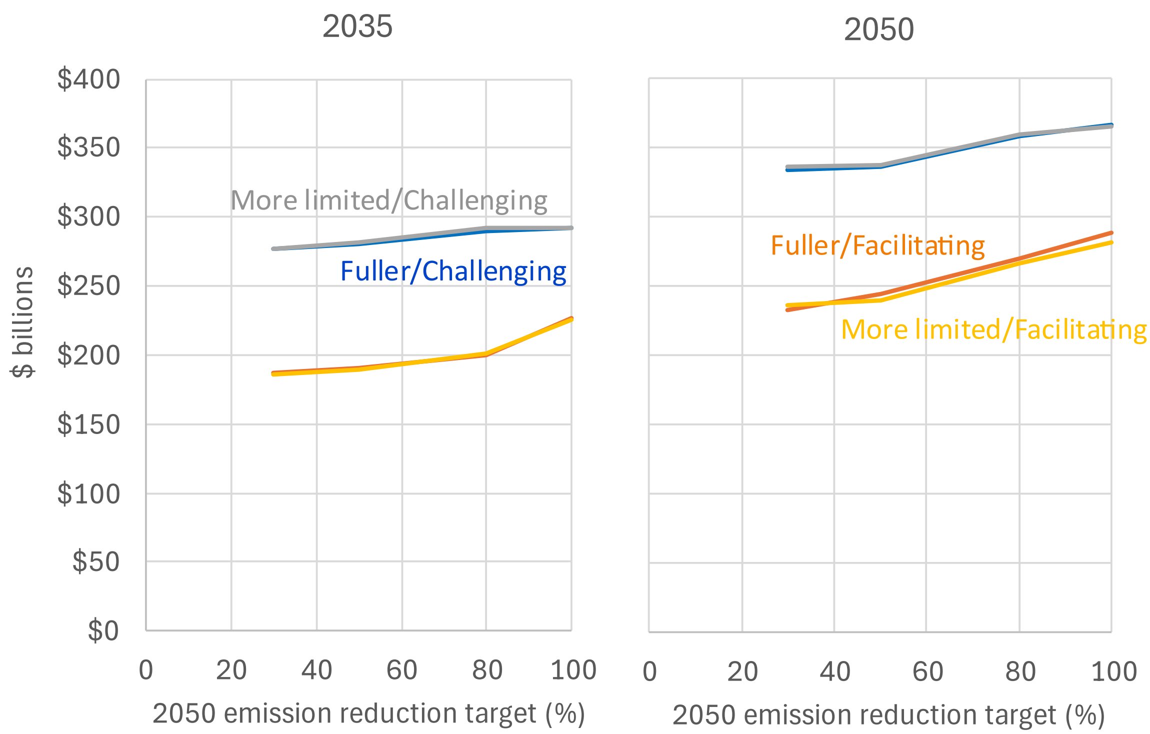

Figure 15. Illustrative regional incremental discounted gross electric sector costs through 2035 and 2050 for the increasing levels of potential 2050 emissions reduction levels

Figure note: Illustrative results for a Midwest region of the U.S. and for the illustrative scenario design and specification. Results will vary by region of the world and scenario design and specification. Gross costs include all fuel, investment, transmission, operations and maintenance, CO_2 pipeline and storage, and power imports costs. Power export revenues not included.

Finally, Table 19 illustrates the type of transition uncertainty insights that can be produced looking across the scenarios, as well as across variables relevant to different priorities that are important to near-term and long-term decisions—affordability, system flexibility and reliability, and sustainability. The ranges help communicate the uncertainty, where wider ranges represent greater uncertainty.

The table also helps identify risky outcomes. For example, there is the possibility of near-term (2035) electricity price increases of almost 370%, with investments of almost $300 billion and electricity capacity additions of over 100 GWs. In these illustrative results, all the scenarios are producing significant price increases and costs; thus, net-zero is going to be challenging regardless of the conditions. Looking at the individual scenarios behind Table 19, we can also identify the specific conditions contributing to the more and less risky outcomes (see Appendix B for these results). Depending on a company's needs, other metrics and outputs could also be produced, such as individual technology transitions, load growth details, or air pollutant emissions.

The set of figures and tables also provide milestone and contingency insights. For instance, the results suggest the need to evaluate which future is emerging in a few years to determine if the strategy needs to be adjusted. If, for example, the decarbonization options available are turning out to look more like the More Limited set, instead of Fuller, the company, in order to stay on track for their emissions targets, may want to consider alternative strategies for gas, solar, wind, storage, and hydrogen, as well as possibly slowing coal retirements if annual additions of renewables are likely to be constrained. Furthermore, those strategies will depend on whether sector or economy-wide decarbonization incentives are emerging, which is another milestone development the company can monitor. In general, milestones defined in terms of the Fuller/More Limited decarbonization options, the Facilitating/Challenging condition sets, and the state of sector and economy-wide low-carbon transitions, can be used to guide company timing for when to re-evaluate their low-carbon strategy and how they might respond.

Results like those in Table 19 also facilitate more nuanced discussion of risk. For example, utility regulators may not allow recovery of some of the decarbonization costs shown in Table 19, which represents an important consideration and risk. Alternatively, large electricity customers might be willing to pay for low-carbon power, which would help manage the cost risk. It is important to keep in mind that revenues from increased electricity demand in the economy-wide scenarios is not shown; however, those revenues are supporting increased electric sector low-carbon investments and a more rapid decarbonization of the power sector.

Overall, the set of results from Phase 4 shed light on the opportunities, challenges, and enabling conditions for ATs and QTs. See Appendix B for full implementation examples of the methodology and types of insights.

Phase 5: Review potential transitions and target implications – based on decision-making needs

- *Phase inputs: Phase 4 preliminary transition analysis pathways and insights.*
- *Phase outputs:*
    1. *Preliminary insights regarding potential transitions, targets, and risks,*
    2. *Revisions to core scenario design, model implementation, and output reporting, and*
    3. *Additional recommended and sensitivity scenarios and specifications the company would like to evaluate.*
- *Who should be involved: Company decision-makers (e.g., directors, executives), staff related to planning, policy, sustainability, risk management, strategy, and outreach, as well as any external experts on scenario analysis and modeling with which you are collaborating.*
- *Documentation: None. This is an intermediate phase. Phase 7 documents the final modeling results and insights once iterations are complete.*

This phase consists of critical engagement with the company's decision-makers and their business units to review the preliminary transition analysis results and insights. This phase takes the transition pathway results and insights from Phase 4 as inputs and evaluates them in terms of decision-making needs and considerations. Effective presentation and discussion of the results are important. The phase has two key outputs: agreement on preliminary insights regarding potential transitions, targets, and risks; and, identification of needed revisions to the scenario design, model implementation, and output reporting. In addition to identifying revisions to the core scenario design, this phase also helps identify ideas for additional scenarios.

Table 19. Illustrative regional cross-scenario results ranges for multiple variables for the required electricity supply emissions Aspirational Target scenarios

Table note: Illustrative results for a Midwest region of the U.S. and for the illustrative scenario design and specification. Results will vary by region of the world and scenario design and specification.

	Affordability			**Stability**					**Optionality**	**Sustainability**			
	Change in Wholesale Electricity Price	Electric Sector Costs		Total New Generation Builds	Total Generation Retirements	Net Power Imports	Variable Renewable Generation	Electric Load Growth	Dispatchable Resources	CO_2 Emissions Reductions		CO_2 Emissions Intensity	In-State Clean Electricity
	% Change vs 2020	$ Billions NPV		GW from 2020	GW from 2020	% of Load	% of Total MWh	% Change vs. 2020	% of Total Capacity	% Change from 2020		% reduction in tCO_2/MWh from 2020	% of MWh
		Total	Capital							Electric	Economy		
Ranges for 2035	+109% to +373%	212 to 305	29 to 72	103 to 196	33 to 41	-23% to -3%	50% to 73%	6% to 24%	47% to 56%	78% to 100%	46% to 95%	79% to 100%	75% to 100%
Ranges for 2050	+21% to +50%	263 to 376	64 to 113	277 to 379	63 to 78	-6% to -2%	74% to 94%	30% to 79%	38% to 45%	100% to 100%	72% to 114%	100% to 104%	95% to 100%

Given our need to identify enabling conditions, this is the time to think about challenges, trade-offs, risks, and risk management. Are there transition outcomes that the company considers risky and future conditions associated with them that the company would like to avoid? Similarly, are there conditions that allow the company to achieve a target and balance the trade-offs? This phase is also the time to consider the likelihoods of the different futures and potential hedging strategies. If, for instance, the company believes that the likelihood of an economy-wide policy is low, they might invest less in new low-carbon electricity capacity since the demand for the clean electricity is uncertain.

In the Phase 4 illustrative results above, we find the following challenges, trade-offs, risks, and risk management strategy insights:

- *Challenges and trade-offs:* The ATs are being met (or more) in all the transitions, but in each transition, we also observe challenges with affordability and reliability implications, investment implications in capacity build results, and sustainability implications with a range of emissions reductions by 2035.
- *Risks:* The set of results highlight that all three categories of uncertainties create risk for this location, with large variation in the transitions and implications for futures achieving the ATs. Thus, uncertainty regarding the decarbonization incentive (sector versus economy-wide), decarbonization options (Fuller versus More Limited), and other conditions (Facilitating and Challenging) are all important considerations contributing to uncertainty in the transitions, with some more difficult to manage in terms of trade-offs in prices, costs, load growth, generation and capacity resource choices, traded power, and emissions transitions.
- *Risk management strategies:* Looking across the scenarios, we can identify enabling conditions that allow for transitions with more manageable trade-offs. From careful comparison of scenarios that differ in only one category of uncertainty, we find that encouraging an economy-wide policy with end-use decarbonization incentives would facilitate faster low-carbon generation investments and emissions reductions in the electric sector. We also find that costs are lower when there are the Facilitating (versus Challenging) conditions. Therefore, strategies that accelerate technology cost improvements, reduce capacity additions barriers, or lower fuel costs will be helpful. The lower costs shown in the results help justify pursuing and collaborating on strategies like these. Finally, we find that having Fuller decarbonization options (versus More Limited) has mixed effects on costs. In the power sector only decarbonization transitions the differences are modest, which only highlights the importance of modeling and evaluating how the economics might change. However, having Fuller options is found to help reduce the decarbonization challenge in the economy-wide decarbonization transitions for this region.

As discussed in the overview, and evaluated in the next step (Step 5), companies should keep in mind that Paris Alignment of their transition strategy will be assessed qualitatively relative to the robust transition insights from global emissions pathways and the strategies associated with achieving the Paris Agreement. The company's transition analysis results will be assessed for consistency with these Paris Agreement aligned transition characteristics. The illustrative Phase 4 sample results above, for instance, are qualitatively aligned in that they exhibit increasing reliance on electricity, decreasing reliance on fossil fuels, increasing deployment of low-carbon technologies, and the use of carbon dioxide removal and energy conservation and efficiency (last two not shown). In addition, the transitions and insights align with Paris Agreement recognition of differences in country decarbonization opportunities, multiple societal priorities, and the value of cooperation (in this case across sectors via the economy-wide scenarios).

After developing the preliminary insights, the company will then identify whether revisions are needed to the scenario design, model implementation, and/or output reporting. This conversation should include discussion of whether to run additional scenarios—the recommended additional scenarios above or custom sensitivity scenarios. See the Phase 6 discussion for sensitivity scenario examples.

Phase 6: Revise and iterate as needed – revising scenario design, implementation, and model results

- *Phase inputs:*
    1. *Phase 5 revisions to core scenario design, model implementation, and output reporting, and*
    2. *Phase 5 sensitivity scenarios and specifications the company would like to evaluate.*
- *Phase outputs:*
    1. *Revised insights regarding potential transitions, targets, and risks, and*
    2. *As needed, additional revisions to scenario design, model implementation, and transition pathways.*
- *Who should be involved: Staff related to planning, policy, sustainability, risk management, strategy, and outreach, as well as any external experts on scenario analysis and modeling with which you are collaborating.*
- *Stakeholder engagement: This is a good time to seek external stakeholder feedback.*
- *Documentation: None. This is an intermediate phase. Phase 7 documents the final modeling results and insights once iterations are complete.*

Iterate as needed to finalize the transition and target results and insights. This entails repeating Phases 2 through 5 until comfortable with the results information and insights. Thus, the company should revise the core scenario design and implementation, add and revise sensitivity scenarios as appropriate, re-run the model with a revised scenario design and implementation, and review results as necessary. For instance, upon reviewing draft results, the company might revise the scenario design to add a technology to their initial Fuller decarbonization options set (such as agriculture or forestry GHG offsets), remove a technology from the More Limited decarbonization options set, or relax annual new build rate constraints a bit in the Challenging conditions. The company might also wish to run the additional recommended scenarios or sensitivity scenario or explore additional modeling outputs. For example, in the case of sensitivity scenarios, the company might wish to evaluate the benefits of having CDR available in the More Limited and Challenging conditions or, in the case of additional outputs, the company might want to evaluate end-use energy consumption transition details regarding potential transitions in technology adoption and fuel use.

Finally, Phase 6 is another good time for external stakeholder feedback. At this point, after the company's internal iterations, they will have final drafts of their scenario design, results, insights, and strategies to share and discuss. It is an opportunity for education, dialogue, and feedback on the company's potential transitions, challenges, uncertainties, risks, enabling conditions, risk management, and collaboration opportunities.

Phase 7: Communicate results – targets, transitions, risks, enabling conditions, risk management

- *Phase inputs:*

1. *Phase 6 final scenario design (core and additional scenarios), model implementation, and transition pathways, and*
2. *Phase 6 final insights regarding potential transitions, targets, risks, enabling conditions, and risk management.*

- *Phase outputs:*
  1. *Documented scenario analysis, outputs, and insights,*
  2. *Aspirational Targets (ATs), strategies, and risk management, and*
  3. *Qualified Targets and their qualifying conditions (QTs) and strategies.*
- *Who should be involved: The company's decision-makers (e.g., directors, executives), staff related to planning, policy, sustainability, risk management, strategy, and outreach, as well as any external experts on scenario analysis and modeling with which you are collaborating.*
- *Documentation: SMARTargets Reporting Template summarizing the following:*
  1. *The company's ATs and QTs with corresponding conditions,*
  2. *The company's enabling conditions, strategy, risks, and risk management,*
  3. *The company's transition risk analysis (modeling, scenario design and specification, potential transitions, insights), and*
  4. *The implementation process.*

This phase is focused on documenting all of Step 4 for transparency, communications, and validation. The scenario analysis provides a wealth of information that can educate readers on uncertainties, potential futures, opportunities, enabling conditions, and risks, as well as opportunities for collaboration on enabling conditions. This phase also provides justification and transparency for the company's GHG targets, strategies, and risk management.

At the end of Phase 7, the company should use the SMARTargets Reporting Template to finalize the documentation for their Step 4 transition risk analysis (Phases 1 through 7). This includes the summary tables of key output indicators, as well as graphics to help communicate the company's modeling results and insights. Additionally, the company should report the identified enabling conditions for ATs, QTs and corresponding conditions, and the risks and opportunities identified. Finally, the company should indicate their risk management strategies along with their milestones and contingency plans.

Required Outputs

Step 4 has a minimum set of required outputs. Table 20 lists the required outputs related to electric power, gas, and transmission and distribution utility emissions transitions. Additional variables may be added based on company need (e.g., air pollutant emissions, differentiated affordability indicators). Together, the variables in Table 19 provide useful insights related to:

- Transition possibilities,
- Transition uncertainties and risks,
- Transition trade-offs between objectives,
- Robust strategies identified from findings found consistently across transitions,
- Enabling conditions that facilitate outcomes and help manage trade-offs and risks,
- Contingency strategies for responding if different futures emerge, and
- Risk management strategies to reduce the likelihood of riskier outcomes.

Not only are the outputs of transition risk analysis helpful to internal decisions, but they provide valuable material for educating, engaging, and communicating externally, including communicating on enabling conditions that facilitate coordination and collaboration.

Table 20. Required outputs from electric power, gas, and T&D utility transition risk analyses

Table note: The full set of variables and metrics from a specific analysis can vary with decision-maker needs and modeling capabilities.

Electric utility	Gas utility	Transmissions & distribution utility
Affordability		
Electricity prices	Gas prices	Electricity prices and/or T&D rates
Costs	Costs	Costs
Investments	Investments	Investments
System Operation, Flexibility, and Reliability		
Generation levels and mix	Gas consumption (total & by fuel type)	Electricity demand, i.e., load (aggregated, disaggregated)
Generation capacity additions, retirements, and resource mix	Gas consumption (total & by consumption type)	Transmission and distribution flows
Electricity transmission utilization and capacity additions		Inter-regional imported and exported power
Electricity demand, i.e., load (aggregated, disaggregated)		Transmission and distribution capacity expansion
Fuel use		
Sustainability		
GHG emissions	GHG emissions	GHG emissions

Step 5: Strategy and Qualified Target Alignment with International Goals

Step 5 Outputs: International goal alignment assessments of qualified targets and strategies.

In this step, a company will evaluate two types of *qualitative* alignment of their transition strategy. The company will also evaluate *quantitative* alignment of their QTs with the international goals.

Assessing qualitative alignment of the company's transition strategy

SMARTargets requires that companies qualitatively align their low-carbon strategies with (a) the types of transitions robustly observed in global emissions pathways consistent with the Paris Agreement temperature goals, and (b) the provisions in the Paris Agreement associated with achieving the temperature goals.

While quantitative energy and economic transition results vary significantly across global emissions pathway models and assumptions (IPCC, IEA, PRI, etc.), they all consistently produce the same set of qualitative low-carbon transition insights (EPRI, forthcoming; EPRI, 2020). These robust characteristics of transitions reliably inform company thinking and strategy, as well as stakeholder expectations. Below is a list of robust insights from global 1.5°C and 2°C emissions transitions. Across models and assumptions, we consistently find:

- Increasing low-carbon technology deployments,
- Increasing reliance on electricity,
- Transitions away from fossil fuels but continued use,
- Use of carbon dioxide removal,
- Improvements in energy conservation and efficiency,
- Differences in regional low-carbon transitions, and
- For any climate goal, substantial uncertainty in the levels, rates of change, and composition (e.g., technologies, energy, activity) of the transition of the global economy.

Furthermore, a company's strategy should qualitatively align with the Paris Agreement's provisions. Paris Agreement provisions, other than the temperature goal, represent important insights and international agreement regarding how to move forward with pursuing the temperature goal. Provisions like recognizing country differences in decarbonization opportunities, multiple societal priorities, and the value of cooperation are as relevant to companies throughout the world, just as they are to countries, in their supporting pursuit of the temperature objectives.

While the opportunities for company decarbonization vary from company to company, the types of robust transitions noted above and the strategies recognized by the Paris Agreement are reliable and aligned guides for company low-carbon strategies. The list above represents a partial list of strategy categories for each company. A company can use the list, along with their Step 4 transition analysis, to guide their strategic discussions to develop specific Paris Agreement aligned strategies for pursuing their targets.

Assessing alignment of the company's Qualified Targets

SMARTargets also requires that companies assess quantitative alignment of their QTs. The assessment is based on comparison to the global emissions pathway ranges consistent with the Paris Agreement primary objective of limiting warming to "well-below" 2°C. Comparing to the relevant total CO_2, non-CO_2, or CO_2e global percent reduction emissions pathway ranges aligned with limiting warming to well-below 2°C provides useful high-level insights regarding the consistency of the QTs with pursuing the Paris Agreement temperature goals (Figure 7 and Table 6). For example, a net CO_2 QT of -40% in 2030 would be considered aligned with the Paris Agreement since it falls within the 2030 range of +10% to -100% consistent with limiting global warming to well-below 2C as defined by the IPCC, which includes both 1.5°C and 2°C (with 67% likelihood) global emissions pathways (see Scientific Foundations). While -40% is less ambitious than the 2030 AT of -56%, it is consistent with global pathways aligned with containing global warming to well-below 2°C.

The high-level insight from this comparison is that QTs within the ranges are aligned with global futures consistent with limiting warming to well-below 2°C. Furthermore, if all companies have QTs within the range, the sum will also be aligned with well-below 2°C. However, it is critical to keep in mind that this comparison is not conclusive. Comparing to the global pathway range is not a conclusive assessment of company alignment, first and foremost, because the global pathways do not capture the transition opportunities and challenges for individual companies, or differences across companies. In addition, the global pathway ranges do not reflect all the sub-global and local transitions found to be aligned with a global temperature (see Scientific Foundations). For example, broad ranges of US, EU, and China electric sector transitions are found to be consistent with a single global emissions pathway. Furthermore, in well-below 2°C global pathways emissions for some regions can be rising while they are falling for others due to differences in energy demand, population growth, and other drivers. Thus, QTs for some companies may not fall within the global pathway ranges due to their transition challenges. That should not be interpreted negatively. It is simply an indication of their challenges. It is important to keep in mind that the key virtue of, and information gleaned from, the QTs is that they are the highest possible ambition for a company under different conditions while balancing trade-offs and risks. Some companies may face particularly challenging circumstances, such as in developing countries. The Step 4 transition risk analysis will help them identify and communicate their challenges, which will be valuable information for the company and their stakeholders. The QTs represent actionable and substantive contributions to the Paris Agreement goals with additional ambition possible if enabling conditions can be put in place. Policymaker and stakeholder cooperation and coordination to create enabling conditions are especially valuable in these cases.

Alignment with national goals

Some companies might want to speak to their countries NDC emissions goals as well. The company can simply note the emission goal in percent reduction terms and timing relative to the global total emissions pathways and the company's targets and company low-carbon transition pathways. Visually, the company could overlay the NDC emission goal onto a chart with the relevant global percent reduction pathway range (see illustrative examples in Appendix B). The company can also explain how they see their targets contributing to the national pledge. Comparing to sectoral national goals, however, is not recommended since it can be misleading. As discussed, a company can cost-effectively differ substantially from a sectoral aggregate and from other companies due to their unique opportunities. Furthermore, what is practical for the company will be a function of the specific policy incentives for the sector, as well as other sectors. Finally, if there are sectoral policies regulating emissions, they should be considered within the context of Step 2 where the impact of regulated emissions on target setting is explicitly addressed.

Step 6: Documentation and Communication

Step 6 Output: SMARTargets documentation.

In this step, a company will document and communicate their SMARTargets. Using the SMARTargets Reporting Template, a company will document their implementation of the SMARTargets Methodology. This includes documenting implementation choices with justification, transition analysis insights, targets, strategy, and milestones.

The SMARTargets Methodology provides a scientifically grounded, transparent, consistent, and comparable process and outputs that provide users and stakeholders with confidence in the approach, results, and insights, as well as the resulting company's targets and strategy. The methodology itself is a scientifically derived, standardized, systematic, in-depth process that each company implements and that creates the standardized, comparable information needed to inform stakeholders and validation activities.

Communicating SMARTargets involves presenting a clear and comprehensive package of information about both the process and the outcomes. The SMARTargets Reporting Template helps document a company's implementation of each step of the methodology—naturally guiding the creation of a standardized set of information.

The SMARTargets reporting template consists of a series of structured tables designed to help companies systematically document their implementation of the eight steps of the SMARTargets methodology. By completing these tables, companies will generate standardized outputs that enhance transparency, support effective communication, and enable stakeholders to more easily assess the credibility and alignment of their targets and transition strategies. Each table corresponds to a specific aspect of the implementation process, guiding users through data collection, analysis, and alignment. Specifically, the SMARTargets Reporting Template includes the following sections of information (see Reporting Template for details):

- General Company Information and Stakeholder Engagement
- GHG Inventories and base year
- Practical issues and climate target groupings
- Company Transition Risk Analysis of Opportunities and Risks
- Alignment Assessment
- Documentation and Communication of Targets, Strategies and Indicators
- Implementation and Monitoring

Overall, in applying the methodology, a company will produce the following standardized and comparable information that reflects their process and opportunities:

a. Paris Agreement-aligned targets and enabling conditions, including Aspirational Targets (AT) and Qualified Targets (QT) and their associated conditions,
b. Insights into potential low-carbon transitions,
c. Assessment of risks, risk management strategies, and overall transition strategy, and
d. Documentation of methodology implementation, including:
    - GHG inventory by required emissions category,
    - Responses to practical considerations and target-setting decisions for each category,
    - Transition risk analysis components:
        - Modeling approach
        - Reference conditions and key uncertainties
        - Core scenario definitions and specifications
        - Criteria for identifying risks and enabling conditions

A company is encouraged to holistically communicate their strategy. This goes beyond emissions targets and may include the following that together can help create the enabling conditions identified by the company for achieving their targets, increasing ambition, and supporting economy-wide decarbonization: transition plans, research and development (R&D), educational outreach (stakeholder and policy), and collaboration and coordination with customers and supply chain partners.

Implementing SMARTargets creates tremendous leadership opportunities for a company, including educational opportunities to inform and elevate conversation, such as on the science and issues relevant to corporate low-carbon transitions and sound decision-making, and the company's specific decarbonization opportunities, risks, and enabling conditions. The leadership opportunities also include facilitating cost-effective economy-wide decarbonization. For instance, launching a decarbonization initiative with customers and communities for achieving economy-wide decarbonization that is grounded in the Step 4 analysis of transition opportunities, risks, and enablers.

In addition to the standardized outputs, a company should consider communicating on the SMARTargets Methodology itself, including its scientific foundations. This can involve referencing the publicly available methodology, the SMARTargets Scientific Foundations, and other materials and emphasizing how the approach is science-based and aligned with the Paris Agreement (see Justification for the Methodology section).

Step 7: Validation and Verification

Step 7 Outputs: Validated SMARTargets and verified progress.

In this step, a company will validate their SMARTargets and verify their progress. After completing the SMARTargets Reporting Template in Step 6, a company will be able to initiate validation activities. Validation assesses whether the methodology has been properly implemented and whether the target and strategy—by nature forward-looking statements—are supported by sound assumptions, data, and methods. The primary input for validation is the SMARTargets Reporting Template, which documents each step of the methodology's implementation.

SMARTargets facilitates internal and third-party validation according to international best practices for validation and verification procedures based on the principles of impartiality, independence, and objectivity. Companies will need to establish internal controls, auditing practices and consider their climate-related risk disclosure needs and regulations.

Note that independent third-party validation services for corporate GHG targets will need to develop to provide the appropriately grounded, trained, objective, and independent assurance that investors and other stakeholders require. These services do not exist currently.

In addition to validating, the methodology requires periodic verification of progress. This verification relies on GHG inventories, which are based on observable data and are therefore subject to assurance-level assessments.

Internal and external validation and verification of progress

SMARTargets is designed to be validated using internationally accepted concepts, principles, and best practices. Companies should begin with internal validation, leveraging internal audit processes aligned with recognized standards. This step ensures the methodology has been correctly applied and that the resulting targets and strategies are scientifically grounded and aligned with the Paris Agreement. Internal validation also builds confidence by thoroughly documenting the rationale and process behind the targets—information that is essential for both third-party validation and external communication.

Third-party validation, while optional, is recommended. It provides an independent, authoritative assessment of conformity with the SMARTargets Methodology and validation criteria. To ensure impartiality, third-party validation must be conducted by an accredited organization with no vested interest in the company's targets or strategy. As climate-related risk disclosure becomes more prominent, investing in both internal and external validation can enhance credibility and stakeholder trust.

While internal validation is required to develop a SMARTarget, third-party validation may be expected by certain stakeholders. Companies should evaluate whether external validation is necessary based on their specific context and audience.

Section 5 details the full validation process, including criteria for both internal and external validation, as well as the procedures for verifying progress toward targets. Completing this validation and verification cycle is required to formally claim SMARTargets status.

Step 8: Monitoring and Adjusting

Step 8 Outputs: Periodic milestone assessment and, as needed, strategy adjustment and/or SMARTargets refresh.

In this step, a company will monitor their milestones and adjust their strategy as needed. A company with SMARTargets will not only need to verify progress towards their targets (Step 7), but they will also need to monitor conditions with respect to their milestones to determine if strategy adjustments are needed and/or if updated SMARTargets analysis, targets, and strategies are needed.

The transition risk analysis (Step 4) provides milestone and contingency insights as well as insights regarding transition opportunities and risks. The company should articulate meaningful and observable milestones, and potential responses, based on their analysis, with the milestones clearly communicated in the SMARTargets Reporting Template. In general, milestones defined in terms of the More Limited/Fuller decarbonization options, the Facilitating/Challenging condition sets, and the state of sector and economy-wide incentives and transitions, can be used to guide company timing for when to re-evaluate their low-carbon strategy and how they might respond.

For instance, the Step 4 example results suggest the need to evaluate which future is emerging. If, for example, the decarbonization options available are turning out to look like the More Limited set, instead of the Fuller set, in order to stay on track with their long-run emissions targets, the company may want to consider alternative strategies for gas, solar, wind, storage, and hydrogen, as well as possibly slowing coal retirements if annual additions of renewables are likely to be constrained. Furthermore, those strategies will depend on whether sector or economy-wide decarbonization incentives are emerging, which is another milestone the company can readily monitor. In this case, if economy-wide decarbonization incentives are developing that increase low-carbon electricity demand then a company might consider accelerating clean energy investments (and emissions reductions).

While conditions may not meaningfully change year-to-year, an annual review of conditions relative to the milestones would allow the company to assess and communicate how conditions are evolving and whether their SMARTargets strategies are robust. In addition to elucidating changes in conditions, this review would help identify which futures are consistent with observed changes, determine if shifts in the likelihood of the potential futures are merited, and flag the possibility of new futures that are substantively different than those analyzed. This latter insight would suggest that the company should consider the value of updating their SMARTargets analysis and strategies to account for a revised set of future conditions that are not captured by the existing analysis.

5. COMMUNICATING, EVALUATING AND VALIDATING SMARTARGETS

This section outlines the SMARTargets validation and verification process, including the institutional ecosystem envisioned to support these services. It provides a clear overview of the process, key actors, and infrastructure needed to deliver state-of-the-art validation and verification tailored to GHG target setting and progress tracking.

This section also serves as guidance for third-party organizations assisting companies with validation and verification and stakeholders evaluating and using SMARTargets.

As already noted, independent, trained, accredited, third-party validation services for corporate GHG targets do not currently exist. As such, companies will need to rely on internal validation in the near-term, as well as the scientific integrity of the SMARTargets approach. SMARTargets is working to facilitate the development of independent, competent, and accredited validation bodies to support robust validation of GHG targets based on best international practice for conformity assessment.[8]

Validating SMARTargets

SMARTargets facilitates internal and third-party validation according to international best practices for internal controls, auditing, and climate-related risk disclosure that follows principles of impartiality, independence, and objectivity. This section describes what is required in terms of the types of activities and different services needed, including accreditation, training, and other support services.

Targets inherently involve forward-looking information related to conditions that may or may not happen. This means that targets can only be validated, not verified.[9] Establishing robust internal control systems that generate the information supporting emission reduction targets and their validation fosters trust and confidence in the decisions.

Internal and external validation

SMARTargets provides a methodology that can be validated based on accepted concepts, principles, and best international practices. A company should start with internal validation, leveraging their experience in internal auditing processes that follow best practice.[10] Additionally, third-party validation by an accredited external body is recommended when such services become available.[11]

[8] Companies currently providing GHG Inventories verification and/or Offsets Validation and Verification could be candidates to provide validation of GHG targets. However, they would need to be trained in the methodology and comply with any additional requirement for SMARTargets validation and verification.

[9] Verification is a process that applies to historical data, for example GHG inventories. Validation, in contrast, is a process that provides an assessment of forward-looking information, considering the reasonableness of the assumptions, methods, etc. that support a given statement.

[10] For instance, by following ISO 9001 internal audit processes.

[11] For instance, bodies accredited under ISO 14065:2020 for GHG validation.

The internal validation process ensures that the company has implemented the SMARTargets Methodology properly; and, by doing so, their targets and strategy are rigorously derived and supported and they have scientific and Paris Agreement alignment. Internal validation provides confidence in the targets and supporting information by documenting the process and basis for targets and strategies, all of which is essential information for third-party validation and external communications. Third-party validation can provide an objective and authoritative opinion on conformity with the SMARTargets Methodology and validation criteria discussed below.

The sections below outline the SMARTargets validation process and criteria for internal and external validation, as well as verification of progress towards targets. Before getting into those details, we discuss validation of alignment with the Paris Agreement. The discussions below are designed to help prepare a company and validators, as well as inform stakeholders.

How is Paris Agreement alignment validated?

The SMARTargets Methodology results in corporate climate targets and strategies that are aligned with science and the Paris Agreement. The methodology aligns with science by satisfying the scientific requirements for a science-based methodology: science-based alignment with the Paris Agreement temperature goals and science-based decision-making. Furthermore, the methodology provides alignment with the Paris Agreement in three ways that are consistent with science: quantitative targets aligned with the temperature goals, qualitative alignment of strategies for achieving the temperature goals, and assessment of emission reduction transitions that align with the Paris Agreement and science by recognizing differences in opportunities and enabling conditions. Alignment with science and the Paris Agreement is by design: targets and strategies resulting from SMARTargets will be aligned by implementing the methodology.

External assessments of alignment with the Paris Agreement should similarly strive for the comprehensive science and Paris Agreement alignment of SMARTargets in order to generate scientifically grounded and robust insights. Many existing approaches do not currently achieve this rigorous alignment. Many do not consider global pathway ranges, assumptions, varying implications, or the limitations of those pathways in evaluating corporate alignment with a global temperature goal. Many also do not facilitate science-based decisions by accounting for uncertainty, individual opportunities and risks, or multiple priorities, nor do they consider alignment with the other provisions in the Paris Agreement.

Note that, by conforming with the SMARTargets Methodology and criteria, the targets are also validated as aligned with science and the Paris Agreement.

SMARTargets validation and progress verification cycle

Validation and verification is part of a cycle of six stages that companies will undertake and repeat (Figure 16). The following sequence of activities are part of the cycle—from developing SMARTargets to verifying progress:

1. **Developing SMARTargets**: By implementing the SMARTargets Methodology a company will evaluate and pursue targets and identify strategies, including those related to risk management. After working through the steps of the methodology, a company will have completed the Reporting Template and assembled a rich documentation package chronicling the process, results and insights, and decisions.

2. **Internal Validation of Targets**: This stage is the required internal validation of SMARTargets. The validator's job is to confirm the implementation of the methodology based on the documentation and validation criteria below. An independent team within the company, separate from the team implementing the methodology, should validate the implementation using the documentation and validation criteria. The company should leverage internal audit processes in developing the validation procedures. For example, the company should consider establishing internal control procedures to generate and safeguard the documentation resulting from the methodology's implementation, including completing the Reporting Template. The key output from this process is an internal assessment opinion from the validation team on whether the company's implementation of the methodology is reasonable and conforms with the methodology and criteria. The internal validation team might also identify areas for improvement, which could result in implementation and documentation revisions that strengthen communications, increase transparency and the integrity of the decisions, and help prepare the company for third-party validation.

3. **Third-Party Validation**: Third-party validation is recommended but not required. In this stage, companies should decide whether this is needed based on the internal validation, availability of quality (accredited and independent) validation services, and internal and external stakeholders' needs. If the company decides to undertake third-party validation, it will need to work with an accredited validation body through an engagement agreement.

4. **Implementing Emissions Reduction Strategies**: In this stage, the company will be implementing the strategies identified for achieving targets. The company should document emissions changes (via their GHG inventory) and actions taken with respect to emission reduction strategies, including efforts to put enabling conditions in place and collaborate with others.

5. **Internal Verification of Progress Towards the Target Based on the GHG Inventory**: In this stage, the company will internally verify progress towards their targets. The company should have an internal verification process to assess progress on an annual basis that can be communicated (via their sustainability or climate report, regulatory requirements, or by another means). Annually assessing progress is critical to evaluating strategies and identifying opportunities for corrective actions if needed. This assessment can also identify opportunities for being more ambitious and where additional collaboration could be beneficial to facilitate an enabling environment.

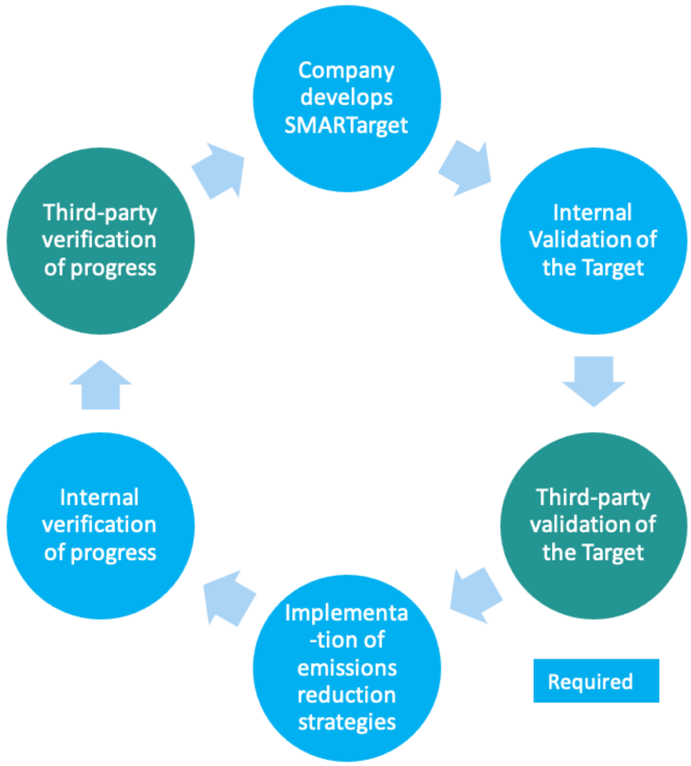

Figure 16. SMARTargets validation and progress verification cycle

6. **Third-Party Verification of Progress Towards a SMARTarget**: Third-party verification of progress is recommended but not required. In this stage, the company should decide whether third-party verification of progress is needed. Among other things, the company should consider the internal verification, GHG inventory verification regulatory requirements, and internal and external stakeholder needs. This type of verification might also be considered when there are special circumstances (e.g., structural changes in the company that affect emissions). This type of verification need not be annual.

The validation and verification process is a cycle because the evaluation of progress might lead a company to revisit their climate targets and strategies based on the conditions emerging, such as making adjustments to improve management of transition risks and/or increase ambition. Figure 17 identifies the key documentation and outputs generated by each stage of the cycle, some of which are common validation and verification products.

Stage	Documentation
Company develops SMARTargets (required)	• SMARTargets and strategies • Documentation of methodology implementation
Internal validation (required)	• Validation Report, including: Summary of Findings, Data and Analysis, and Compliance Assessment • Recommendations • Documentation of validation activities • Approval and acceptance of the validation results
Third-party validation	• Validation report • Statement of conformity • Recommendations • Documentation of validation activities • Approval and acceptance of the validation results
Implement Emission Reduction Strategies (required)	• Document emissions reduction strategies • Annual update of GHG emissions inventory
Internal Verification (required)	• Verification Report, including Summary of Findings, Data and Analysis • Recommendations for Improving Data Accuracy, Enhanced Internal Controls, and preparation for external verification • Documentation of the verification activities
Third-party verification	• Verification report • Statement of assurance (assurance level, verification opinion) • Recommendations • Documentation of the verification activities

Figure 17. Documentation associated with each stage in the validation and verification cycle

Who can validate and verify?

Internal validation and verification: Companies should establish an Internal Independent Team (IIT) to conduct internal validation. The team should be independent from the team responsible for implementing the SMARTargets Methodology. It is recommended that, when an internal audit team exists, they get involved in the IIT, and that a formal internal control process be established. This includes defining roles and responsibilities within the company and documentation procedures for the methodology implementation.

Third-party validation and verification: SMARTargets third-party validation should be undertaken by an independent validation body with ISO-14065 accreditation and certified training in the SMARTargets Methodology. ISO 14065 is a standard that establishes "*General principles and requirements for bodies validating and verifying environmental information*" (ISO, 2020). This process involves an assessment of the Validation and Verification Body's (VVB) competency, impartiality, and ability to perform validation and verification. In the United States, the American National Standards Institute (ANSI) National Accreditation Board (ANAB) offers accreditation for GHG VVBs according to ISO 14065:2020, (ISO, 2020).[12] A list of trained and accredited validators and verifiers for SMARTargets will also need to be maintained and made available to the public.

Stakeholder evaluation of SMARTargets

What does it mean when a company says they have SMARTargets? It means the following:

1. They have ambitious and actionable GHG targets that are aligned with the Paris Agreement global temperature goals and science,
2. They followed a grounded, rigorous, well-defined standardized process that provides transparency and comparability, which includes:
    a. Using a methodology developed from scientific assessment and requirements, and
    b. Implementing all the steps of the methodology,
3. They are working to pursue the targets and enabling conditions,
4. They are managing low-carbon transition risk, and
5. They produced a standardized set of outputs transparently documenting the process, decisions, and results, and justifying the strategy.

Overall, it means that the company's targets and strategies are science-based in their alignment with international temperature goals and in facilitating science-based decision making and that they are aligned with the Paris Agreement's temperature goals and provisions for achieving those goals.

What should stakeholders be looking for when they evaluate a company's GHG targets? They should be looking for the following:

- ***Alignment with science:*** Is the methodology used to develop the targets aligned with all the relevant science associated with global and sub-global low-carbon transitions consistent with limiting global warming to the Paris Agreement temperature goals? Evaluating alignment with science consists of evaluating whether alignment with international temperature goals is science-based in considering ranges, assumptions, varying implications of alternative aligned pathways, and the limitations and guidance of global pathways; in particular, that they do not provide information about actual company opportunities and risks but can help identify aspirational goals and coordinate effort. Evaluating alignment with science also consists of evaluating whether the methodology supports science-based corporate decision-making by considering uncertainty, the unique decarbonization opportunities of individual companies, the set of relevant social priorities, and risk management.

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[12] ISO 14065 accreditation can be provided by various accreditation bodies. A list of ANAB's Greenhouse Gas VVB Accreditation (Accredited) organizations is available on its website. The company should consult ANAB's website for the most up to date list of VVBs and review the VVB certificates including the expiry date and scope. The International Accreditation Forum (IAF) accredits National and regional accreditation bodies. For the purposes of this discussion, we refer to an ANAB-accredited body, but this could change depending on your country. For details on ISO 14065: 2020, see https://www.iso.org/standard/74257.html.

- ***Alignment with the Paris Agreement:*** Is the methodology producing targets and strategies consistent with the Paris Agreement temperature goals and its provisions for achieving those goals? As noted, SMARTargets are aligned with the Paris agreement in three ways: the targets are quantitatively aligned with the temperature goals, the strategies are qualitatively aligned with the robust transitions consistent with the goals and the strategies within the Paris Agreement for achieving the goals, and the two types of emission reductions (Aspirational and Qualified Targets) align with the Paris Agreement's recognition of differences in decarbonization opportunities and uncertainty in enabling conditions.

- ***Grounded targets:*** Are the company's targets supported by meaningful information? SMARTargets are developed from company-tailored transition risk analysis based on exploring plausible, actionable, and transparent low-carbon transitions and risks relevant to each company.

- ***Grounded and viable strategies:*** Is the company's strategy supported and appropriate? The transparent Step 4 company-tailored transition risk analysis provides the information needed for stakeholders to be able to evaluate the viability of the targets and the appropriateness of the company's strategy.

- ***Comparability:*** SMARTargets standardized process and outputs provides comparability and facilitates comparison across companies. However, because companies have different decarbonization opportunities and risks, stakeholders should expect the enabling conditions and strategies to vary. The standardized information will help stakeholders understand and interpret the differences and similarities in opportunities, enabling conditions, and risks, and help stakeholders work with companies to facilitate achieving targets.

SMARTargets Validation Template and Criteria

As noted, implementation of the SMARTargets Methodology includes documenting the process, outputs, and decisions from each of the steps in the SMARTargets Reporting Template. The template collects implementation, justification, and decision details that can be validated according to the criteria listed in this section.

SECTION 1. COMPANY INFORMATION, IMPLEMENTATION TEAM & ENGAGEMENTS

General Company Identification

- ✓ Was the following reported?
  - Company general information identifying the company and points of contact

Company Implementation Team

- ✓ Was the following reported?
  - A list of internal organizations involved in the methodology's implementation (e.g., directors, executives, planning, policy, sustainability, risk management, strategy, outreach)?
  - Indication of those responsible for approval of the SMARTargets
  - Indication of those responsible for coordinating the methodology implementation

External Stakeholder Engagement

- ✓ Was the following reported?
  - Indication of whether external stakeholders were engaged
  - If engaged, a description of that engagement

Experts, Consultants, and Other Support

- ✓ Was the following reported?
  - Indication of whether external experts were involved
  - If involved, a description of that involvement

STEP 1. GHG Inventories and base year

GHG Emissions Inventory Methodology and Third-party Verification, Target Base Year, Company Emissions Trends

- ✓ Was the following reported and, as relevant, reasonably implemented?
  - A verified GHG emissions inventory
  - Indication of the most recent year of the GHG inventory
  - Indication of the base year for the GHG targets
  - Justification for the base year for the GHG targets
  - Consistent use of the base throughout implementation (e.g., targets, transition pathway analysis, global pathway comparisons)
  - Description of GHG emissions trends related to each target, including the base year and most recent inventory year
  - A summary of the GHG inventory for the base year and most recent year for each emissions category

STEP 2. PRACTICAL ISSUES AND CLIMATE TARGET GROUPINGS

- ✓ Was the following reported and, as relevant, reasonably implemented?
  - Documentation of the conclusion regarding each practical consideration for each emissions category
  - Documentation of the overall decision and justification regarding pursuing a target for each category (either setting a SMARTarget, not setting a target because the emissions are already covered by Paris Agreement aligned policy or another company's targets, not setting a target with justification based on the practical considerations, or not setting a target because the category is not relevant to business)
  - This Summary indication of whether each emissions category is covered by own SMARTargets, Paris aligned regulation, other's Paris aligned targets, or not covered
  - Documentation of target groupings

STEP 3. ASPIRATIONAL CLIMATE TARGETS ALIGNED WITH INTERNATIONAL GOALS

- ✓ Was the following reported and, as relevant, reasonably implemented?
  - The Paris Agreement aligned targets that are to be evaluated for each emissions target grouping, which could be by category, by GHG across categories, or across GHGs and categories

STEP 4. COMPANY TRANSITION RISK ANALYISIS OF OPPORTUNITIES AND RISKS

Modeling requirements and capability

- ✓ Was the following reported and, as relevant, reasonably implemented?
  - The type of modeling approach used (utility planning, economy-wide, or integrated)
  - Summary of the modeling approach and how it meets minimum capability requirements
  - If a utility planning model was used, discussion of how uncertain economy-wide factors were considered
  - If regulations regarding resource planning allow, has the optional use of coordinated (or integrated) economy-wide and planning modeling been considered?

STEP 5. STRATEGY AND QUALIFIED TARGET ALIGNMENT WITH INTERNATIONAL GOALS

- ✓ Was the following reported and, as relevant, reasonably implemented?
  - Qualitative assessment of Paris Agreement alignment of the company's transition strategy
  - Quantitative assessment of Paris Agreement alignment of the companies Qualified Targets, including narrative regarding qualifying conditions and challenges to contextualize deviations from the well-below 2°C ranges

STEP 6. DOCUMENTATION AND COMMUNICATION

- ✓ Was the following reported and, as relevant, reasonably implemented?
  - The required documentation from implementing the seven phases associated with the transition risk analysis:
    - Phase 1: Summary of reference conditions and uncertain transition factors for scenario design consideration
    - Phase 2: Summary of the core scenario design assumptions
    - Phase 3: Summary of the core scenario design specifications
    - Phase 4-6: No documentation requirement since these are intermediate steps
    - Phase 7: Final full set of scenarios, specifications, modeling results, insights, and conclusions (see below for specific requirements)
      - Final full set of scenario assumptions and modeling specifications (core, recommended, and sensitivity)
      - Have transition risk analysis results, including:
        - Alternative potential transitions and insights
        - Transition risks and robust strategies
        - Aspirational and Qualified Targets and associated conditions, including enabling conditions
        - Criteria used for identifying risks, enabling conditions, and qualified targets
        - Contingency plans for alternative futures
        - Strategies for pursuing targets and managing risks
        - Qualitative assessment of Paris Agreement alignment

STEP 7. VALIDATION AND VERIFICATION

Validation and verification

- ✓ Was the following reported and, as relevant, reasonably implemented?

- Communication to the public of GHG targets
- Internal validation (required)
- External validation
- As relevant, communications on progress and verification activities

Alignment with science and the Paris Agreement

- ✓ Was the following reported and, as relevant, reasonably implemented?
  - Alignment with the scientific requirements
  - Confirmation regarding the three types of Paris Agreement alignment (quantitative, qualitative, and two types of emissions reductions evaluated)
  - (Optional) Consideration of alignment with country aggregate emissions pledge (NDC). See Step 5 discussion for guidance.

STEP 8: MONITORING AND ADJUSTING

- ✓ Was the following reported and, as relevant, reasonably implemented?
  - As relevant, communications on milestones, scenario realization and revisions to strategies

6. JUSTIFICATION FOR THE METHODOLOGY

The SMARTargets Methodology results in corporate climate targets and strategies that are aligned with science and international climate goals. This is by design. A company implementing SMARTargets will achieve both types of alignment automatically. Science and Paris Agreement alignment are objectives sought by stakeholders and companies. This section discusses the justification for the methodology and how alignment with science and the international goals are achieved.

At its core, the SMARTargets Methodology is based on understanding and communicating individual company decarbonization opportunities and risks and identifying aligned and actionable targets and strategies. As such, the following are key company-specific features of the methodology:

- Consideration of practical issues for setting and pursuing targets,
- Evaluation and pursuit of aspirational targets and identifying qualified targets, and
- Assessment of transition opportunities, risks, enabling conditions, and risk management strategies.

Each of these features emerged as a response to the scientific and operational requirements identified for a methodology to be science-based and aligned with the Paris Agreement. Both types of requirements are summarized in this section. See the Scientific Foundations document—*SMARTargets Scientific Foundations: The Science Relevant to Corporate Greenhouse Gas Emissions Target Setting Based on Science*—for detailed discussion of the relevant science, key scientific observations, and the derived scientific and operational requirements for methodologies.

A science-based methodology

Companies and stakeholders want GHG targets and strategies based on science. However, to date, the scientific basis for company-level GHG targets and the criteria for determining whether a target is or is not "science-based" have not been well-defined and transparent. The Scientific Foundations document defines the relevant science and the requirements for a science-based methodology. This section summarizes key insights from the Science Foundations. See the document for additional details, supporting discussion and graphics, and additional references to the literature.

From assessing the relevant science, we have identified scientific and operational requirements for a methodology to be science-based. These requirements apply to climate target setting, climate strategy evaluation, and transition risk assessment methodologies. Below we describe the scientific and operation requirements and the key scientific observations underpinning the requirements.

Scientific requirements

We identify two types of requirements for a methodology to be "science-based" (Figure 18):

1. The methodology must have science-based alignment with a global temperature goal, and
2. The methodology must facilitate science-based decision-making.

It would be more appropriate to call a methodology that satisfies these requirements "science-informed" since the science is unable to tell us exactly what each company should do. Science only provides guidance regarding what each company needs to consider for scientifically grounded targets and strategies. Given the familiarity of the term "science-based," however, we will continue to refer to that phrase.

Science-based alignment with a global temperature goal

There are many global and sub-global pathways aligned with any global temperature goal. This Key Scientific Observation, and the others discussed below, cannot be ignored. Specifically, alignment with a global temperature goal must recognize and account for the following:

- The ranges of aligned pathways (Key Scientific Observation #1),
- The assumptions in pathways and uncertainty about them (Key Scientific Observation #2),
- The varying implications of different aligned pathways (Key Scientific Observations #3 and #4), and
- The limitations of global pathways, as well as their guidance (Key Scientific Observation #5).

The Key Scientific Observations discussed below emerge from assessment of the science in the Scientific Foundations document. Thus, in seeking or evaluating corporate alignment with any global temperature, we must recognize that there is more than one way to be aligned, conditions could be different than those assumed, and the different conditions imply different aligned pathways and different challenges. The last point is perhaps the most important. It implies that global pathways can help identify aspirational goals and coordinate effort; however, we must recognize what they do not tell us. Specifically, they provide no information at all about an individual company's actual transition opportunities.

Thus, global pathways can be helpful in providing direction and coordinating effort, but we need to acknowledge the limitations. Given the disconnect between global pathways and company opportunities (Key Scientific Observation #4), we should not expect companies to be able to achieve the global outcomes, nor necessarily want them to for economic efficiency reasons, given differences in opportunities. In addition, a comparison to global pathway results (e.g., global, regional, sectoral, technology) is not a conclusive test of corporate alignment given that the global pathway information does not reflect who the company is now and its transition opportunities. Not only are companies not the global, regional, or sectoral average, the global pathway results are contingent on assumptions that are uncertainties that need evaluation, with many equally credible pathways, and uncertainty and risk being ignored.

In general, public transition expectations for companies should also be aligned with science. As noted, this means we should not be surprised when some companies say that they cannot achieve a global pathway outcome without enabling conditions, such as CDR and supportive policies. We should expect the challenge of achieving a global pathway outcome to vary across companies, with some finding it harder than others and some finding it impossible without enabling conditions. Most importantly, however, we should expect and want companies to evaluate their individual opportunities, challenges, and risks to be able to identify what they can do under different uncertain conditions and facilitate progress as possible.

Science-based decision-making

Scientific observations also provide guidance regarding what needs to be considered for scientifically grounded decision-making. Specifically, for a methodology to support science-based decision-making it must (Figure 18):

1. **Consider uncertainty** – A company needs to consider uncertainty about the future when setting a target. Specifically, a company needs to consider the plausible alternative futures because different conditions can imply different practical GHG targets, transitions, and strategies, as well as risks. *Follows from Key Scientific Observations 1, 2, 3, and 4.*

2. **Recognize uniqueness** – A company needs to consider its transition opportunities and constraints and risks, which can vary by region and company due to differences in endowments, assets, systems, markets, regulatory structure, future options, and more. *Follows from Key Scientific Observations 4, 5, and 6.*

3. **Account for multiple priorities** – A company needs to consider the set of objectives and social priorities that they are supporting, which could include affordability, reliability, economic development, equity, and sustainability. *Follows from Key Scientific Observations 3 and 4.*

4. **Provide flexibility** – With the future uncertain, a company needs flexible strategies, with contingency plans and options available, to allow the company to respond and adjust to the different futures that could unfold. *Follows from Key Scientific Observations 1, 2, 3, and 4.*

5. **Support resilience** – A company's GHG target should be consistent with overall corporate risk management and support company resilience to potential futures. *Follows from Key Scientific Observations 1, 2, 3, and 4.*

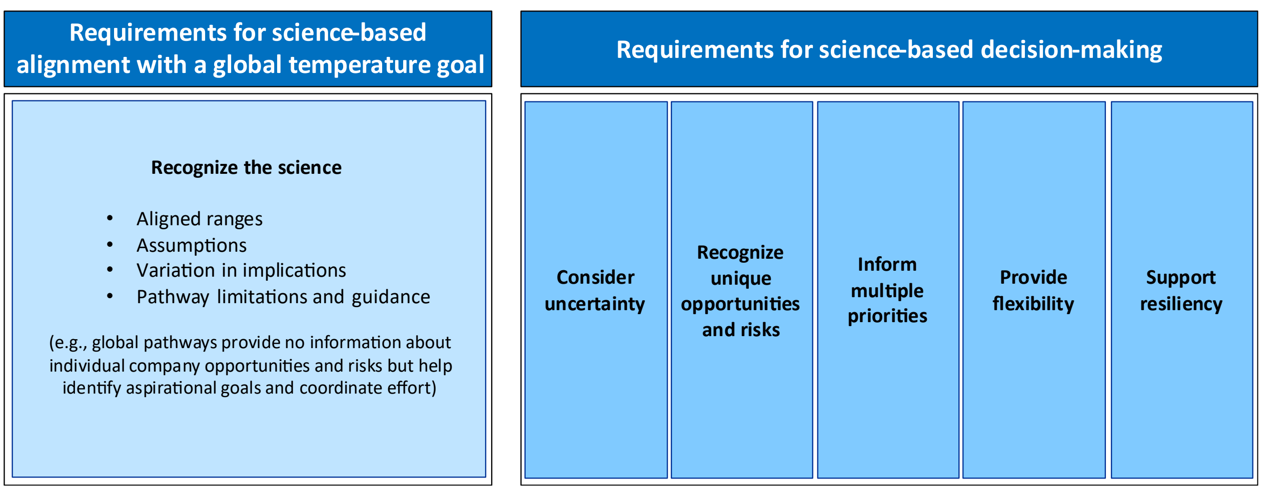

Figure 18. Requirements for a methodology to be "science-based"

Operational requirements

The scientific observations and requirements, along with the needs of business integration, also provide guidance on the functionality required from a science-based methodology. Specifically, the methodological design needs to achieve the following:

1. Inform the identification of actionable targets and strategies for each company,
2. Help a company assess and manage low-carbon transition risk,

3. Help a company integrate GHG abatement into strategic planning,
4. Help a company communicate the most ambitious level of GHG reductions they can achieve under different conditions and the role of enabling conditions for greater ambition,
5. Assist with climate-related transition risk disclosure, and
6. Facilitate cost-effective economy-wide decarbonization.

The SMARTargets Methodology was designed to meet both the scientific and operational requirements. By doing so, the methodology is well-grounded in all the relevant science and it provides meaningful, actionable results for an individual company based on their opportunities. The methodology also facilitates enhanced planning and risk management and informs internal strategy, investors, and other stakeholders on company opportunities under different conditions, including challenges constraining ambition, and enabling conditions for greater ambition.

Key scientific observations and company target setting insights

The SMARTargets Methodology was built from the ground up, starting with identification and assessment of the relevant science, from which a scientific foundation of Key Scientific Observations and company climate target setting insights were derived, and the scientific and operational requirements above identified.

Assessment of the relevant science began with a fundamental question: what is the relationship between a global average temperature goal and a company (Figure 19)? Answering this question helped identify the science relevant to setting a company target. Specifically, setting a company target requires understanding of climate system dynamics and uncertainties, potential transition pathway dynamics and uncertainties, relationships across scales (global, sub-global, local, and company), and relationships between transition variables (emissions, activity, and policy). From assessing this set of science, we identify the factors that define the relationship between a company and global temperature. These are the factors that define the potential role, opportunities, and risks for a company, which is the information required for informed corporate climate target setting and strategy development.

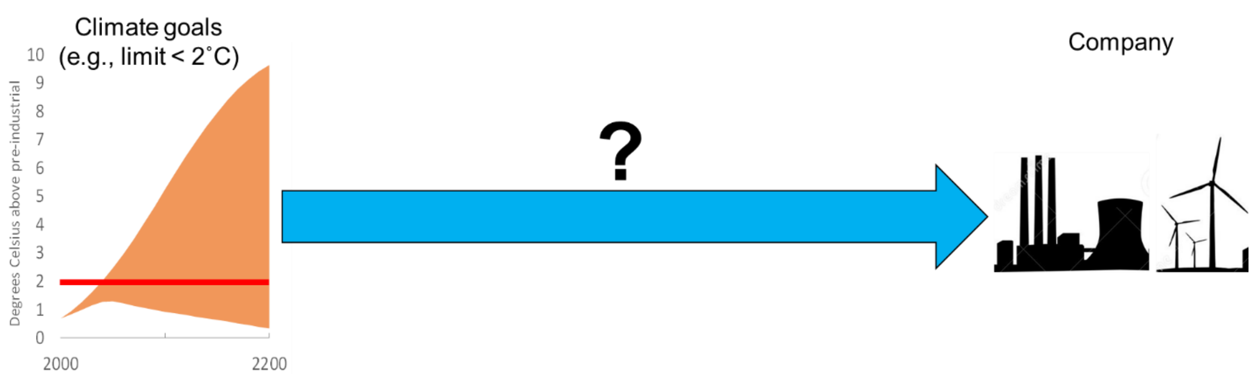

Figure 19. It is essential to understand the relationship between a global climate goal and a company

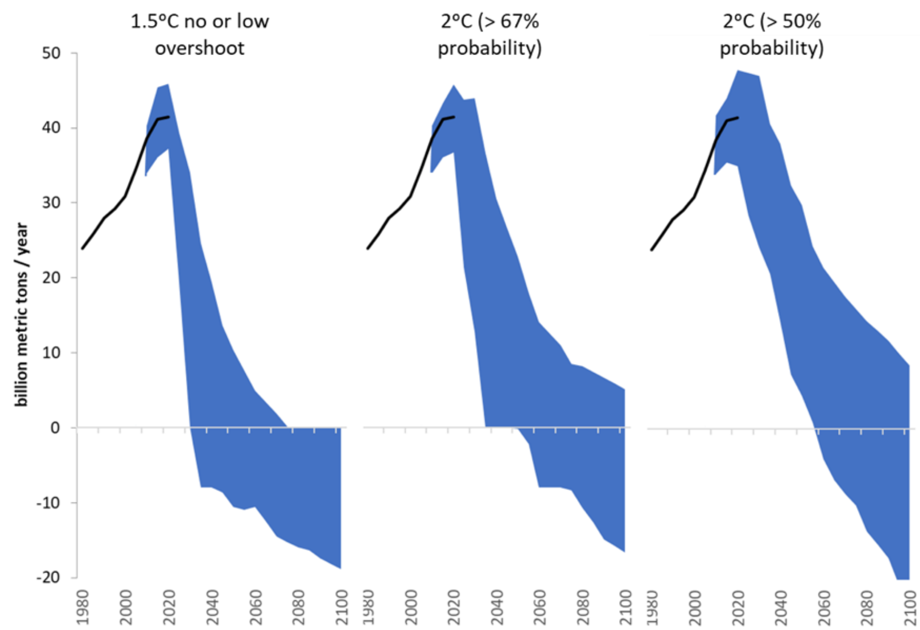

Figure 20. Global net CO_2 emissions pathway ranges consistent with limiting global average temperature to 1.5°C, 2°C with a 67% likelihood, and 2°C with a 50% likelihood

Source: EPRI (forthcoming)
Figure note: Results based on assessment of recent IPCC (Byers et al, 2022; Riahi et al, 2022), IEA (2023, 2021), TPI (2023), and PRI (2021) pathways. The 1.5°C pathway range shown is for pathways categorized by Riahi et al (2022) as "no and low overshoot" of 1.5°C. Full ranges from IPCC data included since all are relevant possibilities.

From assessing the relevant science, we have identified the following Key Scientific Observations (Table 21):

1. Many different transition pathways are consistent (aligned) with achieving a global temperature goal (see, for instance, Figure 20 for global pathway examples),
2. Global pathways aligned with limiting warming to 2°C and 1.5°C have influential but uncertain assumptions,
3. Alternative future conditions can have very different transition implications,
4. Transition opportunities vary by company,
5. Global pathways provide high-level guidance but have significant limitations in informing companies, and
6. Practical issues defining a company's circumstances affect GHG abatement opportunities.

Each Key Scientific Observation has important company GHG target setting implications (Table 21). For instance, in Table 21, the observations that there are many different transition pathways consistent (aligned) with achieving a global temperature goal (Key Scientific Observation #1) yields important company insights. In particular, it elucidates that the science does not provide guidance regarding a specific transition pathway for a company. Table 21 only lists the primary company implication. The Scientific Foundations includes more expansive discussion of company implications. For instance, in the case of Key Scientific Observations #1, there is no one pathway that can fully inform companies on potential transition opportunities. There are many Paris Agreement aligned future conditions and pathways for each company with the relationship to a global pathway weak. It is not a 1-to-1 relationship. Instead, there are many local pathways consistent with a global pathway. As a result, we conclude that the science does not provide guidance regarding a specific transition pathway for a company, which underscores the need for a company to explore their set of transition options.

Table 21. Key Scientific Observations and key company GHG target setting implications

Key Scientific Observation		Key Company Climate Target Setting Implication
1	Many different transition pathways are consistent (aligned) with achieving a global temperature goal	The science does not provide guidance regarding a specific transition pathway for a company
2	Global pathways aligned with limiting warming to 2°C and 1.5°C have influential but uncertain assumptions	Policy design and technology deployment are uncertainties companies cannot ignore
3	Alternative future conditions can have very different transition implications	It is essential to evaluate transition implications uncertainties and risks
4	Transition opportunities vary by company	Each company needs to evaluate its transition opportunities and risks
5	Global pathways provide high-level guidance but have significant limitations in informing companies	Global pathways help identify aspirational levels of effort and facilitate coordination, but it is impractical to expect all individual companies to achieve the aggregate outcomes
6	Practical issues defining a company's circumstances affect GHG abatement opportunities	Assessment of target setting capacity and a company's current situation are necessary

Alignment with the Paris Agreement

Alignment with the Paris Agreement and science-based alignment are different concepts. These are frequently conflated in public dialogue, but it is important to differentiate them. Aligning targets and strategies with science means having a methodology aligned with the scientific and operational requirements discussed above. Aligning with the Paris Agreement, on the other hand, implies aligning targets and strategies with the provisions of the Paris Agreement, which include the following:

1. Aligning with the Paris Agreement's specific global temperature goals, and
2. Aligning with other provisions of the Paris Agreement associated with achieving the temperature goals.

The Paris Agreement temperature goal is to limit global average temperature increase to "well below" 2°C, and to "pursue" limiting the increase to 1.5°C. As discussed above, the science provides guidance on how to properly align with a global temperature goal for science-based alignment. Aligned global pathways can provide aspirational goals; however, we need to account for the limitations of global pathways in informing or assessing companies. In particular, we need to evaluate company-specific opportunities and risks, which will likely not look like the aggregate global pathway transitions.

Aligning with the Paris Agreement implies also needing to consider the other provisions of the agreement that facilitate achieving the temperature goals. This includes recognition of country differences in opportunities, the pursuit of multiple priorities, and the importance of enabling factors, such as cooperation, for achieving country pledges. In adopting the agreement, the countries recognized key issues like these as being relevant to making progress towards the temperature goals, which the science also highlights as being important. In sum, when discussing alignment with the Paris Agreement, we should be discussing alignment with the temperature goals and the provisions for achieving them.

The SMARTargets Methodology requires both quantitative and qualitative alignment with the Paris Agreement. Quantitative alignment refers to quantitative GHG emissions targets that are scientifically consistent with achieving the agreement's specific temperature goals. Qualitative alignment refers to (1) aligning corporate low-carbon strategies qualitatively with the robust types of transitions found in the global pathways consistent with achieving the Paris Agreement temperature goals, and (2) qualitatively aligning corporate strategies with the strategies represented by the other provisions of the Paris Agreement.

The first type of qualitative alignment leverages the insight that certain types of transitions are found consistently in all Paris Agreement aligned global pathways regardless of the model and assumptions (see Scientific Foundations). These include increased electrification, increased deployment of low-carbon technologies, use of carbon dioxide removal, declining but continued use of fossil energy, increases in energy efficiency, and uncertainty. These robust changes represent reliable guidance for strategies consistent with pursuing the Paris Agreement temperature goals. The second type of qualitative alignment refers to aligning with the types of strategies identified by the international community as important to pursuing the temperature goals. These include recognition of differences in country opportunities, multiple priorities, and enabling conditions. This also provides valuable strategic guidance for company strategies.

In the end, the SMARTargets Methodology aligns with the Paris Agreement in three ways:

1. It produces targets aligned with the temperature goals,
2. It produces company strategies aligned with the types of transitions consistent with the temperature goals and the Paris Agreement's key provisions for achieving the goals, and
3. It requires companies to evaluate two types of emissions reductions—aspirational and qualified targets (ATs and QTs respectively), which aligns with the Paris Agreement's recognition of country differences in decarbonization opportunities, multiple priorities, and uncertainty in enabling conditions.

Alignment of aspirational and qualified targets

As noted, the two-target concept (ATs and QTs) is aligned with the Paris Agreement, as well as science. Recall that, ATs are based on global total emissions pathways consistent with the Paris Agreement temperature goals and they are used to encourage ambition and help identify enabling conditions for greater ambition. QTs, on the other hand, are derived from the transition risk analysis and reflect the greatest emissions reductions possible for a company under different future conditions while successfully balancing other societal priorities, where QTs could be greater than or less than ATs.

The two-target concept recognizes the Paris Agreement temperature goal aspiration while also recognizing differences in country decarbonization opportunities, multiple priorities, and enabling conditions, which, as discussed above, are all elements of the Paris Agreement provisions for achieving the temperature goals. Evaluating the two types of reductions helps companies define and communicate their ambition in terms beyond emissions, creating quantitative information that supports the identification and development of narratives regarding challenges, risks based on multiple priorities, enabling conditions, risk management, and their overall strategy, including pursuing enabling conditions through collaboration, R&D, and other activities.

Quantitatively, the ATs are, by definition, aligned with the Paris Agreement. They are the midpoints of the global total emissions pathways aligned with limiting warming to 1.5°C. Alignment of the QTs is more subtle. Companies are required to compare their QTs to the "well-below" 2°C global pathway ranges. However, this is not a conclusive test of alignment. Comparing to the relevant global emissions pathway ranges aligned with limiting warming to well-below 2°C only provides high-level insights regarding the consistency of the QTs with pursuing the Paris Agreement temperature goals. The high-level insight from this comparison is that QTs within the range are aligned with global futures consistent with limiting warming to well-below 2°C, and if all companies have QTs within the range, the sum will also be within the range and aligned with well-below 2°C.

However, comparing to the global pathway ranges are not conclusive alignment assessments because the global pathway ranges do not capture all the global, sub-global, and local transitions found to be aligned with a global average temperature (see Scientific Foundations). QTs for some companies may not fall within the global pathway ranges. This result should not be interpreted negatively. The QTs, by construction, align with the Paris Agreement. It is important to keep in mind that the key virtue of the QTs is that they are the highest possible ambition for a company under different conditions while balancing trade-offs and risks. Some companies may face particularly challenging decarbonization circumstances, such as in developing countries. The transition risk analysis helps a company transparently identify and communicate their challenges, and the QTs represent actionable and substantive contributions to the Paris Agreement goals with additional ambition possible if enabling conditions can be put in place. Thus, as discussed above, the QT concept is consistent with the Paris Agreement's recognition of country differences in opportunities, multiple priorities, and enabling conditions. In that regard, it aligns with the Paris Agreement's provisions to pursue the highest possible level of ambition.

Why is the SMARTargets quantitative alignment of ATs and QTs with respect to global total emissions pathway ranges? We use total global emissions, versus sub-global emissions for sectors or countres, because they have the strongest alignment relationship with global average temperature since they are constrained by the physical dynamics of the climate system. Sectoral, or other sub-global results, however, are contingent on policy and non-policy assumptions that are highly uncertain. With many sub-global transitions found to be consistent with any global emissions transition, companies should not be comparing to a global future dependent on an uncertain, and potentially unlikely, assumption. Instead, companies need to evaluate these uncertainties, and most importantly, companies need to evaluate their unique transition opportunities and risks.

The global emissions pathway *ranges* are used to derive the ATs because all of the pathways represented within the ranges are equally credible global transitions and all have been found to be consistent with the global temperature outcome (see Scientific Foundations). The *midpoints* of the ranges are used for the ATs simply because they are reasonable representative emissions transitions for the set of transitions associated with the ranges. Note that the ranges themselves are still very much relevant to the rest of the SMARTargets Methodology. They are a key justification for evaluating uncertainty about future decarbonization conditions and opportunities.

Many current approaches use sectoral information from a global pathway or two to guide or evaluate alignment, such as a global electricity emissions intensity pathway from an IEA, TPI, IPCC, or custom global pathway (e.g., SBTi, TPI, Moody's). This approach is appealing because the sectoral information is believed to be the most relevant to companies within a sector. However, it ignores the other information relevant to science-based alignment with a temperature (Figure 18). We must recognize the ranges of aligned pathways, the assumptions in pathways and uncertainty about them, the varying implications of different aligned pathways, and the limitations of global pathways in informing company strategies.

Despite the many virtues of the SMARTargets' target setting approach, we must acknowledge the limitation that it is asking companies to consider the same CO_2 or non-CO_2 AT levels (e.g., net-zero in 2050 for CO_2). Science has shown us that uniform targets across companies are not cost-effective (Key Scientific Observation #4). However, it has also shown us that there is cost savings through coordination. Thus, coordination across companies, sectors, and countries can help manage the overall societal costs of limiting warming to well-below 2°C. This is the reason why SMARTargets encourages evaluation or regional economy-wide transitions, the identification of enabling conditions, and company collaboration with stakeholders, including policymakers, suppliers, customers and environmental groups, to create conditions that facilitate achieving the ATs economy-wide. Coordination of this type is a critical role for public policy, which can put in place policies and programs that recognize differences in opportunities and facilitate coordination and the realization of more cost-effective transitions.

Practical target setting considerations for real solutions

The practical considerations step in the methodology (Step 2) helps companies consider and communicate issues that can affect a company's ability to set or achieve targets and can inform the company's analysis evaluating targets (Key Scientific Observation #6).

The Scientific Foundations document provides the technical and scientific justification for considering these issues. For instance, a GHG inventory is a pre-requisite for GHG target setting. Furthermore, inventory approaches and capabilities can facilitate, bound, and/or hinder target setting. Similarly, a company should consider whether an emissions category is significant enough ("material") to justify the resources needed for developing a management strategy and managing the emissions. In addition, a company should consider whether an emissions category is already regulated or constrained by company targets at the source, and to what level. This is important for economic efficiency reasons to manage the decarbonization costs to society, and it is important for the company to consider whether targets could facilitate or complicate regulatory compliance. Lastly, setting and pursuing targets for emissions a company does not control is more challenging. Recognizing this situation helps a company identify uncertainties that should be evaluated in their transition risk analysis. Note that, in SMARTargets, a lack of control is a reason for evaluating the related uncertainty. It is not a reason for choosing not to set a target for an emissions category.

Other approaches

The discussion above defines what it takes for a methodology to be science-based, Paris Agreement aligned, and practical. It provides guidance for all corporate target setting, target evaluation, and transition risk assessment methodologies.

Many current methodologies, however, are not aligned with the scientific requirements above for being science-based: both in terms of science-based alignment with a global temperature goal and science-based decision making. Furthermore, most do not consider the comprehensive alignment with the Paris Agreement defined above, which includes alignment with the temperature goals, as well as the agreement's provisions for achieving those goals.

In terms of scientific requirements (Figure 18), temperature alignment for most methodologies does not recognize the ranges of aligned pathways, the assumptions in pathways and uncertainty about them, implications of different aligned pathways, and the limitations of global pathways with respect to companies, as well as the type of guidance they provide. Furthermore, many do not help companies make science-based decisions by considering uncertainty, differences in opportunities, multiple priorities, flexibility, and risk management.

As for Paris Agreement alignment, many methodologies do not consider qualitative alignment with the provisions associated with achieving the temperature goals or the robust strategies found in global pathways. In addition, their quantitative alignment is problematic. Many guide or assess company alignment with the Paris Agreement based on quantitative sectoral benchmark information from global pathways, such as a global or OECD electric sector emissions intensity pathway (e.g., SBTi, TPI). This information is not a meaningful benchmark for companies and can be very misleading. Not only is the aggregate information not representative of who a company is today or its transition opportunities, but the sectoral results are dependent upon modeling assumptions that are key uncertainties that need to be evaluated, such as immediate global climate policy with comprehensive coverage and global cooperation. Furthermore, the pathway being used is but one possibility with many equally credible Paris Agreement alternative pathways. Finally, by using one pathway, the approach ignores the other possible conditions and the risk it represents for companies.

Other methodologies also frequently do not acknowledge the practical issues, such as whether emissions are regulated, material, and can be adequately characterized.

By considering the scientific and operational requirements, broader alignment with the Paris Agreement, and practical issues, SMARTargets are aligned with science and international goals, and actionable in identifying actual company opportunities under different conditions, while encouraging ambition, and facilitating constructive dialogue and progress in managing the climate.

7. APPENDIX A. GHG ACCOUNTING

	Scope 1 Emission Sources	Scope 2 Emission Sources	Scope 3 Emission Sources
Electric utilities	**Stationary combustion at electricity generating facilities:** ● Boilers and turbines used in the production of electricity, heat, or steam **Mobile combustion:** ● Mobile combustion (trucks, barges and trains for transportation of fuels) **Fugitive emissions:** ● SF_6 emissions from transmission and distribution equipment	**Stationary combustion:** ● Emissions associated with electricity, heat or steam purchased for use by an entity. ● Consumption of electricity during transmission and distribution	**Category 3: Fuel- and energy-related activities (not included in scope 1 or scope 2)** • Emissions from the generation of purchased energy • Emissions from T&D losses*: emissions from generation of electricity that is consumed (i.e., lost) in a T&D system – reported by end user
Natural Gas Utilities	**Stationary combustion:** ● Process heaters ● Engines ● Turbines ● Flares ● Incinerators ● Oxidizers ● Production of electricity, heat, and steam **Process emissions:** ● Process and equipment vents ● Maintenance/turnaround activities ● Non routine activities **Mobile combustion:** ● Transportation of raw materials/products/waste by company owned vehicles **Fugitive emissions:** ● Leaks from pressurized equipment ● Wastewater treatment ● Surface impoundments	**Stationary combustion:** ● Consumption of purchased electricity, heat, or steam	**Category 3: Fuel- and energy-related activities (not included in scope 1 or scope 2)** • For upstream emissions of purchased fuels: All upstream (cradle-to-gate) emissions of purchased fuels (from raw material extraction up to the point of, but excluding combustion) **Category 11: Use of sold products** • The direct use emissions of sold products over their expected lifetime (i.e., emissions from the combustion of natural gas)

8. Appendix B. Methodology Implementation Illustrative Examples

See separate Appendix B document.

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