SCIENCE BASED TARGETS

DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

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SECTORAL DECARBONIZATION APPROACH (SDA):
A method for setting corporate emission reduction targets in line with climate science

A product of the Science Based Targets Initiative

DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

CDP
DRIVING SUSTAINABLE ECONOMIES

WORLD RESOURCES INSTITUTE

WWF

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A multi-stakeholder process was used to develop this method and its accompanying online calculation tool. Public workshops were held in London and Washington in 2014 to get input on the first draft. A technical advisory group of experts from industry and NGOs provided detailed input on various drafts of the method. A second draft of the SDA publication was released for public consultation along with three webinars to provide an overview of the method. During the public consultation process, written feedback was received from more than fifty organizations representing a diverse range of sectors. Science-based target setting tool, which was developed to assist companies in implementation of the SDA method, was beta tested by more than twenty companies from various sectors. Beta testers provided calculation results, as well as detailed feedback on the functionality and usefulness of the tool. This helpful feedback throughout the SDA development process was carefully considered and integrated into this version of the method. A summary of stakeholder feedback from the public consultation is provided in Appendix VII.

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FOREWORD

The scientific community has provided continuous warnings that global emissions are jeopardizing our ability to limit warming to a 2˚C temperature increase above preindustrial levels, the politically agreed-upon level of international ambition. As governments consider new emissions pledges, an increasing number of companies are taking the initiative to align their own emission reduction goals with what climate models tell us is required for the 2˚C decarbonization pathway. New technologies and practices demonstrate that companies can decouple environmental impacts from economic activity. This report presents least-cost pathways for companies in energy-intensive sectors to reduce emissions to levels commensurate with a global 2ºC pathway.

In considering target setting to reduce GHG emissions, many corporations have sought guidance from CDP, WRI, and WWF. In 2014, these organizations decided to join forces and provide more comprehensive guidance including a method that illustrates the scale of emissions mitigation required to achieve a 2ºC pathway and the differences facing each sector to achieve reductions. The first step is the target setting method presented in this publication to help companies set targets based on the best science and modeling currently available. This method takes as a point of departure the premise that a global carbon budget must be distributed not only amongst countries, but also among sectors, since each sector bears a unique set of opportunities and reduction pathways that must be met to add up to the 2ºC mitigation pathway.

For those companies looking to set targets, there is really no other credible target than one informed by science. The Sectoral Decarbonization Approach is a method for companies looking for credibility and also flexibility. This method differentiates itself from other approaches informed by climate science by taking into account the different situations of each sector. If your company believes in the science and urgency of climate change, this is an approach to consider.

Our expectation is for companies to adopt this method and commit to a shared long-term vision toward a low-carbon, thriving economy. We propose this method as a robust science-informed approach to raise the ambition of current target-setting practices, and also as a complement to existing methods informed by climate science. As it is, the method leaves the door open for further improvements, updates to climate models, and technological innovations as it operates under the assumption that companies should be able to set targets without sacrificing economic growth.

We hope the results of this and other target-setting methods will help companies understand the level of transformation required in their business and production models to meet the 2ºC goal. We have confidence that, in applying this goal-setting method, companies will find new sources of innovation and opportunities to become more competitive in a carbon-constrained economy. Many businesses have already taken steps to measure and reduce their greenhouse gas emissions. However, the growing impacts of climate change and the alarming scientific projections suggest that the bar needs to be set much higher.

Any target is no longer a good target. Responsible companies need to increase their levels of ambition and set credible, science-based greenhouse gas emission reduction targets and strategies that will allow us to meet the 2ºC goal and avert the most harmful effects of climate change.

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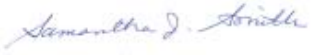

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QUICK GUIDE TO THE SECTORAL DECARBONIZATION APPROACH

SCIENCE-BASED TARGETS DEFINITION:

Targets adopted by companies to reduce GHG emissions are considered "science-based" if they are in line with the level of decarbonization required to keep global temperature increase below 2˚C compared to preindustrial temperatures, as described in the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).

1. INTRODUCTION TO SCIENCE-BASED GREENHOUSE GAS REDUCTION TARGETS

Preliminary data indicate that global greenhouse gas (GHG) emissions related to energy use began to decouple from economic activity in 2014.[1] Numerous public and private sector programs are helping to bend the curve toward global emissions mitigation. However, atmospheric concentrations of carbon dioxide continue to climb[2] and global climate modeling indicates that global mean temperatures are projected to increase by 3.7 to 4.8 ºC by the end of this century[3]. Current GHG emissions trajectories and reduction targets are not aligned with the politically agreed-upon goal of limiting warming to a 2˚C temperature increase above pre-industrial levels.

The purpose of science-based targets is to inform business stakeholders on the level of emissions reductions required to achieve the 2ºC pathway and how this can inform future business activities and company greenhouse gas reduction targets.
A number of science-based target methods have been developed in recent years. This is a short guide to the Sectoral Decarbonization Approach (SDA) method. The Science Based Targets initiative has developed the above-mentioned definition for use throughout this document.

2. WHAT IS THE SDA?

The Sectoral Decarbonization Approach (SDA) is a scientifically-informed method for companies to set GHG reduction targets necessary to stay within a 2˚C temperature rise above preindustrial levels.

The method is based on the 2˚C scenario, one of the International Energy Agency's detailed CO_2 sector scenarios modeled in their 2014 Energy Technology Perspectives report. The Energy Technology Perspectives report's budget is consistent with the representative concentration pathway 2.6 (RCP2.6) scenario from the IPCC's Fifth Assessment Report, which gives the highest likelihood of staying within the global target temperature of less than 2˚C in the year 2100. The probability is estimated by the IPCC at a minimum of 66 percent. The IEA 2˚C scenario estimates an overall carbon budget of 1,055 $GtCO_2$ up to 2050.

The SDA is differentiated from other existing methods by virtue of its subsector-level approach and global least-cost mitigation perspective. SDA results and assumptions are based on mitigation potential and cost data from the IEA's TIMES model 2ºC scenario, which identifies the least-cost technology mix available to meet final demand for industry, transport, and buildings services. The SDA is intended to help companies in homogenous, energy

[1] IEA, 2015. http://www.iea.org/newsroomandevents/news/2015/march/global-energy-related-emissions-of-carbon-dioxide-stalled-in-2014.html
[2] See monthly and annual data at http://www.esrl.noaa.gov/gmd/ccgg/trends/
[3] IPCC (Intergovernmental Panel on Climate Change). 2014a. Fifth Assessment Report. Summary for Policymakers.

intensive sectors align their emissions reduction targets with a global 2ºC pathway. The SDA is best suited for companies in the following subsectors with well-defined activity and physical intensity data: electricity generation; iron and steel; chemicals; aluminum; cement; pulp and paper; road, rail, and air transport; and commercial buildings.

3. HOW WAS THE SDA DEVELOPED?

The SDA method was developed by the partners (CDP, WRI, & WWF) of the Science Based Targets initiative with technical support from Ecofys. The process to develop the method and accompanying online-tool also included extensive opportunities for feedback from stakeholders. Public workshops were held in London and Washington in 2014 to get input on the first draft. A technical advisory group of experts from industry and NGOs provided detailed input on various drafts of the method. A second draft of the SDA publication was released for public consultation along with three webinars to provide an overview of the method. During the public consultation process, written feedback was received from than fifty organizations representing a diverse range of sectors.

The science-based target setting tool , which was developed to assist companies in implementation of the SDA, was beta tested by more than twenty companies from various sectors. Beta testers provided calculation results, as well as detailed feedback on the functionality and usefulness of the tool. This helpful feedback throughout the SDA development process was carefully considered and integrated into the final version of the method and tool.

Please visit our website -http://sciencebasedtargets.org/ - to learn more about the initiative.

4. HOW DOES THE SDA WORK?

The Sectoral Decarbonization Approach (SDA) allocates the 2˚C carbon budget to different sectors. This method takes into account inherent differences among sectors, such as mitigation potential and how fast each sector can grow relative to economic and population growth. Within each sector, companies can derive their science-based emission reduction targets based on their relative contribution to the total sector activity and their carbon intensity relative to the sector's intensity in the base year.

Using the detailed sector-scenarios from the International Energy Agency's 2˚C Scenario (IEA 2DS) model, it is possible to estimate the 2˚C-compatible carbon intensity for any detailed-sector scenarios by dividing the total direct emissions of the sector in any given year by the total activity of the sector in the same year. This yields a sector intensity pathway.

For homogeneous sectors physical activity indicators - for example, tons of cement - are used as the allocation method. The assumption is that the carbon intensity of each company in a homogeneous sector will converge with the sector carbon intensity in 2050.

For the sector "Manufacture of light-road automotor vehicles", value added (revenue minus the cost of purchased goods and services) is used as indicator and is assumed to grow proportional to GDP growth.

A company's intensity pathway—given by the method—multiplied by their projected activity yield a company's carbon budget in absolute terms for the target period. In principle, the sum of these budgets should be contained within the sector projected budget given by the IEA 2DS.

In the absence of more sector-specific decarbonization pathways for heterogeneous sectors, the SDA method uses the compression assumption described in the methodology below to limit emissions within the 2˚C carbon budget. The activities and sectors covered in this method represent over 60 percent of current yearly global GHG emissions and up to 87 percent of the CO_2 budget up to 2050.

5. WHAT DATA ARE USED TO CALCULATE TARGETS?

The data that organizations need to calculate their emission reduction targets using the SDA method are:

a) **Activities and sectors:** Identify the different activities of the company. Some companies may perform several activities that fall under different sector categories. Include in the target-setting process the most carbon-intensive activities and sectors of the company.

b) **Activity levels:** Determine the activity in the base year for each sector where the company operates. Companies need to identify the specific activity indicator amounts for each sector as proposed in the method.

c) **Commitment period:** Define the most appropriate commitment period, taking into consideration the organization's circumstances and the need to establish clear long-term targets aligned with science requirements. The earliest base year that can be selected by the company in the SDA is 2010 and the latest target year is 2050. By defining a base year and a target year, you will have defined the commitment period to which you are committed to follow an emission reduction pathway for your company.

d) **Annual activity growth rate:** Forecast the annual activity levels for the commitment period, for example by calculating the growth rate based on historical data of the company or by using future growth rates as estimated by the company.

e) **Electricity use:** Determine electricity use in the base year for each sector selected, expressed in kilowatt-hours and forecast future electricity consumption for the commitment period. Future electricity use is used to disaggregate scope 2 emissions targets.

f) **GHG emissions:** Determine corporate base-year

scope 1 and scope 2 carbon dioxide emissions and corporate emissions disaggregated by each sector in which the company operates. The SDA emissions pathways are scaled to incorporate the effect of non-CO_2 emissions. Emissions offsets are not covered by the SDA.

6. WHAT IS THE SCIENCE-BASED TARGET SETTING TOOL?

Accompanying the method, a free, publically-available tool has been developed for companies to use.

The tool determines the company´s target trajectory compared to the sector intensity pathway. Businesses can use the SDA method and tool to set scope 1 and/or 2 reduction targets informed by climate science or to compare the level of ambition of their current targets (scope 3 is only available for light road vehicles manufacturing). All the data described in section 5 above is required for use of the tool.

Please use http://sciencebasedtargets.org/tools/ to access a web-based version of the tool.

7. WILL THE METHOD CHANGE OVER TIME? SHOULD THE TARGET BE REVISED?

The SDA method uses both sectoral GHG emissions pathways and sectoral activity growth projections. Both can deviate over time due to changing decarbonization or demand rates. This fact requires that the method is periodically revised to check the validity of the projections used, including all the carbon budget assumptions. Regularly updating the global budget figure will constitute an important condition of the robustness and integrity of the method.

Companies should also revise and check achievement of their targets, by checking if activity matched their previous projections and if intensities are below their specified pathway.

8. CAN I USE OTHER SCIENCE-BASED TARGET SETTING METHODS?

Other methods exist to set science-based GHG reduction targets. Each method has its strengths and weaknesses and there is currently no universally preferred approach. Companies should review the various methods and choose the method or methods that are best suited for their business.

9. WHAT ARE THE KEY LIMITATIONS OF THE SDA?

While the SDA succinctly summarizes subsector emissions and activity pathways that are consistent with a 2°C climate stabilization scenario, it has significant limitations for some sectors, companies and situations. The SDA approach does not cover all sectors, economic activities, or types of emissions. Appendix VI of the SDA methodology describes the SDA's subsector classification assumptions, but boundaries must be clearly defined to avoid exaggerated mitigation through outsourcing or leakage and create more consistency across company targets within a sector.

The SDA's global convergence assumption also creates potential equity and distributive issues that may affect companies in certain regions.

Finally, the SDA is reliant on cost, technology, market, and demographic assumptions that are likely to vary before 2050.

INTRODUCTION

The environmental, economic, and political impacts of climate change are transforming the way businesses operate. A decade ago, only a handful of forward-looking companies were measuring and disclosing their greenhouse gas emissions.

In 2013, CDP reported that over 80 percent of the Global 500 companies had targets to reduce their emissions (CDP 2013). However, emissions of the fifty largest emitters, responsible for over 70 percent of the Global 500 emissions, increased in the past five years, according to data reported to CDP. A similar trend was observed for the five largest emitters in every sector analyzed by CDP.

These companies have been spurred to action by increasing energy costs, technological developments, growing awareness, and rising scrutiny from stakeholders and investors. Without additional efforts, annual anthropogenic GHG emissions are expected to increase to over 100 $GtCO_{2e}$ by 2100, resulting in an increase in global temperatures of 3.7°C to 4.8˚C (IPCC 2014a). The myriad of actions already undertaken by governments, businesses, and civil society are not enough to change this risky trajectory.

In response to the disparity between the private sector's current trajectory of emissions and the pathway required to meet the internationally-agreed-upon 2˚C target, CDP, WRI, and WWF formed the Science Based Targets initiative to increase the level of ambition of emission reduction targets in the corporate sector. The proposed method, called the Sectoral Decarbonization Approach (SDA), builds on existing approaches that allocate a carbon budget to companies based on their contribution to the economy or value-added. However, unlike existing approaches, this method looks at sector-specific decarbonization pathways that are compatible with the 2˚C threshold rather than applying a generic decarbonization pathway for all companies regardless of the nature of their operations.

The sector modeling for the SDA method is built on the 2-degree scenario (2DS) developed by the International Energy Agency (IEA) as part of its 2014 Energy Technology Perspectives (ETP) outlook. IEA's 2DS provides a cost-competitive mitigation pathway[5] to achieve the 2˚C target, while acknowledging differences in activity growth, mitigation potentials, and technological options for each sector. The SDA method is well-suited to relatively homogenous sectors, where it uses physical indicators (e.g., metric tons of product) to express activity. SDA is not developed at a detailed level for heterogeneous sectors. The method is mainly recommended for companies from homogeneous sectors. In homogeneous sectors, the 2˚C carbon budget is allocated to companies based on their specific intensity pathway as calculated by the method and their relative contribution to the total output in the respective sector (or sectors) in which they operate.

This document is structured into four sections followed by detailed appendices. The first section provides an overview of climate science and related goal-setting methods; the second section discusses the development, structure, strengths, weaknesses, and assumptions of the SDA; the third section provides SDA company case studies; and the fourth section discusses next steps. The appendixes provide detailed information on homogenous sectors well-covered by the SDA and heterogeneous

[5] Based on the cost-minimization criteria.

sectors that are covered more loosely, as well as other information on the method. The method is intended to be a living document. We anticipate upgrades to the SDA method and the underlying modeling as more accurate data and additional models become available. We invite businesses and other users to test the SDA method, to challenge the underlying assumptions, to push the limits of this approach, and to make recommendations for improvements.

1. SCIENCE-BASED TARGET SETTING: OVERVIEW

This section gives an overview of the climate science as well as descriptions of available methods for companies to align their targets with climate scenarios. The first part explains the pertinence of the 2°C benchmark and gives background on the method's underlying carbon budget and emission scenarios, including how the political context is related to climate science. It also explains how non-CO_2 greenhouse gases are considered in the overall budget.

1.1. PERTINENCE OF THE 2°C BENCHMARK

1.1.1. Carbon budget and emission scenarios

Despite a growing number of climate mitigation efforts, global GHG emissions increased from 27 to 49 $GtCO_{2e}$ between 1970 and 2010 (see Figure 1). In the period 1970–2000, the growth was 1.3 percent per year. In the period 2000 to 2010, growth was even higher at 2.2 percent per year, and annual anthropogenic GHG emissions increased by 10 $GtCO_{2e}$ (IPCC, 2014b).

Carbon dioxide emissions from fossil fuel combustion and industrial processes contributed about 78 percent of the total GHG emission increase from 1970 to 2010 (IPCC, 2014b).

IPCC concluded that without additional efforts to reduce GHG emissions, emissions will grow further. The main drivers are growth in economic activities and global population.

Of the 49 $GtCO_{2e}$ of global GHG emissions in 2010, the energy sector accounted for 35 percent (17 $GtCO_{2e}$); agriculture, forestry, and other land use (AFOLU) for 24 percent (12 $GtCO_{2e}$); industry for 21 percent (10 $GtCO_{2e}$); transport for 14 percent (7 $GtCO_{2e}$); and commercial buildings for 6 percent (3.2 $GtCO_{2e}$). When emissions from electricity and heat production are attributed to the sectors that use the final energy (i.e. indirect emissions), the shares of the industry and buildings sectors increase to 31 percent and 19 percent, respectively (see Figure 2).

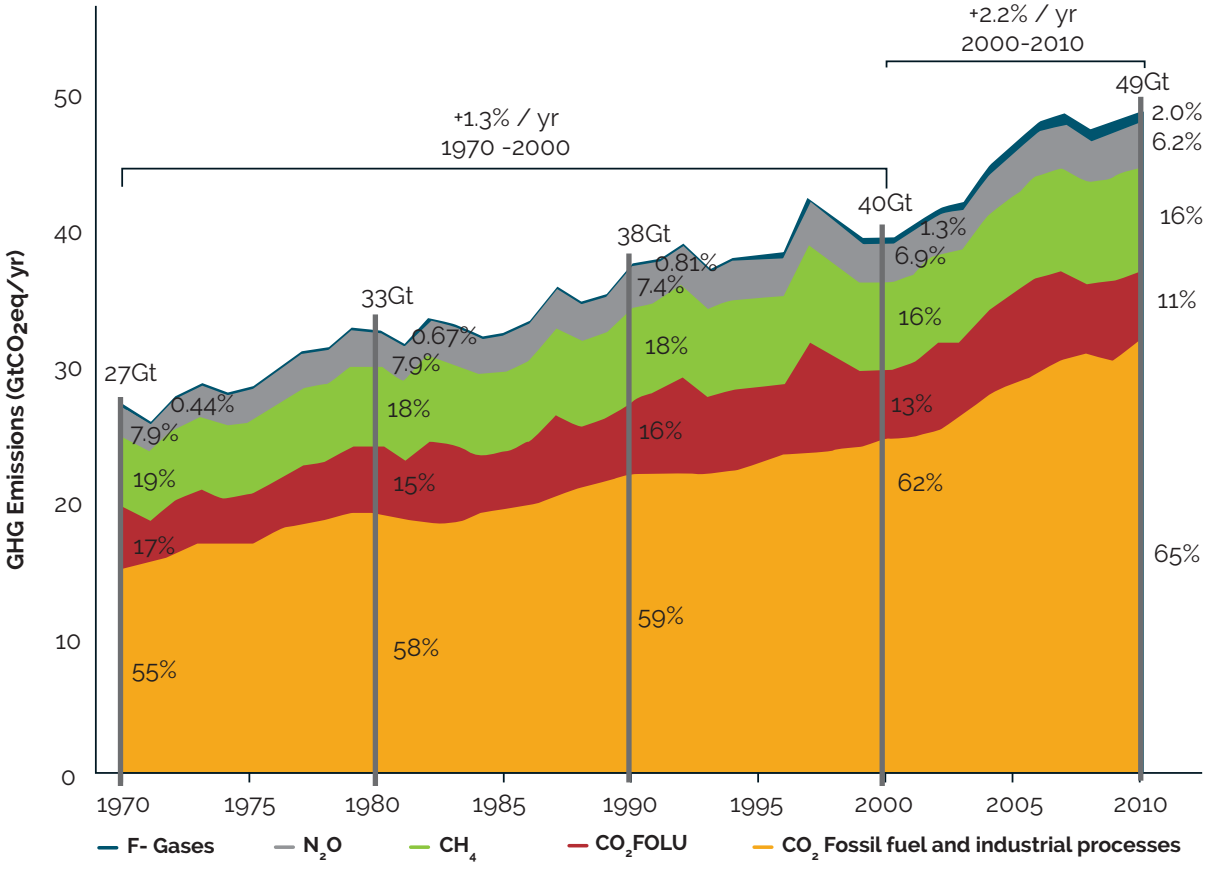
Without additional efforts, anthropogenic GHG emissions are expected to increase to over 100 $GtCO_{2e}$ by 2100, resulting in an increase in global temperatures of 3.7°C to 4.8°C (IPCC 2014a).

To prevent the most severe impacts of climate change, parties to the UN Framework Convention on Climate Change (UNFCCC) agreed in 2010 to commit to a maximum temperature rise of 2°C above preindustrial levels (UNFCCC 2011).

Most recently, the concept of a cumulative carbon emission budget has entered the public domain.[6] "The principal driver of long-term warming is the total cumulative emission of CO_2 over time. To limit warming caused by CO_2 emissions to a given temperature target, cumulative CO_2 emissions from all anthropogenic sources need to be limited to a certain budget. Higher emissions in earlier decades simply imply lower emissions by the same amount later on" (IPCC 2014a).

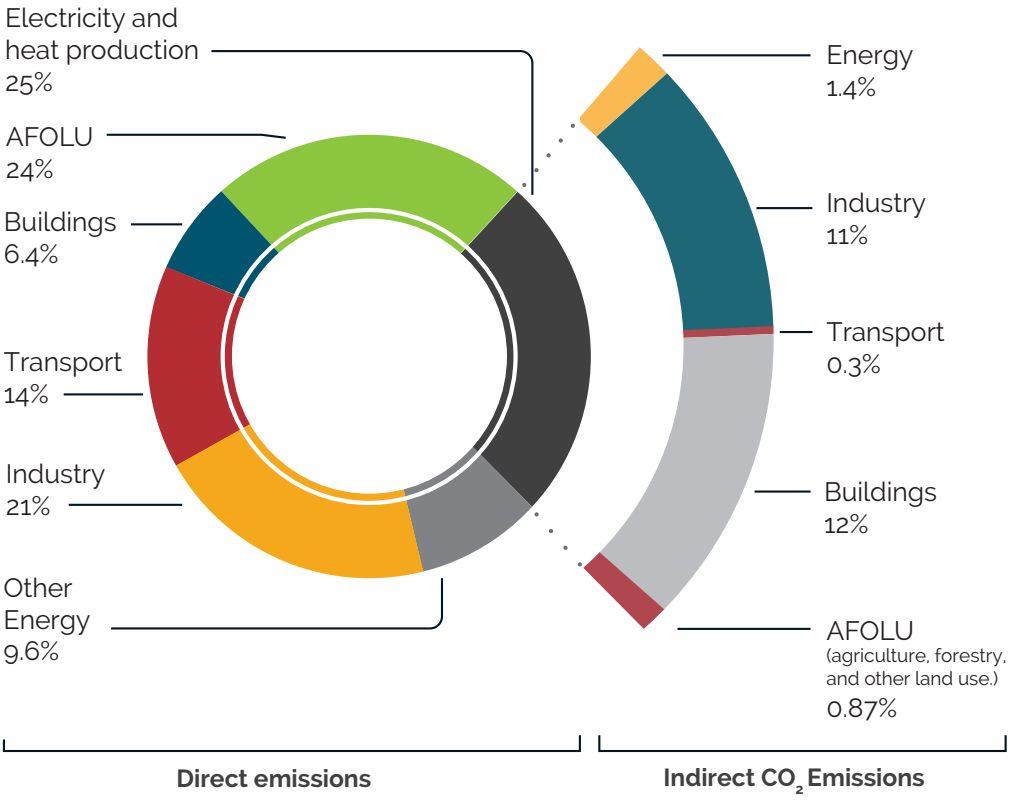
[6] The validity of this approach is presented in Meinshausen et al. (2009), who show the approximate linearity between temperature and CO_2 emissions. Its use is also discussed in IPCC (2014a).

Figure 1. Total annual anthropogenic GHG emissions by groups of greenhouse gases



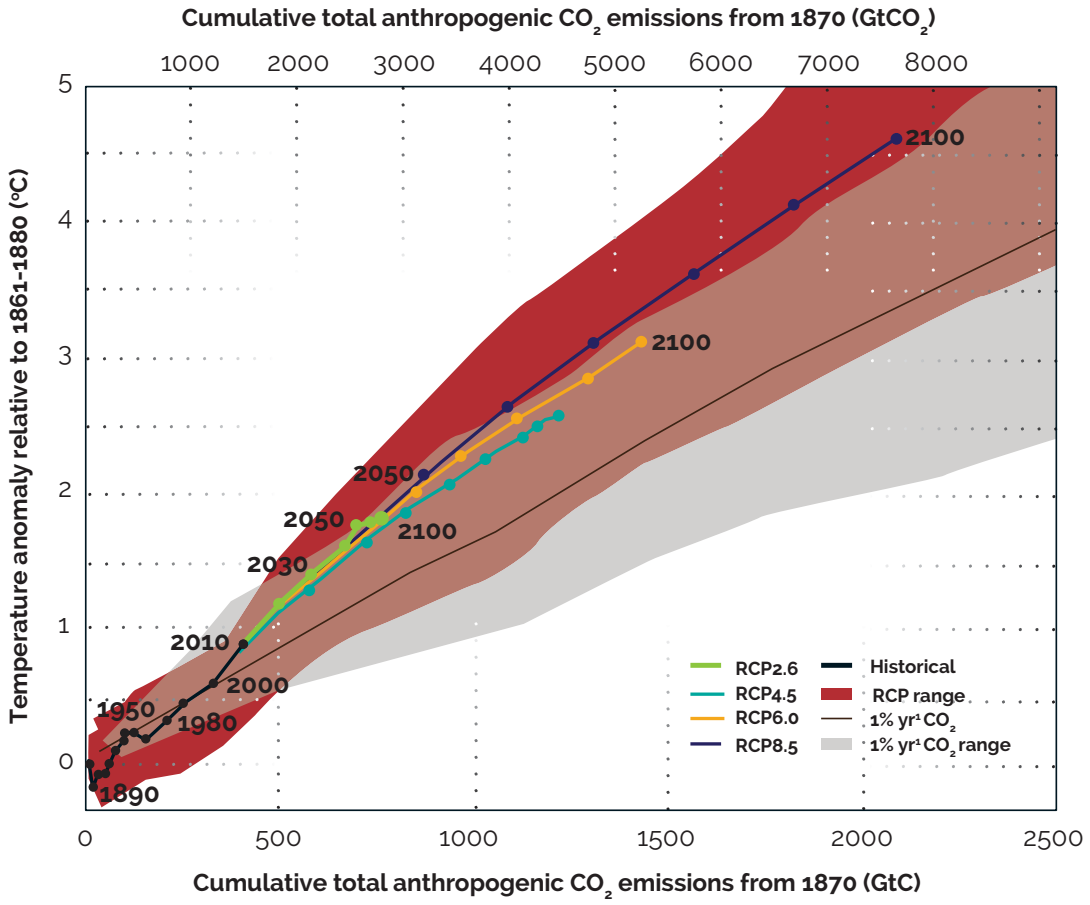
Source: IPCC (2014).

Figure 2. Share of direct and indirect GHG emissions in 2010 by economic sector



Source: IPCC (2014).

Figure 3. Cumulative total anthropogenic CO2 emissions from 1870 illustrate the concept of a carbon budget for a given increase in global average temperature



Source: IPCC (2014).

A global carbon budget is a practical and powerful concept that is easy to communicate. In practice, even if in certain 2˚C scenarios some sectors do not fully decarbonize, in the long term (beyond 2050), net zero emissions to the atmosphere must occur to avoid exceeding the budgeted CO_2 amount that would lead to warming higher than 2˚C.

The global budget at the core of the method is calculated as follows: limiting the global warming caused by anthropogenic CO_2 emissions to less than 2˚C since preindustrial levels will require cumulative CO_2 emissions (the CO_2 budget) to stay below 3,670 $GtCO_2$ since the preindustrial period. This budget gives a minimum 66 percent chance probability of less than 2 degrees of warming occurring according to the IPCC. When taking non-CO_2 gases into account, this remaining budget reduces to about 2,900 $GtCO_2$ (IPCC 2014a). Since 1,890 $GtCO_2$ were emitted by 2011, the remaining CO_2 budget from 2011 onward is 1,010 $GtCO_2$ (IPCC 2014a).[7]

Over time the remaining global budget will change; it will decrease as economic activity continues to emit CO_2 into the atmosphere. New technological innovations might lead to increases or decreases in emissions; or a new political and social consensus might arise to limit emissions. The authors acknowledge that regularly updating the global budget will be important for the robustness and integrity of the sector-based method as a tool to help companies set emission reduction targets.

The representative concentration pathways (RCPs) are the latest generation of IPCC scenarios that provide input for climate models (see Appendix IV for more information). They are based on newly developed, more detailed knowledge and are better integrated with other disciplines than previous scenarios (van Vuuren 2011).

RCPs describe the possibility of different radiative forcing values (W/m2) by the end of the 21st century relative to preindustrial values, as a function of the greenhouse gases (and aerosols) released in future years and consequently their concentration outcome in the atmosphere.

The four RCP scenarios are peer-reviewed and represent the most recent scientific literature. IPCC's RCP 2.6 scenario gives the highest likelihood (probability of 66–100 percent) of staying below 450 ppm CO_{2e} and thus keeping the average global temperature rise below 2 ˚C in 2100. The RCP 2.6 scenario is the basis for the 2˚C decarbonization pathway for this sector-based method and is compatible with the global carbon budget. RCP 2.6 estimates emissions of 990 tCO_2 up to 2050,[8] with a

[7] This budget is expressed in CO_2 and not in CO2e. This means that the budget accounts for CO_2 from fossil fuel combustion and industrial processes, already taking the forcing of non-CO_2 gases into account in the remaining budget.

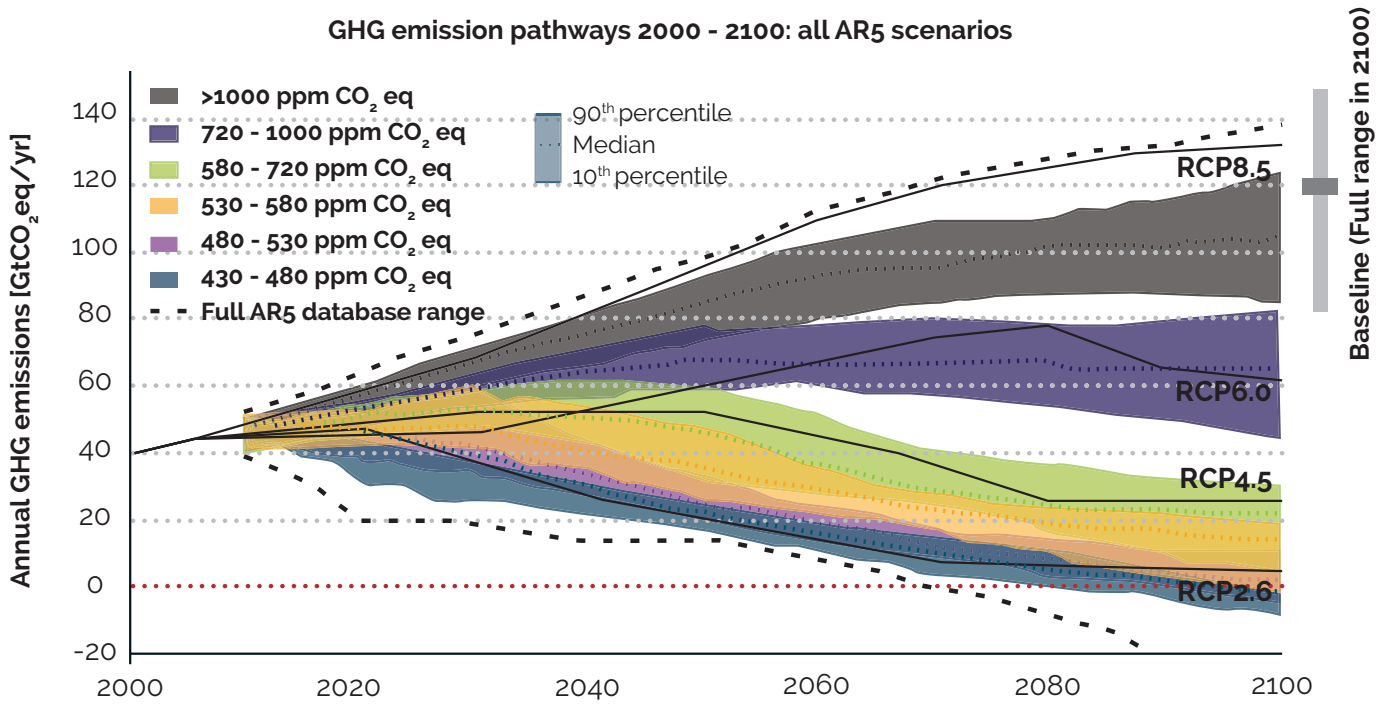
relevant and important component of carbon capture and storage being deployed beyond 2050.

Linked to this 2°C decarbonization pathway, IPCC AR5 Working Group III recently published its report "Mitigation of Climate Change" (IPCC 2014b), in which 2°C mitigation scenarios for the sectors "energy systems," "transport," "buildings," "industry and agriculture," and "forestry and other land use" are assessed.

However, most mitigation scenarios for industry are not detailed enough. Therefore, following the IPCC AR5 Working Group III report, the detailed CO_2 scenarios that the International Energy Agency (IEA) has created in its 2014 Energy Technology Perspectives (ETP) report are used for all sectors. IEA's 2°C scenario (2DS) is consistent with the RCP 2.6 scenario (see Figure 8 and Table 1) and has breakdowns of several industrial sectors, which makes it useful for developing the sector-based method. This scenario estimates an overall net emissions budget up to 2050 of 1,055 $GtCO_2$,[9] with CCS playing an important role after 2050, and representing up to 93 $GtCO_2$ of reductions up to that year.

The ETP report has been reviewed by scientists and compared with RCP 2.6 in a peer reviewed paper (Schaeffer & van Vuuren 2012). Furthermore, the IEA ETP-TIMES model (see Appendix V) is used by more than 250 groups in seventy countries, is peer reviewed, and is revised and updated regularly by a large network of collaborators in which IEA plays a central role.

Figure 4. Pathways of global GHG emissions, 2000–2100



Source: IPCC (2014).

Note: $GtCO_2e/yr$= gigatons of carbon dioxide equivalent per year.

[8] This budget is for the period 2012–50 and is a mean value for a range that varies between 510 to 1505 GtCO2 (IPCC 2014a).

[9] IEA provides emission values for the years 2011 and then 2020 to 2050 every five years. This value was calculated by linear interpolation of the values for the years where no emission value is defined.

1.1.2. Ambition of the 2˚C target and corresponding global carbon budget

In 1996, the European Union proposed to limit global warming to 2˚C relative to preindustrial times based on evidence that many ecosystems were at risk with larger climate change and with support from some environmentalists and scientists.[10]

It was also adopted under the 'Copenhagen Accord' (2009, 15th Conference of the Parties of the UNFCCC), where international governments "agree[d] that deep cuts in global emissions are required according to science, as documented in the IPCC 4th Assessment Report with a view to reduce global emissions so as to hold the increase in global temperature below 2 degrees Celsius […]" Again, at the 2010 UNFCCC conference in Cancún, parties reiterated this consensus and agreed to commit to a maximum temperature rise of 2˚C above preindustrial levels (UNFCCC 2011). Thus, a political consensus was formed through the negotiation process to limit global warming to 2˚C.

Nevertheless, this consensus has its critics—ranging from scientific experts (e.g., Hansen et al. 2013), who think it is insufficient to avoid dangerous climate change, to economists, who argue that the target is an infeasible, expensive, and inappropriate way of framing climate policy (Tavoni and Tol, 2010).

It is assumed that the political commitment to limit the temperature rise of 2˚C above preindustrial levels is the starting point of the SDA approach in setting a global carbon budget that is sufficient to avoid dangerous climate change.

Scenarios built around the 2˚C emission pathway have levels of risk that are commonly expressed as probabilities to achieve the 2˚C target. The method heavily relies on IEA's 2ºC scenario, which describes "an energy system consistent with an emissions trajectory that recent climate science research indicates would give at least a 50 percent chance of limiting average global temperature increase to 2˚C" (IEA 2014a).

The 2DS is modeled for 2011–50, an appropriate time frame because both the cumulative emissions up to 2050 and the 2050 emissions level are robust indicators of the probability of meeting the 2˚C target (Meinshausen et al. 2009; O'Neill et al. 2010).

Using alternative scenarios proposing different probabilities of achieving a 2˚C target is theoretically possible, but such scenarios are not currently available at the level of sector disaggregation available in the IEA 2DS.

1.1.3. Consideration of non-CO_2 GHGs in the budget

The global budget considered for the method—totaling 1,010 $GtCO_2$—is expressed in gigatons of CO_2 rather than in CO_2 equivalent, which includes other greenhouse gases. Though the SDA emissions budget is in CO_2, other greenhouse gases are considered.

The budget originates from AR5 (IPCC 2014a), which mentioned that the figure is achieved when accounting for non-CO_2 forcings as in RCP 2.6. This means that the budget accounts for CO_2 emissions only, but considers that other gases that cause forcing are also emitted. This aspect is important because the relationship between CO_2 and the increase in the average global temperature (TCRE or ratio of global temperature change to total cumulative anthropogenic CO_2 emissions) "only characterizes the warming due to CO_2 emissions, and contributions from non-CO_2 gases need to be considered separately when estimating likelihoods to stay below a temperature limit" (IPCC 2014a).

Warming as a function of cumulative CO_2 emissions in the presence of non-CO_2 forcing is larger since non-CO_2 forcings contribute warming in these scenarios (Hajima et al. 2012).

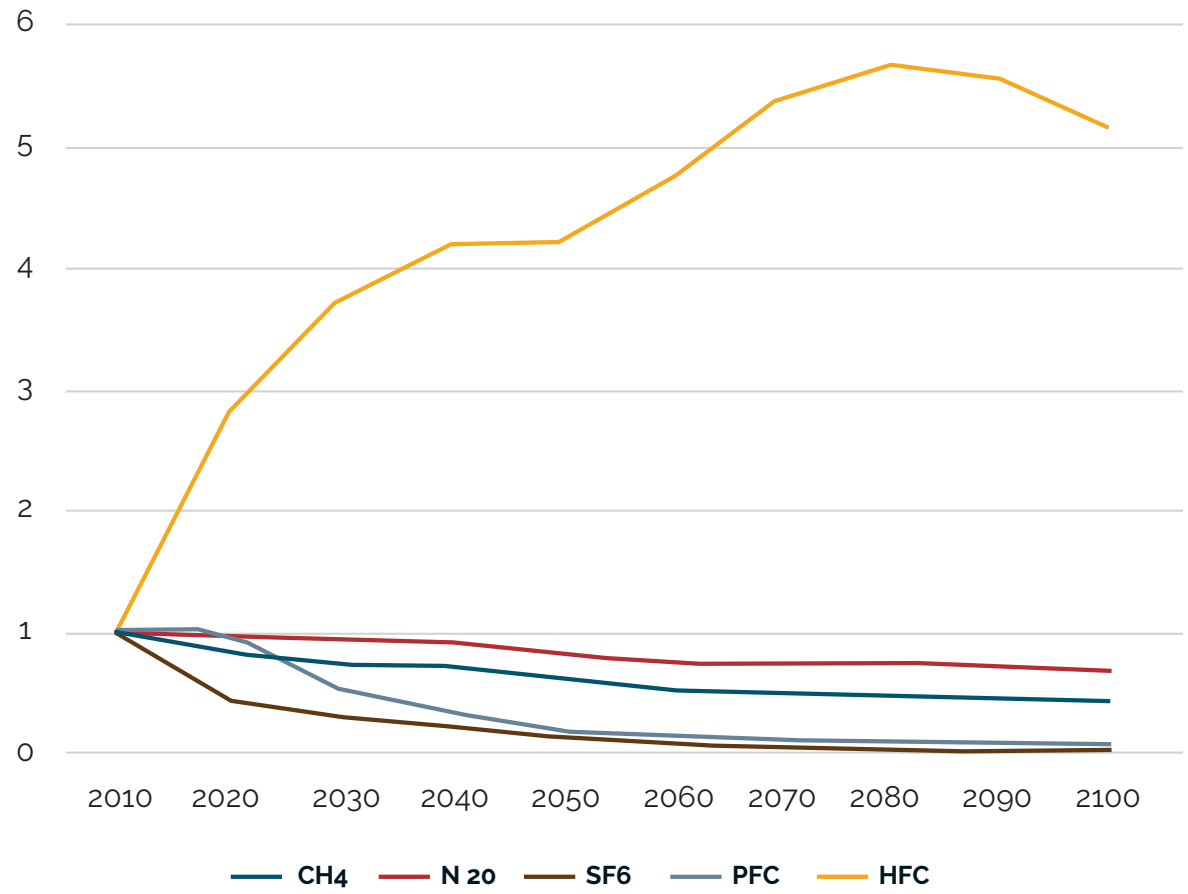
Considering that the budget of 1,010 $GtCO_2$ and RCP 2.6 take into account the effect of non-CO_2 forcing, and that "by far the most important contribution to increased radiative forcing compared to preindustrial levels comes from CO_2, both in the baseline and the mitigation case" (IPCC 2014a), the authors decided to use CO_2 emissions as the measure in the carbon budget for the method (Van Vuuren, 2011).

Non-CO_2 emissions are negligible for a majority of corporations and in the most significant emissions processes (e.g., in most combustion processes they represent less than 2 percent of emissions). There are, however, GHG sources where non-CO_2 gases might not be negligible. For example, some agricultural activities are significant sources of nitrous oxide (N2O) and methane (CH4), and the production and exploration for oil, gas, and coal, can produce significant methane. Unfortunately, these sectors are currently not covered in the method. In special cases of sectors covered by the method where there might be non-negligible sources of non-CO_2 gases, the recommendation is to set the target based on the full CO_2e corporate footprint. This way, the effect of non-CO_2 gases would be counted twice and the method would be conservative, by decreasing the budget more than it would otherwise be.

Finally, the RCP 2.6 does contain mitigation scenarios for non-CO_2 gases, namely CH4, N2O, and perfluorocarbons (PFC), sulfur hexafluoride (SF6), and hydro-fluorocarbons (HFC). These gases are not discriminated by sectors, so their use under the current version of the method was not possible. Methods other than the SDA cover GHGs beyond carbon and may provide more insight for companies from sectors beyond the SDA scope.[11] A potential area for further improvement of the method would be to address sectors that are currently excluded. The following figure shows the indexed emission pathways of non-CO_2 greenhouse gases of the Kyoto Protocol from 2010 to 2050.

[10] For further discussion on the limitations and benefits of the 2°C target, see: S. Randalls. 2010. "History of the 2°C climate target….." WIREs Clim. Change 1: 598–605.

Figure 5. Indexed emission pathways for non-CO2 greenhouse gases (2010=1)



Source: IPCC (2014).

1.2. CORPORATE TARGET SETTING TO REACH THE 2°C GOAL

The critical role of business in the transition to a low-carbon economy is unquestionable. Business is not only a key contributor to the 49 gigatons of emissions released to the atmosphere on a recent annual basis, but they also have the potential to reduce emissions through innovation and technological change. Over 80 percent of the Global 500 companies have adopted emission reduction targets (CDP 2013). Most of these targets are conservative and in response to existing or expected regulations, or are based on existing plans for short-term efficiency projects, leading to incremental improvements in the companies' carbon footprints. However, a few forward-looking companies have aligned their emissions targets to the emission reductions that the scientific community deems necessary to limit global warming to less than 2°C.

Science-based targets as defined by the science-based targets initiative:

Targets adopted by companies to reduce GHG emissions are considered "science-based" if they are in line with the level of decarbonization required to keep global temperature increase below 2˚C compared to preindustrial temperatures, as described in the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).

1.2.1. The difference between absolute and intensity targets

Absolute targets reduce a specified quantity of emissions from the base year to the target year. For example, an absolute target may be a 20 percent reduction in a company's scope 1 emissions from 2010 to 2020. Absolute reduction targets are the most meaningful in reducing global total atmospheric emissions. Future regulations may require companies to reduce their emissions on an absolute basis and companies may prepare themselves by setting absolute targets now. Overall, absolute targets are more straightforward to measure and communicate. However, the absolute nature of these targets may be a disadvantage to some companies. These targets are more challenging to achieve if a company is growing and similarly not the best way for a company to improve its environmental performance if it is shrinking.

Intensity targets, also known as normalized targets, are emissions per unit of economic output (e.g. unit of production, number of employees, or value-added). For example, an intensity target might be a 35 percent reduction in CO2e emissions per unit of value-added from 2010 to 2020. Unlike absolute emissions, there is no guarantee that emissions to the atmosphere will be reduced. This is because absolute emissions can increase while a company's emissions intensity decreases. However, under the initiative's definition, a science-based target would make the absolute reductions necessary to stay within a 2˚C temperature increase, though the absolute target may also be expressed as an absolute intensity target. Future emissions regulations will likely not be made on an intensity basis. There may also be issues in reporting because companies may want to keep these economic or physical output measurements confidential. On the other hand, basing a target on a consistent output metric provides a common metric to measure performance between different companies. Lastly, companies may prefer intensity targets because they allow for growth.

The range of methods available to companies that wish to set science-based targets is available at sciencebasedtargets.org/methodologies and will be in other products of the initiative. The purpose of this document is to introduce the Sectoral Decarbonization Approach.

2. SECTORAL DECARBONIZATION APPROACH (SDA): METHOD OVERVIEW

The Sectoral Decarbonization Approach (SDA) is a freely available method informed by climate science that allows companies to set emission reduction targets in line with a 2°C decarbonization scenario. It is based on the 2°C scenario (2DS) developed by the International Energy Agency (IEA) as part of its publication, Energy Technology Perspectives 2014 (IEA 2014).

This section provides an overview of the main features of the method and includes a step-by-step description on how companies can use it to set greenhouse gas (GHG) emissions reduction targets. Additional detail on underlying assumptions is provided at the end of this section. A user-friendly tool for companies to set science-based targets applying this approach can be found in http://sciencebasedtargets.org/tools/.

2.1. A snapshot into the method development

The elements and phases for the development of the SDA's science-based target-setting method are illustrated in Figure 6.

In developing this method, the following elements were considered: carbon budget and emission scenarios; sector and emissions coverage; marginal abatement costs among covered sectors; sector classification and activity indicators; treatment of Scope 1, Scope 2, and Scope 3 emissions; and double counting. Each element is described below.

2.1.1. Carbon budget and emission scenarios

The first step in defining science-based emission reduction targets is to understand the maximum increase in global average temperature that would prevent "dangerous anthropogenic interference with the climate system" (United Nations 2012). As discussed in the previous section, the threshold generally identified in scientific literature and agreed upon by the policy community is a ceiling of 2˚C increase in global average surface temperatures compared with preindustrial levels. While a cap of 1.5°C holds better chances of averting "dangerous climate change," there is considerably more modeling and publicly available data with sufficient resolution at the sector level for a 2°C threshold (United Nations 2012; IPCC 2014a). Therefore, the 2°C limit is applied in this method.

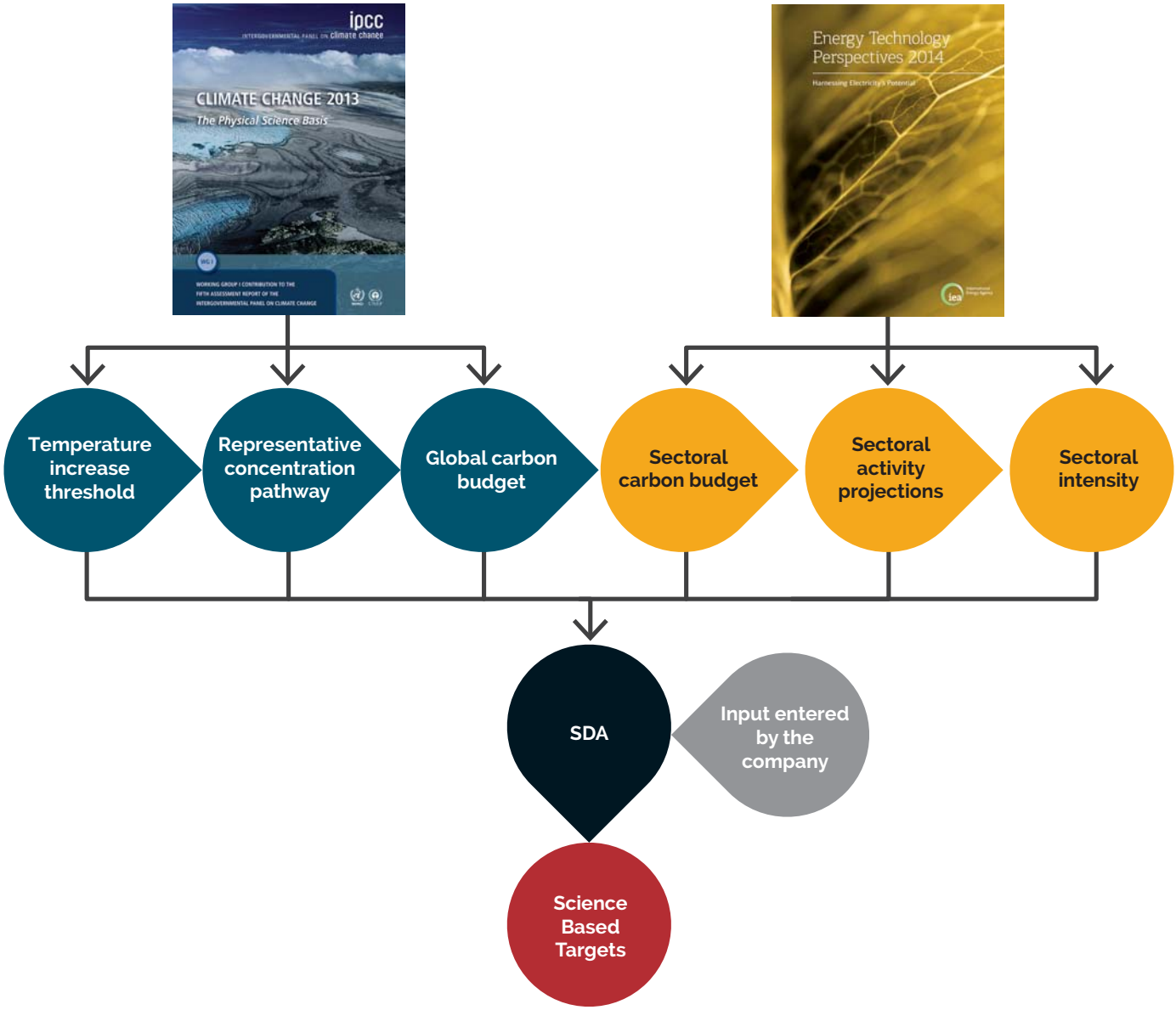
According to the IPCC's Fifth Assessment Report: Working Group I, limiting anthropogenic global warming to less than 2°C with a probability of more than 66 percent, requires keeping cumulative CO_2 emissions from all anthropogenic sources below about 1,000 gigatons (Gt) of carbon (IPCC 2013). This figure constitutes the carbon budget for all anthropogenic carbon emissions necessary to limit global warming to less than 2˚C.

From the four different emission scenarios assessed by the IPCC Fifth Assessment Report: Working Group III, the one that holds the best chances of limiting global warming to less than 2°C is the "representative concentration pathway (RCP 2.6)" (IPCC 2014b). [12] This concentration pathway[13] represents a peak-and-decline model that reaches a maximum level of radiative forcing of 3.1 watts per square meter (W/m2) by midcentury and then declines to about 2.6 W/m2 by the end of the century. This scenario would stabilize concentrations of GHG emissions in the atmosphere at about 450 parts per million (ppm) by 2100. For more information on different RCPs, see Box 1.

[12] IPCC developed a total of four scenarios: RCP2.6, RCP4.5, RCP6, and RCP8.5. They are named after a possible range of radiative forcing values in the year 2100 relative to preindustrial values (+2.6, +4.5, +6.0 and +8.5 W/m2, respectively).
[13] This concentration pathway has been developed by the IMAGE modeling team of the PBL Netherlands Environmental Assessment Agency.

While the RCP 2.6 emissions scenario provides a useful framework to understand the emissions trajectory at the macro level, it does not provide sufficient resolution at the sectoral level to understand the type of transformations required in different industries to achieve this level of decarbonization. Thus, IEA's 2°C scenario (2DS) was used for this purpose (IEA 2014). The 2DS scenario describes an energy and industrial system consistent with an emissions trajectory that, according to climate science, has a good chance of limiting global warming to less than 2°C. The correspondence between the RCP 2.6 and 2DS scenarios has been assessed and validated by Schaeffer & Van Vuuren (2012).

Figure 6. Development of the SDA method



CLIMATE SCENARIOS IN THE FIFTH ASSESSMENT REPORT

The IPCC's Fifth Assessment Report defined four concentration pathways—named representative concentration pathways (RCPs)—that correspond to four approximate radiative forcings: 2.6 W/m^2, 4.5 W/m^2, 6 W/m^2, and 8.5 W/m^2. All of the four RCPs cover the period 1850–2100 and represent different scenarios of climate policy. The RCPs do not include the no-climate policy scenario compared to previous scenarios in the third and fourth IPCC assessment reports. The following chart summarizes their key characteristics.

RCP	Scenario Type	Radiative forcing pathway
2.6	Scenario that leads to a low radiative forcing	Radiative forcing peaks and declines by mid-century
4.5	Stabilization scenario	Radiative forcing stabilizes by 2100
6	Stabilization scenario	Radiative forcing does not peak by the year 2100
8.5	Scenario with high GHG emissions	Radiative forcing does not peak by the year 2100

Source: IPCC (2014a).

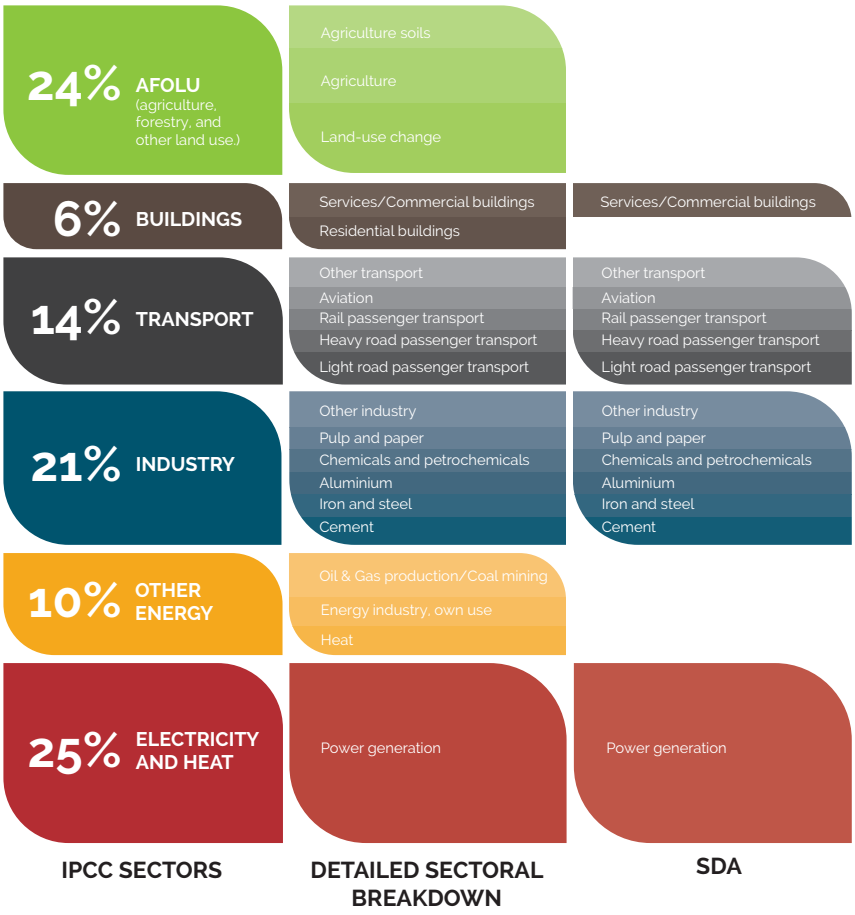
2.1.2. Sector and emissions coverage

The method described in this report allows companies to set emission reduction targets that are in line with IEA's 2DS scenario based on sector-specific decarbonization pathways.

The activities and sectors covered under this version 1.0 of the method are shown in Figure 7. This coverage represents up to 87 percent of the global CO_2 emissions budget to 2050, and over 60 percent of global GHG emissions budget based on current yearly emissions and projections of future emissions.

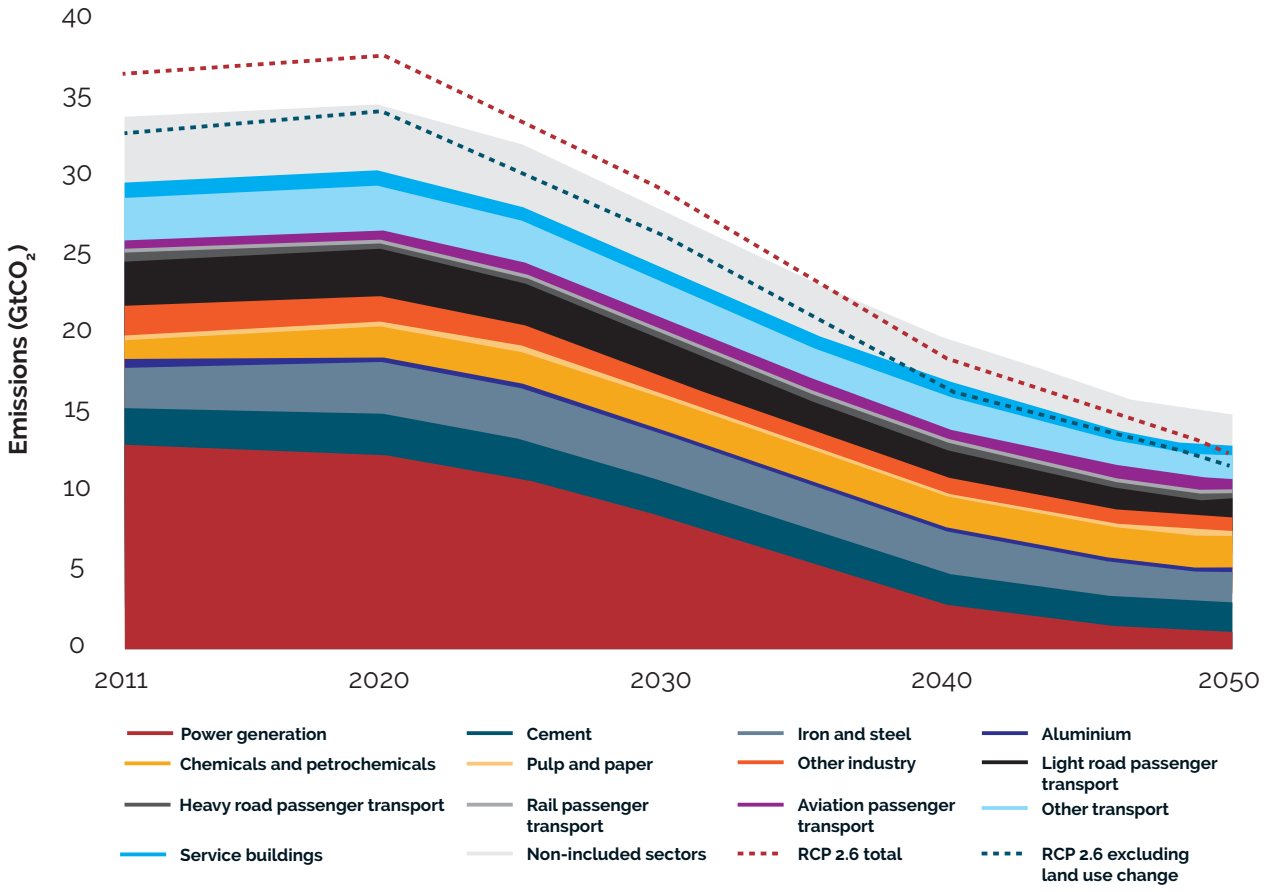
The SDA method uses data from IEA ETP 2DS to break down the CO_2 budget in the period 2011–50 into the sectors that it currently covers. In this way, CO_2 budgets per sector are compatible with the global carbon budget defined in RCP 2.6. To illustrate further, Figure 8 and Table 1 show the Scope 1 sectoral 2˚C decarbonization pathways under the SDA (based on ETP 2DS) and RCP 2.6. The total SDA budgets shown display non-included sectors, totaling 1055 $GtCO_2$. The RCP 2.6 emissions total budget is also shown, totaling 1083 $GtCO_2$ by 2050.
Therefore, the budget presented by IEA and used in the SDA is in close alignment with RCP2.6. ETP does not include land use change CO_2 emissions, but as shown below, under RCP 2.6 up to the year 2050, they represent approximately 10 percent of the budget. Even if this is added to the IEA budget, totaling 1,158 $GtCO_2$, the SDA budget is still well within the range of admissible budgets for a 2˚C pathway (510 to 1505 $GtCO_2$).
Furthermore, since land use change is not attributed to any company, this approach is conservative. The remaining CO_2 emissions in RCP 2.6—fossil fuel use and industry—are well-aligned with the IEA projections. See Appendix II for further detail on how SDA budgets were derived from ETP 2DS. Emissions budgets from ETP 2DS are proprietary data and are available from IEA with purchase of a license.

Figure 7. Sectoral coverage of GHG emissions under the SDA method, considering current GHG emission profile



Sources: IPCC (2014a); IEA (2014).

Figure 8. Sectoral breakdown of absolute CO2 emissions budget, 2011–50



Source: IEA ETP 2DS 2014.

TABLE 1. SECTORAL CO_2 BUDGETS FOR SDA AND RCP 2.6, 2011-50

	Sector	Subsector	Cumulative CO_2 emissions 2011–50 ($GtCO_2$)
SDA	Power Generation	N/A	300
	Industry	Iron & Steel	112
		Cement	89
		Aluminum	11
		Pulp & Paper	8
		Chemicals & petrochemicals	78
		Other industry	51
	Transport Services	Passenger transport - Air	36
		Passenger transport – Light road	93
		Passenger transport – Heavy road	15
		Passenger transport - Rail	1
		Other transport	91
	Services / Commercial Buildings	Trade / Retail	32
		Finance	
		Real estate	
		Public administration	
		Health	
		Food and lodging	
		Education	
		Other commercial services	
	Non-included sectors*	N/A	138
	Total cumulative emissions		**1,055**
RCP 2.6	Fossil fuels and industry	N/A	979
	Land use change*	N/A	104
	Total cumulative emissions		**1,083**

Source: IEA ETP (2014) and IPCC (2014).
Note: *Sectors not included in the SDA

As can be seen in Figure 8, the pathway proposed under the ETP 2DS scenario results in a deep decarbonization of the power sector, which initially reduces emissions modestly between 2011 and 2025, and then decarbonizes faster in the period 2025–2050. This results from the phasing out of coal power through the increase of renewable energies and natural gas. Gas should maintain its capacity up to 2040, at which point it should include carbon capture and storage at its facilities.[14]

Renewable energy should steadily increase its generation share until 2025–30, with a more pronounced uptake after that date (IEA 2014). In addition, decarbonizing the electricity sector can deliver a spillover effect by reducing emissions from end-use sectors without further investments (IEA 2014). This scenario results from a set of assumptions relative to carbon pricing. In this scenario, it is expected to start at $30–$50 per ton of CO_2 in 2020 and go up to $140–$170 per ton in 2050 (IEA 2014).

IEA scenarios estimate levels of economic activity (see Appendix V for IEA's GDP growth rates) and production for each sector. In the period between 2010 and 2050, estimates of the increase in material output range from a low of 26 percent for the cement sector to a high of 169 percent for aluminum. Although other sectors are not expected to reduce their carbon emissions as steeply as the power sector, it will be a considerable challenge to contain emissions with continuously growing economic activity and increased physical output.

Beyond the power sector, reductions of carbon intensities are more than 50 percent for the large majority of the sectors: iron and steel, service buildings, large road, chemicals and petrochemicals, pulp and paper, other industry, light duty vehicles, and rail and other transport sectors. The sectors with less reduction on an intensity basis are the aluminum, air travel, and cement sectors. The aluminum sector is mainly decarbonized through the impact of the decarbonization of the power sector, given that it has very large scope 2 emissions.

More information about the data for each sector under the 2DS scenario, as well as an explanation of how the model forecasts these reductions, can be found in Appendix I. For a description of how the sectoral cumulative CO_2 budgets were derived, see Appendix II.

The metric used for translating sector budgets into company targets can be double checked by performing a validation. In this validation, equations 1 and 2 are assessed:

EQUATION 1

$$\int_{j}\int_{y}\left(A_{j,y}\times SI_{j,y}+Other_{y}\right)\leq Budget_{2^{\circ}C,2050}$$

EQUATION 2

$$\int_{j}\left(A_{j,y}\times SI_{j,y}\right)+Other_{y}\leq Emissions_{2^{\circ}C,y}$$

WHERE:

$A_{j,y}$	Activity of sector j in year y
$SI_{j,y}$	Carbon intensity of sector i in year y
$Other_{y}$	Other GHG emissions (not accounted for in the SI_{jy} variable) in year y
$Budget_{2^{\circ}C,2050}$	Cumulative carbon budget 2011–50 compatible with a below 2ºC scenario
$Emissions_{2^{\circ}C,y}$	Emissions in year y compatible with a below 2ºC scenario

[14] "Regionally, whether the primary decarbonization benefit of gas-fired generation is to displace coal or to support renewables depends on a number of factors. These include a country's existing electricity mix, its relative prices of coal and natural gas, its penetration of VRE [variable renewable energy], its regulation of CO_2 emissions, and the availability of competing technologies for low-carbon dispatchable electricity. Because these factors vary between regions, the evolution of gas-fired generation and other sources of electricity follow different patterns in the 2DS." (IEA 2014)

These equations were checked for scope 1 direct emissions and their emissions pathways to avoid double counting. Based on the scope 1 emissions and the activity of each sector, the carbon intensity in each year per sector was calculated. Multiplying the carbon intensity by the activity leads back to the emission pathway per sector as shown in Figure 8. The cumulative sum of these CO_2 emissions is 1,055 $GtCO_2$. This is consistent with RCP 2.6, where in the last decades of this century negative CO_2 emissions due to scaled-up technologies (including carbon capture and storage) compensate for this overshoot.

Companies' intensity pathways—given by the method—multiplied by their projected activity give a company's carbon budget for the target period. In principle, the sum of these budgets should be contained within the sector projected budget given by the IEA 2DS. However, it can be shown that even if the sum of all activity data by companies in the sector match the activity data of IEA 2DS, it cannot be guaranteed that the sector budget will be met. This fact requires that the method should be periodically revised to check the validity of the projections used and that companies should also revise and check "compliance" to their targets, by checking whether activity matched their projections and if intensities were below the specified pathway.

2.1.3. Sector classification and activity indicators

For the purpose of the SDA method, four broad sector classifications were considered. For each sector, a specific activity indicator is proposed based on the common practice in the sector. Please refer to Appendix VI Sector Definitions, for a detailed breakdown of the sectors for which decarbonization pathways were developed.

TABLE 2. SECTOR CLASSIFICATION AND ACTIVITY INDICATORS

Sector	High-level sector description	Subsector	Activity Indicator
1.Power Generation	Power generation is primary business activity.	N/A	Kilowatt-hour[a]
2.Industry[b]	The industry sector is heterogeneous and very complex. Generally speaking, the industry sector covers the manufacture of finished goods and products, mining and quarrying of raw materials, and construction. Power and heat generation, refineries, and the distribution of electricity, gas, and water are excluded. The International Energy Agency (IEA) energy balance follows this definition (IEA 2014). International Standard Industrial Classification codes usually included in industry sector by the IEA are matched with this sector. [c]	Iron & Steel	Tons steel
		Cement	Tons cement[d]
		Aluminum	Tons aluminum
		Pulp & Paper	Tons paper and cardboard
		Chemicals & petrochemicals	$ value-added[e]
		Other industry	$ value-added
3.Transport Services[f]	The transport sector includes the movement of people and goods by the transport modes of road, rail, water, and air. Energy consumption in the transport sector is driven by a wide range of factors, which are different for the passenger segment and the freight segment. As a result, the passenger and freight energy and efficiency trends are calculated separately (IEA 2014).	Passenger transport - Air	Revenue passenger kilometer[g]
		Passenger transport – Light road	Revenue passenger kilometer
		Passenger transport – Heavy road	Revenue passenger kilometer
		Passenger transport - Rail	Revenue passenger kilometer
		Other transport	$ Value-added
4.Services / Commercial Buildings[h]	The services sector, also referred to as the commercial and public service sectors or the tertiary sector, includes all activities related to trade, finance, real estate, public administration, health, food and lodging, education and commercial services, as classified by ISIC. It covers energy consumed for space heating, cooling and ventilation; water heating; lighting; and other energy-using equipment such as commercial appliances and cooking devices, x-ray machines, office equipment, and generators. Energy consumption for transportation, or for commercial transport fleets, and energy consumption for electricity and heat generation are excluded from the services sector (IEA 2014).	Trade / Retail	Square meter
		Finance	
		Real estate	
		Public administration	
		Health	
		Food and lodging	
		Education	
		Other commercial services	

[a] For the power generation sector, a commonly used indicator for activity is the kWh generated. This is a well-documented indicator that has been calculated for most scenarios, including 2DS (IEA 2012a, 2014; Royal Dutch Shell 2013; UNEP 2011).

[b] The cement, iron and steel, aluminum, and pulp and paper sectors are relatively homogeneous (Farla 2000; Phylipsen et al. 1998). Therefore, it is possible to use the physical output as activity indicator. These are tons of cement, crude steel, aluminum, and paper and cardboard respectively. The activity in the iron and steel sector is based on steel production, but in reality, many different iron and steel products and intermediate products can be distinguished (Farla 2000). This also holds for the cement, pulp and paper, and aluminum sectors to some degree (Phylipsen et al. 1998). Both the emissions and activity data for these sectors is given for five-year intervals in IEA ETP 2DS.
[c] http://www.iea.org/statistics/resources/balancedefinitions/#industry.

[d] Cement is a shorthand for "cementitious products" as defined by the Cement Sustainability Initiative (CSI): Cementitious products consist of all clinker produced by the reporting company for cement making or direct clinker sale, plus gypsum, limestone, cement kiln dust (CKD), and all clinker substitutes consumed for blending, plus all cement substitutes.

[e] Value-added should be measured as U. S. dollars for the company's target base year.

[f] In the light and heavy rail and aviation transport sector, the indicator used in IEA ETP 2DS is total revenue passenger kilometers (rpk).

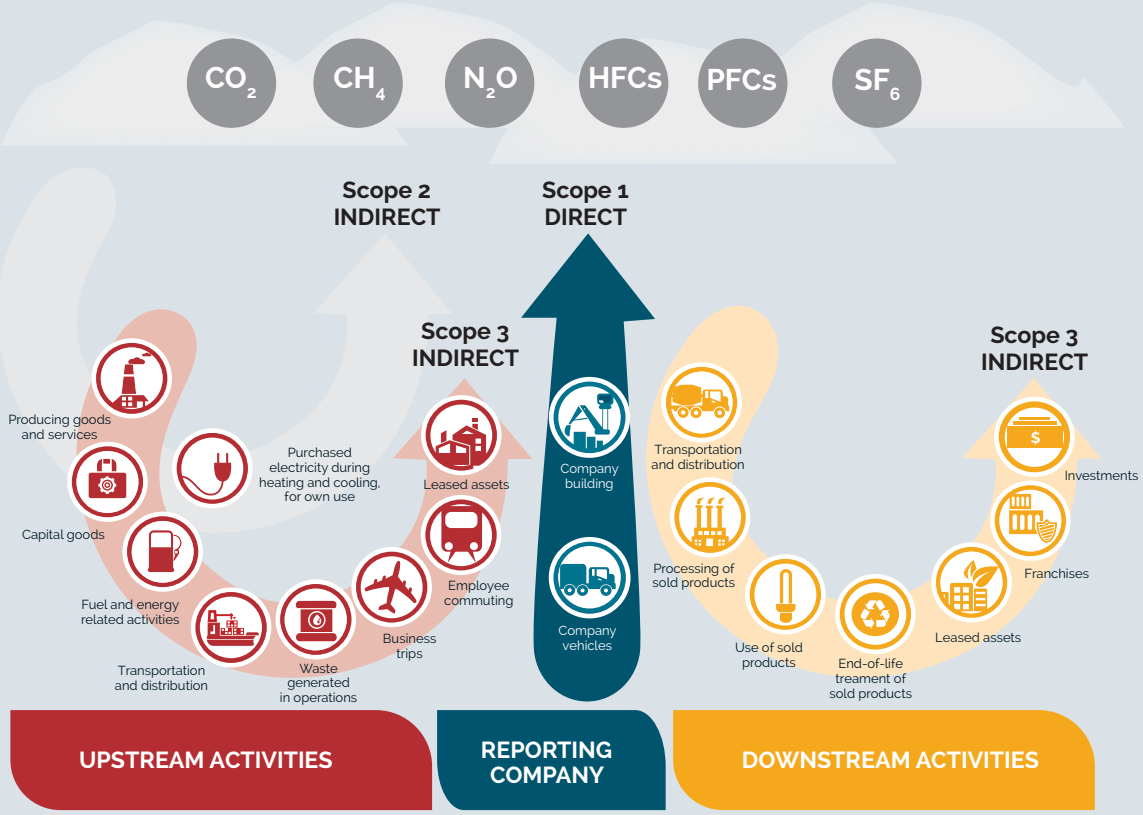
[g] Revenue passenger kilometer is defined as the distance traveled by paying customers in kilometers.

[h] For service buildings, the indicator for activity is square meter, since this data is available for five-year intervals in IEA ETP 2DS and this indicator is also often used in climate science (Girod & De Haan 2010; Girod, van Vuuren, & Hertwich 2014).

2.1.4. Treatment of scope 1 emissions

Scope 1 emissions are direct emissions from sources owned or controlled by the reporting company. They are the most straightforward to estimate and track. For the purpose of applying the SDA, companies can consider their full GHG footprint in CO_{2e}, even though the budgets used as a starting point for the SDA account only for CO_2 emissions. A detailed explanation can be found in section 1.1.3.

Figure 9. The three scopes in the GHG Protocol: Scope 1, direct emissions; Scope 2, indirect emissions; and Scope 3, other indirect emissions in the value chain



Source: GHG Protocol (2011).

The Greenhouse Gas (GHG) Protocol, developed by World Resources Institute (WRI) and World Business Council on Sustainable Development (WBCSD), sets the global standard for how to measure, manage, and report greenhouse gas emissions. The GHG Protocol's suite of standards provides the accounting framework for nearly every GHG standard and program in the world—from the International Standards Organization to The Climate Registry—as well as hundreds of GHG inventories prepared by individual companies.

The GHG Protocol defines direct and indirect emissions as follows:

- Direct GHG emissions are emissions from sources that are owned or controlled by the reporting entity.
- Indirect GHG emissions are emissions that are a consequence of the activities of the reporting entity, but occur at sources owned or controlled by another entity.

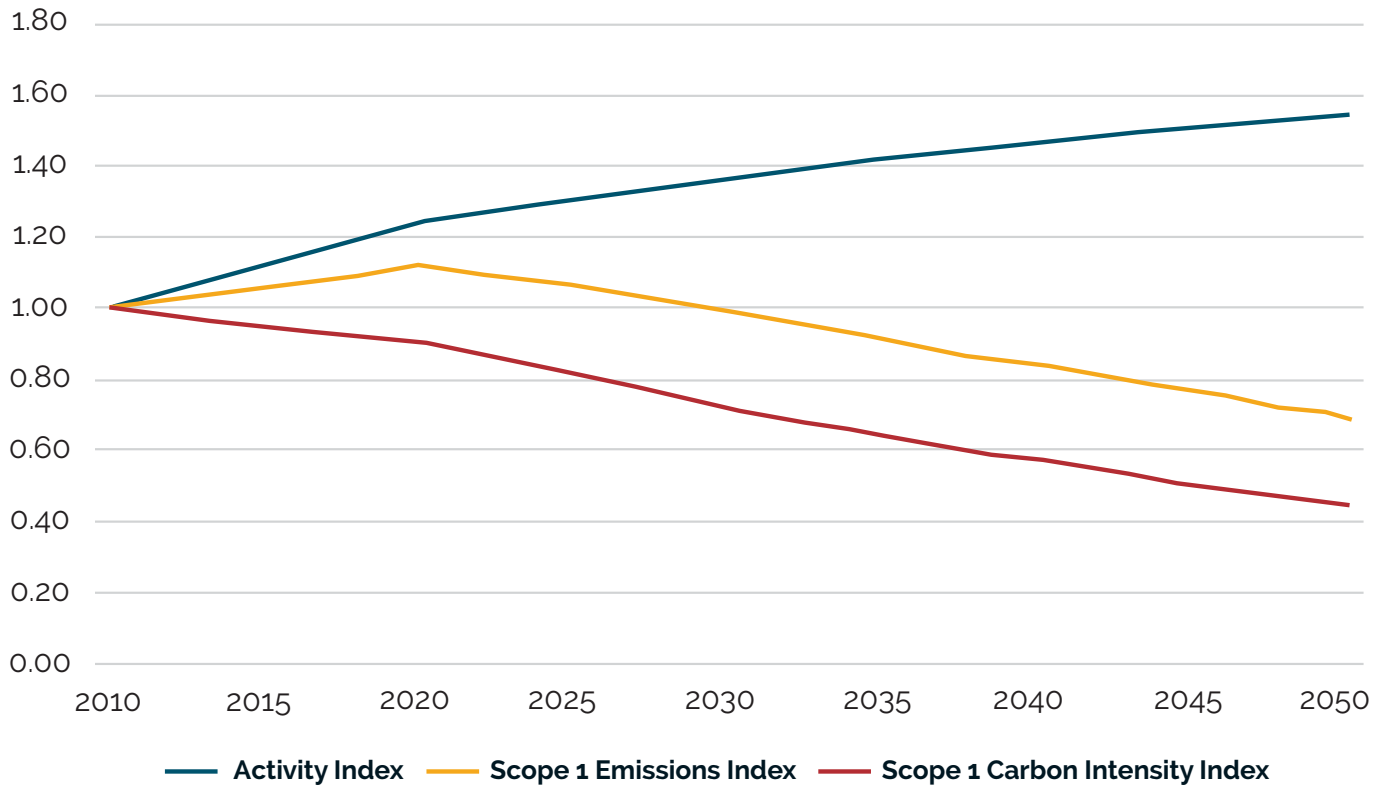
The GHG Protocol further categorizes these direct and indirect emissions into three broad scopes:

- Scope 1: All direct GHG emissions.
- Scope 2: Indirect GHG emissions from consumption of purchased electricity, heat, or steam.
- Scope 3: Other indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities not covered in Scope 2, outsourced activities, waste disposal, etc.[15]

2.1.4.1. Homogeneous sectors

From the detailed sector data in the 2DS scenario, it is possible to estimate the 2˚C-compatible CO_2 intensity for specific sectors by dividing the total direct CO_2 emissions of the sector in any given year (between 2011 and 2050) by the total activity of the sector in the same year. The IEA 2DS scenario represents "peak-and-decline" emissions trajectories, thus the decarbonization pathways and the CO_2 intensity trajectories for the different sectors are not linear. For example, the 2˚C trajectory (emissions, activity, and CO_2 intensity) for the iron and steel sector based on the 2DS scenario produced by the IEA is shown in Figure 10. (For all sector pathways see Appendix I).

Figure 10. 2ºC pathway for the iron and steel sector



Source: Based on IEA 2DS scenario (IEA 2014).

Next, a company-specific carbon intensity trajectory is derived from the sector-specific intensity trajectory. This company pathway depends on its initial performance d, and its expected future market share. The initial performance d is defined as the difference between the company's carbon intensity in the base year and the sector carbon intensity in the year 2050. It is calculated using equation 3.

EQUATION 3

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

WHERE:

d	Initial company performance in the base year relative to the 2050 sector target (tCO_{2e}/activity)
CI_b	CO_2 intensity of the company in base year b (tCO_2/activity)
SI_{2050}	CO_2 intensity of the sector in year 2050 (tCO_2/activity)

[15] The GHG Protocol website, "Frequently Asked Questions," is accessible at: <http://www.ghgprotocol.org/calculation-tools/faq#directindirect>.

The company's expected future activity levels are combined with the sector's expected activity levels from the 2DS scenario to calculate the company's market share parameter for any given year following equation 4.

Note that this is not the change in market share, but rather the inverse, resulting in a decreasing parameter when company's market share is increasing.

EQUATION 4

$$m_y = (CA_b / SA_b) / (CA_y / SA_y)$$

WHERE:

m_y	Market share parameter in year y (%)
CA_b	Activity of the company in base year b
SA_b	Activity of the sector in base year b
CA_y	Activity of the company in year y
SA_y	Activity of the sector in year y

The SDA method assumes that the CO_2 intensity for the companies in all homogeneous sectors tends to converge in 2050 (see section 4.2.1). This convergence is represented by an index of the sector's decarbonization, being equal to 1 in the base year and 0 in 2050. This index is calculated following equation 5.

EQUATION 5

$$p_y = (SI_y - SI_{2050}) / (SI_b - SI_{2050})$$

WHERE:

p_y	Decarbonization index of the sector in year y
SI_y	CO_2 intensity of the sector in year y (tCO_2/activity)
SI_{2050}	CO_2 intensity of the sector in target year 2050 (tCO_2/activity)
SI_b	CO_2 intensity of the sector in base year b (tCO_2/activity)

Combining the company's initial performance parameter d with its market share m and the sectoral decarbonization index p for year y results in an equation that provides the company's intensity target for any year y between the base year and the target value in the year 2050 (equation 6).

EQUATION 6

$$CI_y = d * p_y * m_y + SI_{2050}$$

WHERE:

CI_y	Intensity target of the company in year y (tCO_2e/activity)
d	Initial company performance in the base year relative to 2050 target (tCO_{2e}/activity)
p_y	Decarbonization index of the sector in year y
m_y	Market share parameter in year y
SI_{2050}	CO_2 intensity of the sector in target year 2050 (tCO_{2e}/activity)

Figure 11 shows the effect of different initial performance in the base year on a company's carbon intensity pathway. With all other parameter values fixed, changing the initial carbon intensity of the company results in a change in the convergence speed toward the sector pathway.

Figure 12 shows the effect of different annual activity growth levels. With all other parameter values fixed, a different annual activity growth results in a change in market share, causing the market share parameter m_y to change. The initial carbon intensity and the 2050 target intensity remain the same, but in order to limit emissions within the carbon budget, the pathway is altered in between. The chart shows that different annual activity growth rates for companies result in different carbon intensity pathways compared to the sector. When the annual activity growth rate of the company exceeds that from the sector, it results in an increase of the market share, described by parameter m_y. Lower growth rates result in decreased market share and less aggressive intensity improvements. The company that shows a high activity growth of 4 percent (thus an increasing market share) has a stricter intensity pathway to discount this change in market share.

A detailed forecast of decarbonization pathways (in tCO_2/activity between 2010 and 2050) for the thirteen sectors covered in the method is provided in Appendix I.

Figure 11. Effect of different initial performance on carbon intensity pathways

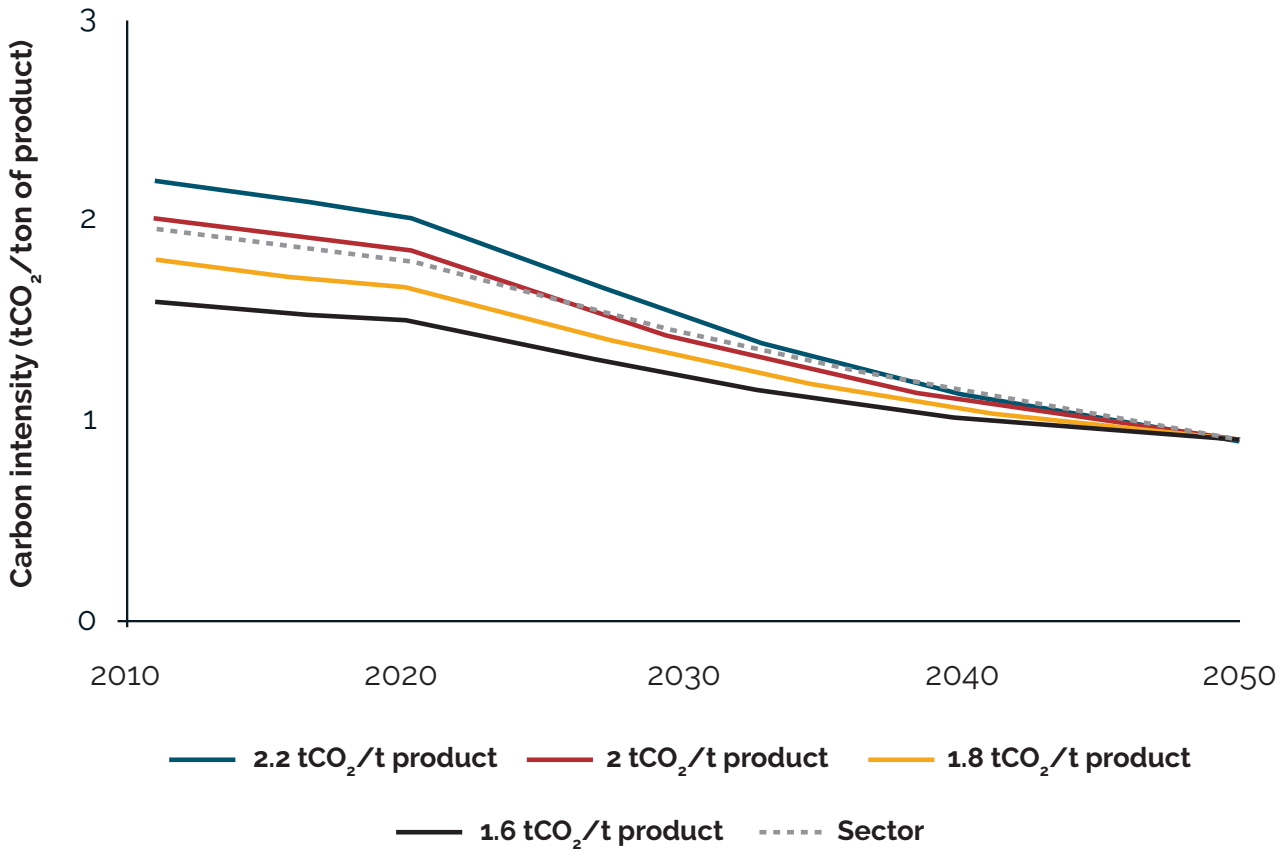
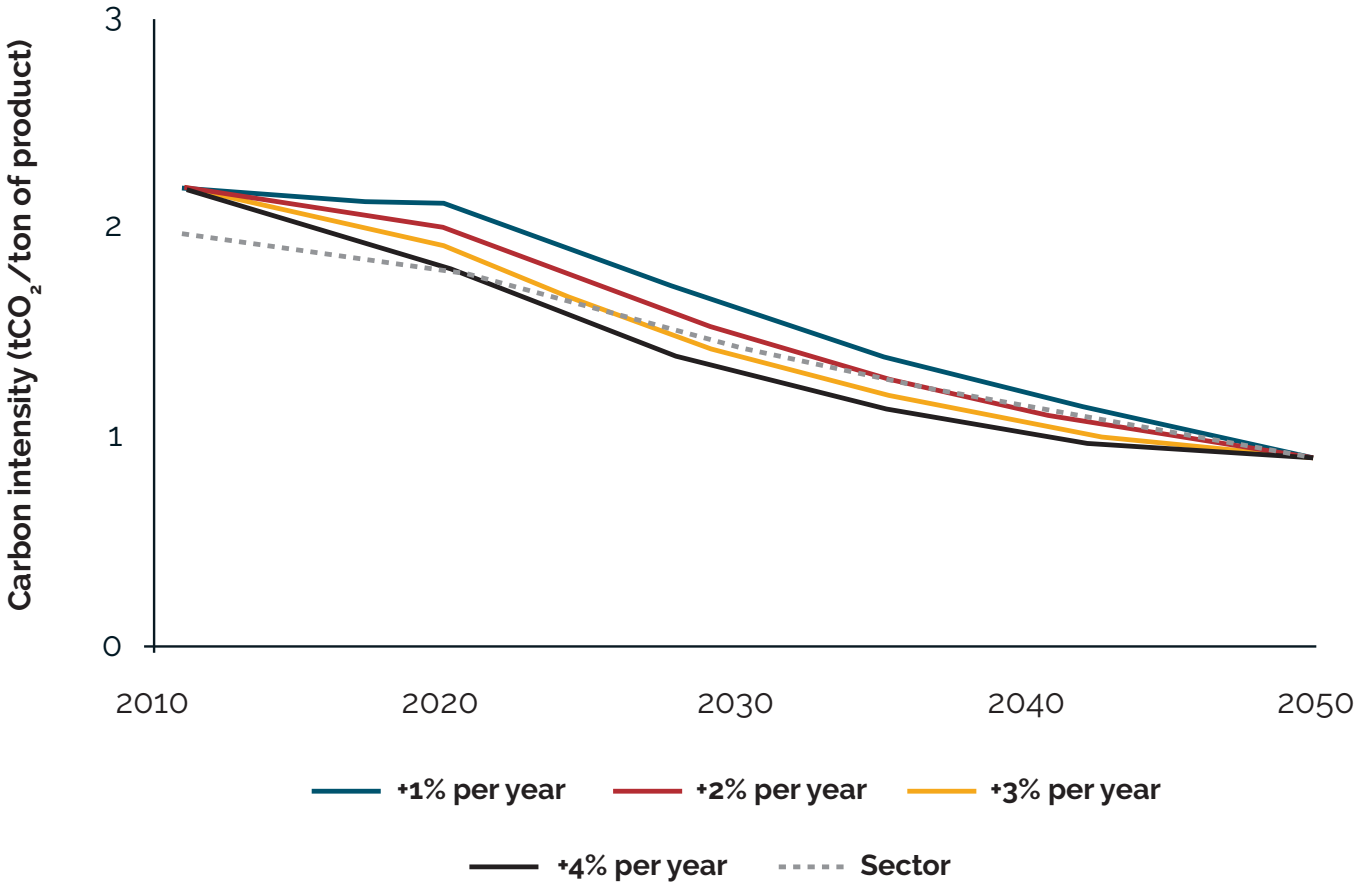


Figure 12. Effect of different activity growth on carbon intensity pathways



2.1.4.2. Heterogeneous sectors

At this point the SDA method has not been developed in detail for companies from heterogeneous sectors. For heterogeneous sectors—that is, sectors that can't be described using a single physical indicator—the method uses a compression method. For these sectors, it is not accurate to assume that the CO_2 intensity of different companies will converge at any point in time, considering the differences across industries and among companies. For instance, a TV manufacturer, a manufacturer of home appliances, and a manufacturer of industrial packaging machines will always generate different volumes of emissions per unit of value-added, despite the fact that they could all fall into a broad category of "manufacturers of electrical equipment." In the absence of subsector-specific decarbonization pathways, the SDA depicts the company´s target based on an absolute reduction compared with the sector´s expected emissions in the target year.

This equation results in the same absolute emission reductions percentage applied to all companies within a heterogeneous sector and thus guarantees to stay within the 2 ˚C carbon budget for this sector.

EQUATION 7

$$CE_y = CE_b * (SE_y / SE_b)$$

WHERE:

CE_y Company emissions in year y (tCO_{2e})
CE_b Company emissions in base year b (tCO_{2e})
SE_y Emissions of the sector in year y (tCO_{2e})
SE_b Emissions of the sector in base year b (tCO_{2e})

2.1.5. Treatment of scope 2 emissions

Scope 2 emissions are defined as the indirect GHG emissions from consumption of purchased electricity, heat, or steam. Indirect emissions are a consequence of the activities of the reporting entity, but occur at sources owned or controlled by another entity (GHG Protocol, 2004).

Given that the consumption of electricity represents the vast majority of scope 2 emissions and that there is a lack of 2 ˚C decarbonization models for the heat and steam sectors, this method uses the indirect GHG emissions from consumption of purchased electricity as a proxy for scope 2 emissions.

Taking the total power consumption at the sector level, the 2 ˚C budget for the generation of this electricity (i.e. using the 2 ˚C CO_2 intensity indicator for the power sector), and the total sectoral activity, it is possible to estimate the scope 2 CO_2 intensity for a sector as in equation 8:

EQUATION 8

$$SI_{s2y} = \frac{PS_y * SI_{Power,y}}{SA_y}$$

WHERE:

$SI_{s2,\ y}$ Scope 2 intensity of the sector in year y (tCO_{2e}/activity)
PS_y Power consumption of the sector in year y (MWh)
$SI_{Power,\ y}$ Intensity target for the power sector in year y
SA_y Activity of the sector in year y (tCO_{2e})

Now that the Scope 2 CO_2 intensity pathway is known at the sectoral level, equations 3 to 6 can be applied using Scope 2 emissions data from the company in a homogeneous sector. Then, the annual Scope 2 emissions budget can be estimated by multiplying the CO_2 intensity with the projected activity. For heterogeneous sectors, equation 7 is used with Scope 2 emissions data from the company.

2.1.6. Treatment of scope 3 emissions

Scope 3 emissions are other indirect emissions, such as emissions from the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities not covered in scope 2, outsourced activities, waste disposal, etc. These may be the largest share of a company's emissions.

Though most scope 3 categories are not included in the online tool, the method can assist companies in managing their scope 3 emissions by identifying science-based emission reduction trajectories for carbon "hot spots" in their value chains (see Appendix III). The GHG Protocol corporate value chain (Scope 3) accounting and reporting standard defines fifteen subcategories for scope 3, highlighted in Figure 9 above.

Scope 3 emissions for light vehicle manufacturing have been included in the transportation portion of the tool, given that vehicle usage is the most carbon-intensive aspect of the automotive sector. The method can also be used to indirectly assess scope 3 emissions for other categories.

2.1.7. Double counting

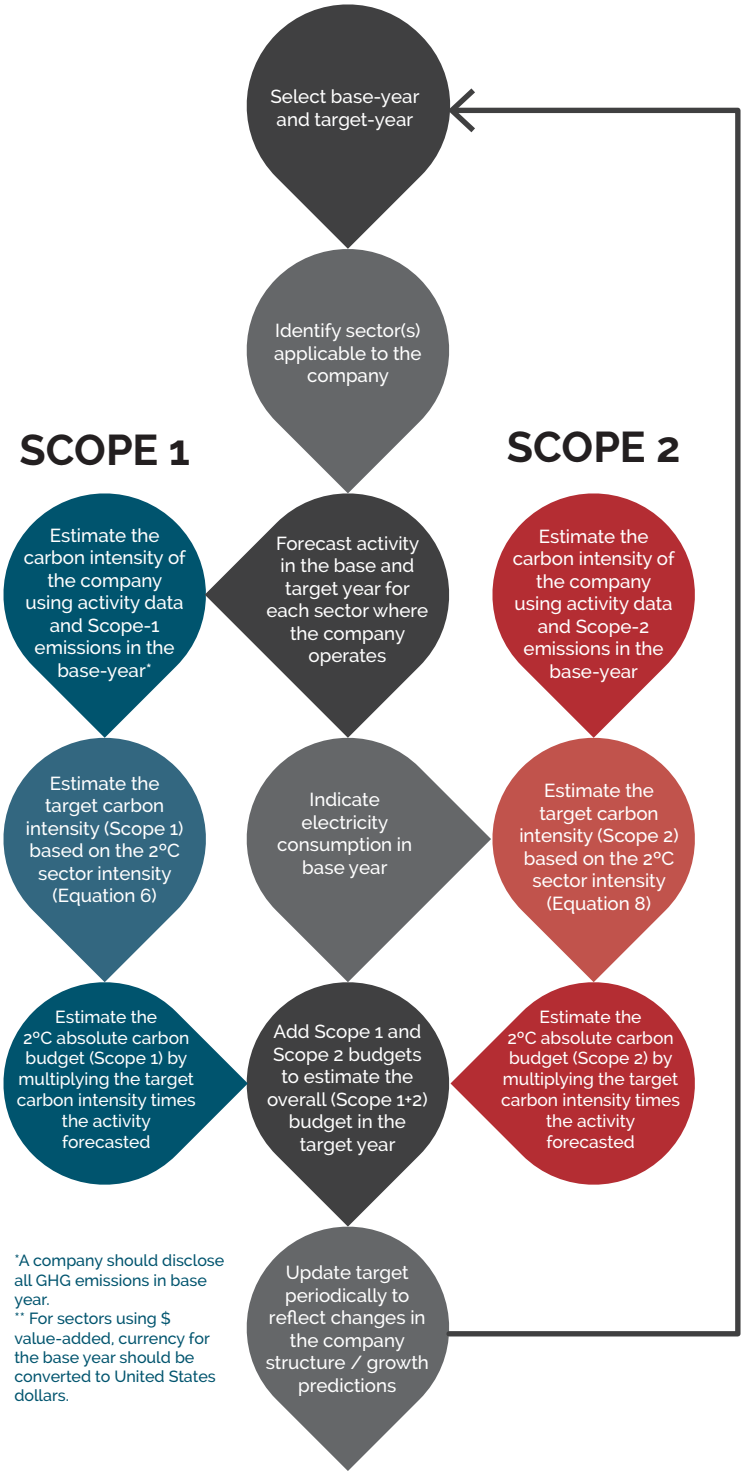
Cross-sector dependencies can hamper proper accounting of emission reductions. For example, a truck manufacturer can achieve a scope 3 target by making more efficient trucks. A transportation company can achieve a scope 1 target by using these more efficient trucks. When both companies claim these emission reductions, it results in double counting. This shouldn't be a problem, since:

- The objective of the method is to set targets for individual companies, not to set up a validated accounting system at the global level. Double counting is only an issue when you aggregate individual results.
- The fact that two companies reduce emissions in the same activity will only create a stronger impetus to achieve this target, and support a better business model, such as the example of the truck manufacturer.
- The objective, in this example, is to reduce the emissions of the transportation sector. By achieving this target, both companies contribute to achieving the global 2˚C decarbonization pathway.

2.2. Step-by-step protocol for using this method

The step-by-step protocol for calculating scope 1 and scope 2 emission reduction targets in line with a 2˚C scenario using the SDA is illustrated in Figure 13.

Figure 13. Scope 1 & 2 target setting using the SDA method for homogeneous sectors



2.3. Periodic revision of method and target adjustment

The SDA method works with data projections and forecasts for different sectors to achieve a least-cost decarbonization pathway in line with a 2°C scenario. Although these projections set the necessary pathway for sectors, some uncertainty (and inaccuracy) is involved as with any future projection.

This inherent uncertainty and the evolution of scientific knowledge in the climate field requires a periodic revision of the method as well as regular updates in the emissions reduction targets by companies to reflect realistic forecasts.

The target-setting SDA method is constructed around the sectoral emission pathways and is based on data from IPCC and IEA ETP 2DS. The emission pathways are used to determine company targets. IPCC has released new assessment reports on a regular basis (every five to six years). IEA plans to release regular updates of the underlying data of the 2DS every two years. The authors plan to update this method in line with the IPCC updates of the assessment report approximately every five years. An earlier revision will be considered if a significant change occurs in the IEA ETP 2DS data. A regular update to the method every five years fits with common practices in the business sector to adjust GHG emissions reduction targets in a similar timeframe.

The SDA method is built on the assumption that each company will do its fair share (in least-cost terms) to close the 2°C emissions gap. However, it is reasonable to assume that not all companies will follow an ambitious decarbonization pathway. Thus, future pathways required to meet a 2°C target might become steeper leading to tighter emission reduction targets. Companies are encouraged to set emission-reduction targets in line with climate science and to involve their sector peers in adopting similar practices.

Next steps for the SDA method include refinement of activity indicators and intensity metrics, expansion of sector coverage, refinement of sector boundaries, and additional consideration of scope 3 emissions targets. These topics will be covered in a future version of the method.

HOW DOES THE SDA METHOD RECOGNIZE EARLY ACTIONS BEFORE THE BASE YEAR?

A common concern of companies that have successfully reduced their carbon footprint in past years is whether the target-setting method considers such improvements when setting a new emissions reduction target. The SDA method intrinsically acknowledges past efforts by using an intensity starting point for setting the target. For example, imagine that company "A" in the pulp and paper industry has made significant progress on energy efficiency in 2014, while company "B" in the same sector hasn't made as much progress on the energy efficiency field as its competitor in the same year. Then, if both companies decide to set a goal for 2020 based on their emissions in 2014, assuming both companies have comparable activity, company "A" intensity in the base year will be lower than for company "B." The SDA method assumes a convergence approach in 2050 for homogeneous sectors; therefore, the steepness of the intensity emissions pathway for company "A" will be less than for company "B". This could be understood as if company "B" has to make a greater effort in the commitment period to catch up with company A, and ultimately with the sector emissions pathway to converge in 2050.

For heterogeneous sectors, a compression approach is followed; therefore, the same absolute emission reductions percentage applies to all companies. This approach attempts to guarantee that company emissions stay within the 2°C carbon budget for these sectors.

The SDA approach thus only acknowledges early actions made by companies within homogeneous sectors in setting their carbon targets.

2.4. Assumptions in the method

Methods and models usually rely on a set of key assumptions. For transparency, we present a rationale and explanation of relevant assumptions in the method. Assumptions include:

1. The carbon intensity of each company in a homogeneous sector will converge with the sectoral carbon intensity in 2050.
2. The SDA method intrinsically accounts for regional differences regarding level of activity and carbon intensity, but not explicitly in relation to geographical resources or historical responsibility.
3. Economic growth is decoupled from CO_2 emissions arising from the use of energy and materials.
4. Value-added is defined as gross profit, which equals revenue minus cost of purchased goods and services.
5. Scope 2 emissions from heat, steam, and cooling are assumed to be negligible compared to those of electricity; this also holds for the longer term (IPCC 2014a).
6. The societal goal to stay below 2˚C is sufficient to avoid dangerous climate change and thus the consequent carbon budgets to stay below that threshold are used (section 1.1.2).
7. The method is built on a CO_2 budget that considers non-CO_2 radiative forcings (section 1.1.3).
8. If companies adopt long-term targets (e.g. in 2050) they are also taking on short-term targets along the non-linear RCP2.6 trajectory that ensures the overall budget is not blown.

These assumptions are described further below. The method also inherits the assumptions and modeling parameters used in the IEA Energy Technology Perspectives 2DS scenario that is the basis of the intensity pathways adopted. Appendix V provides an overview of assumptions in the models behind IEA ETP 2DS.

TABLE 3. DRIVING ASSUMPTIONS IN THE IEA ETP 2DS

GDP growth	2011–20	2020–30	2030–50	2011–50
Compound annual growth rate (CAGR) in %	4.0	3.4	2.7	3.2

Marginal abatement cost[a]	2020	2030	2040	2050
US$/t$CO_2$	30–50	80–100	120–140	140–170

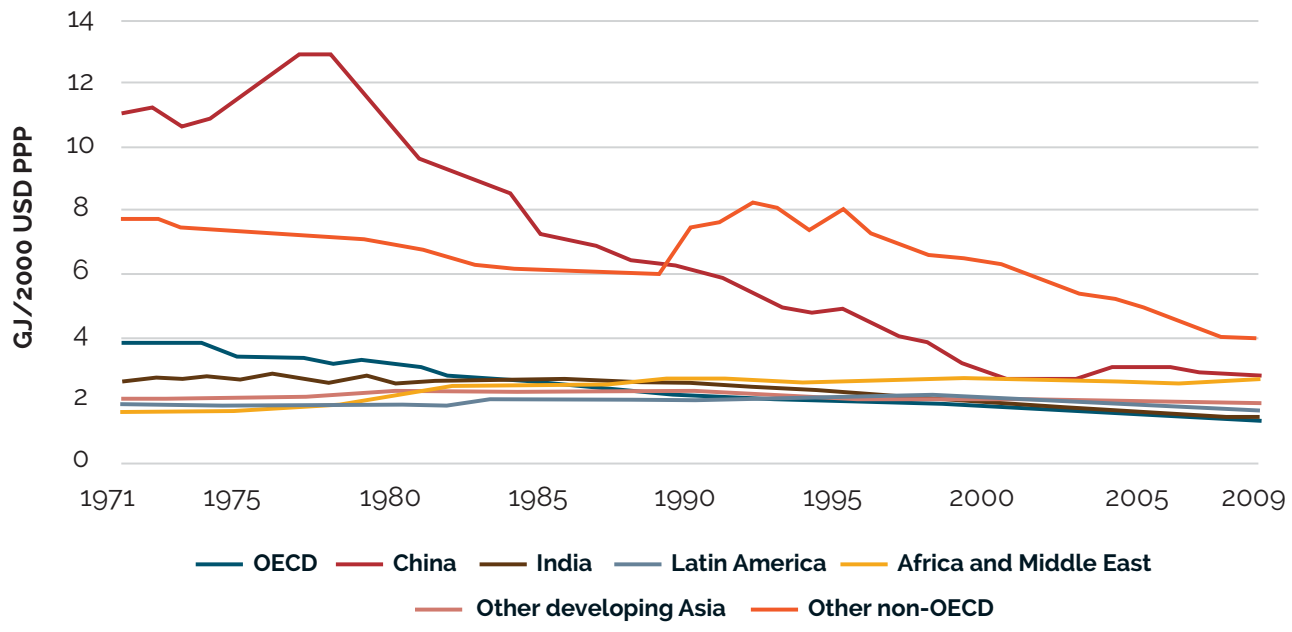
Population projections	2011	2020	2030	2040	2050
Global population (millions)	6,986	7,701	8,406	9,016	9,524

[a] "These values represent the costs associated with the abatement measures to mitigate the last ton of CO_2 emissions to reach the annual emissions target in a specific year. The global marginal abatement costs can be regarded as a benchmark CO_2 price allowing the comparison of the cost-effectiveness of mitigating options across technologies, sectors and regions." (IEA 2014, p. 351). Furthermore, these costs are comparable with the ones achieved in RCP2.6 of \$7/tCO_2 in 2010; \$60/tCO_2 by 2020; \$80/tCO_2 by 2030, and around \$160/tCO_2 by 2050 (Van Vuuren, 2011b).

2.4.1. Long-term development of the carbon intensity and intensity convergence

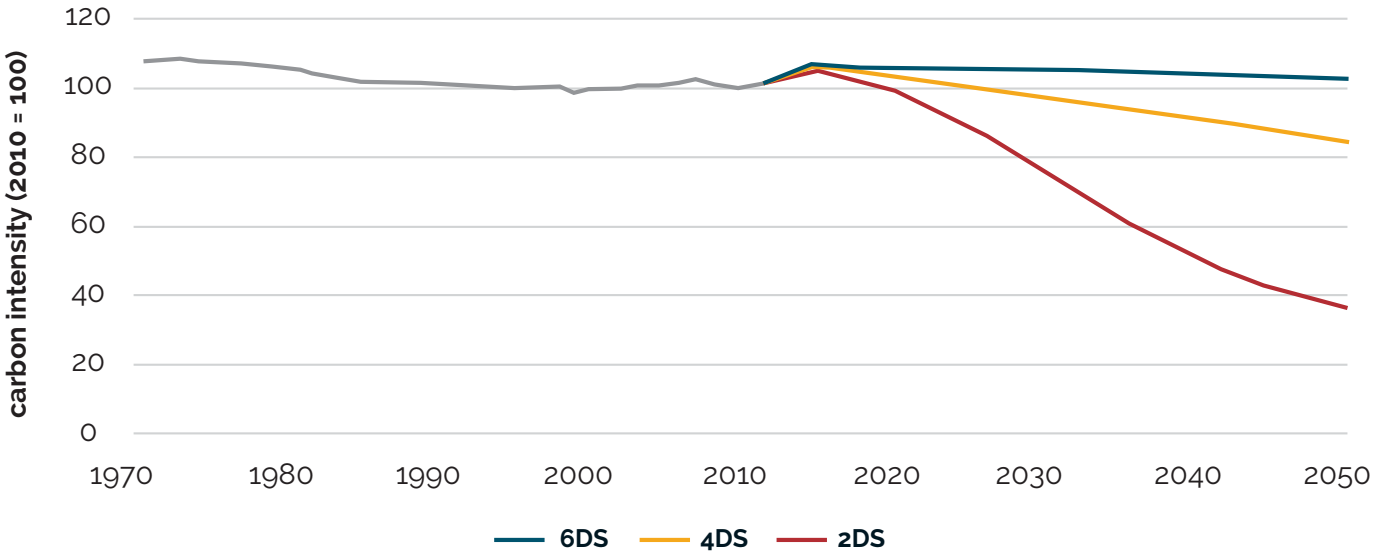
In designing this method, it was anticipated that, in the long run, large companies will have equal opportunities to abate the greenhouse gas emissions of their activities. If the focus lies on reducing carbon dioxide emissions, three elements are important: (1) the energy efficiency of the process, (2) the carbon intensity of the energy used, and (3) the emissions related to the process and its design. Although there are still differences in energy efficiency among world regions, these differences will tend to disappear in the long term because of the convergence of the energy efficiency of technologies—as shown by the historical trend and as projected by the 2DS scenario. In Figure 14 the reduction of energy intensity of GDP from 1971 to 2009 by region illustrates that energy efficiencies are already converging.

Figure 14. Historical convergence of energy intensities, 1971–2009



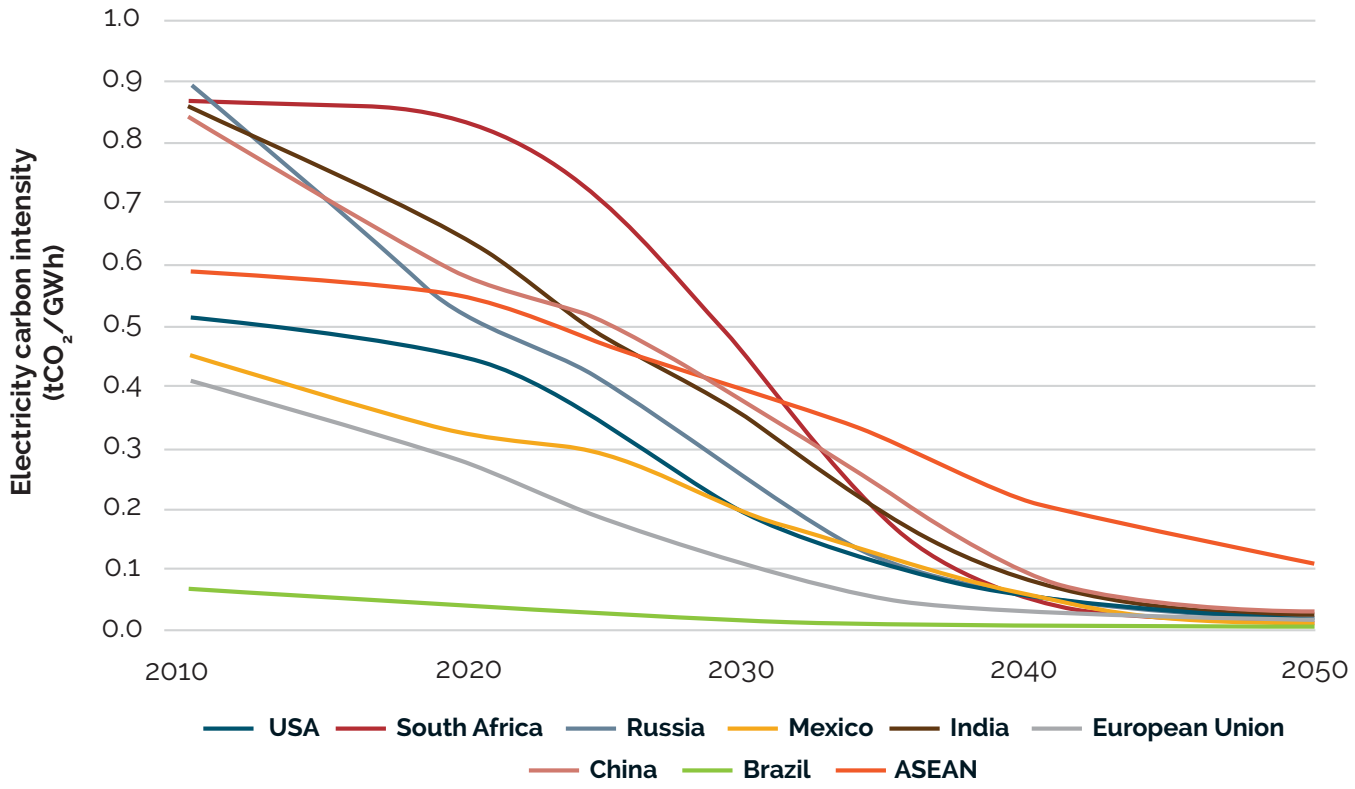
Notes: GJ = gigajoules, PPP = purchasing power parity
Source: IEA (2012a).

Figure 15. The Energy Sector Carbon Intensity Index (ESCII)



Source: IEA (2014).

Figure 16. Convergence of regional electricity intensity under a 2DS scenario



Source: Calculated from IEA (2014).

As for the carbon intensity of the primary energy supply, the historical world trend since the 1970s shows only a slight decrease (Figure 15). This index will vary regionally, but it is thoroughly understood that to meet a 2DS scenario the global profile needs to change radically. This transition depends on the decarbonization of the power sector itself—almost 40 percent of global primary energy is used to generate electricity—which worldwide, under a 2DS scenario, will have to decarbonize steeply up to 2050, (Figure 16).

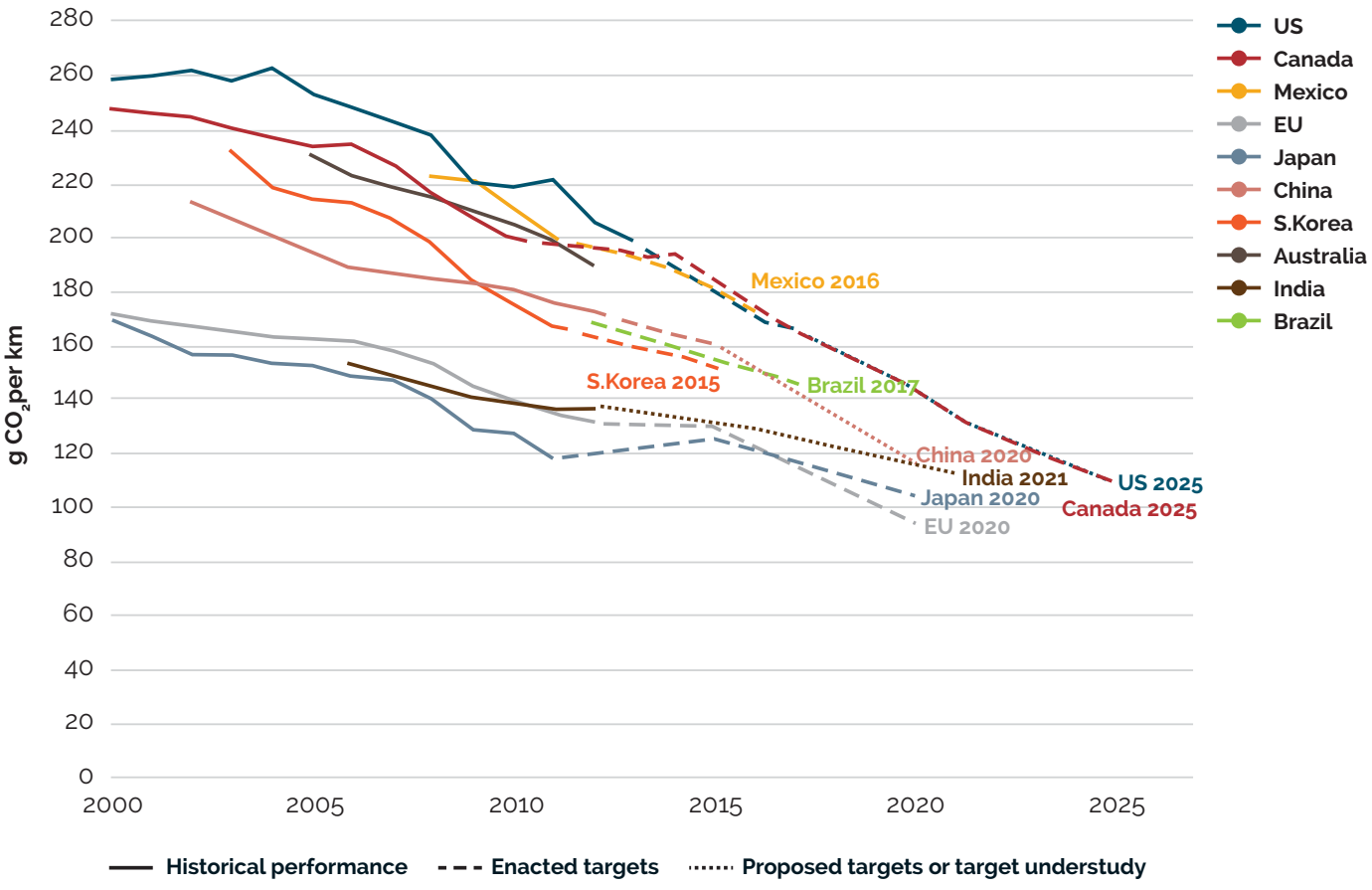
Currently, strong regional variations exist, but under a 2DS scenario the intensity convergence of several regional power systems is forecast, as can be seen in Figure 16.

Finally, technological convergence assumes that

processes all over the world will evolve in the long term to the same level of energy efficiency, close to the minimum value. In most production processes, the energy efficiency required has a minimum value: a certain amount of energy is always required to drive the processes (e.g., the energy required to produce iron from iron ore in a blast furnace). Since companies in developed countries have put more effort into improving the energy efficiency of their processes, they are closer to this minimum value than companies in developing countries. Thus, their potential for improving energy efficiency is smaller than in developing countries. Activity growth is an excellent opportunity to improve energy efficiency because growth requires new investments and because new plants are inherently more efficient than existing plants. Countries with high growth rates can therefore improve their energy efficiency at a steeper rate than countries with low growth rates. Note that growth might result in an increase of absolute emissions when the growth rate exceeds the rate of efficiency improvement. Figure 17 illustrates another example of intensity convergence of the world regions, in this case for emissions of light-duty vehicles.

World regions with higher carbon intensity will have a steeper reduction pathway and a larger potential for improvement than other regions, but will also have bigger needs for financial support to stay within the cumulative budget until alternative technologies become cost-effective for their regions.

Figure 17. Historic and future (projected and mandated) GHG emissions of light-duty vehicles g



Source: IPCC (2014).

2.4.2. Regional Differences

The SDA method intrinsically accounts for regional differences regarding level of activity and carbon intensity, but not explicitly in relation to regional resources or historical responsibility and capability.

The allocation of the sectoral carbon budget intrinsically considers regional differences in two ways: (1) the starting point of a company's intensity trajectory is considered; and (2) the allocation of the carbon budget at the company level is based on the company's own activity and activity forecast.

Regional differences are more pronounced in determined sectors; for example, power companies that operate regionally may need technology and financing support to stay within the cumulative emissions limit in the short-term until alternative technologies become cost effective for the region. However, the SDA method acknowledges that for large multinational companies, with activities spread over world regions, equity issues would be less relevant and carbon intensities will tend to converge at a probably faster rate.

The SDA method does not take into account considerations of equity or fairness across different countries. If an international method to calculate and allocate responsibility is agreed upon, the correspondent modifications will be considered for the method, depending on resources and company adoption.

2.4.3. Economic growth is decoupled from CO_2 emissions arising from use of energy and materials

As noted above, the IEA 2DS assumes continuous population and economic growth. These projections are equal under all the IEA scenarios. In the 6DS, the scenario that leads to a 6°C increase, the extension of recent trends to 2050 imply a global energy demand growth of 70 percent and emissions growth of more than 60 percent against 2011 levels. However, in the 2DS under the same growth projections, radical action dramatically improves energy efficiency to limit increases in demand by just over 25 percent while emissions are cut by more than 50 percent. In the 6DS, oil remains the most important primary energy carrier with demand increasing by 45 percent. Under the 2DS, the policy and technology choices deliver a 30 percent reduction in oil demand (IEA 2014).

Figure 18 shows energy supply and energy intensity by world region from 1971 to 2010. It also includes projections to 2050 under the assumptions of the 2DS scenario. Energy intensities of economies will continue to decrease and converge in this scenario.

The policy and technology scenarios of IEA models imply that decoupling economic growth from demand for energy and materials is possible. IEA notes that "achieving the ETP 2014 2˚C scenario (2DS) does not depend on the appearance of breakthrough technologies. All technology options introduced in ETP 2014 are already commercially available or at a stage of development that makes commercial-scale deployment possible within the scenario period. Costs for any of these technologies are expected to fall over time, making a low-carbon future economically feasible" (IEA 2014). However, the challenge is to ensure required financing is provided to make these technologies more cost-effective in the short term so key sectors in poor regions with more pressing development priorities can adopt them and stay within the cumulative emissions limits.

2.4.4. Value-added as a monetary indicator

The "light-road vehicle manufacturing" sector uses value added as a monetary measure of activity that tries to capture a given company's contribution to the overall economic growth. Economic growth is universally expressed as GDP, which is an established metric for global and local economies. Thus, the method aims to establish a measure that captures the contribution of a single company to GDP, to be used in the construction of intensity pathways.[16] However, this link is not straightforward.[17] For the purpose of GDP and national accounts, gross value-added (GVA) usually accounts for more than 90 percent of GDP[18] and is calculated as:

GVA = output at producer prices - intermediate consumption at purchaser prices

The equivalent measure of gross value added for an organization can be calculated as:

GVA = Employee costs + Taxes net of subsidies (excluding those applied to products) + Profit

According to the Institute of Chartered Accountants in England and Wales (ICAEW) and consistent with Figure 19, a company's value-added is also equal to "revenue less costs of sales, so is less than its revenue but more than its profits." Thus, accordingly, value-added can also be defined as:

VA[19] = Revenue - cost of purchased goods and services

Note that this not an alternative definition but just another way of expressing the same measure.
For reference, in its application of the "Climate Stabilisation Intensity Targets," BT used the same two equivalent ways to define value-added by companies (Tuppen 2009):

Value Added = EBITDA[20] + all personnel costs

[16] That, as previously mentioned, is established proportional to its contribution to global GDP in 2011 and projected in the future assuming equal economic growth rates as the ones used in IEA 2DS for the entire economy.
[17] See: <http://www.icaew.com/en/technical/sustainability/what-is-economic-success-going-beyond-gdp-and-profit/current-measures-of-economic-success,,,,> (consulted on August 25, 2014).
[18] See: <http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Glossary:Value_added, > (consulted on August 25, 2014).
[19] Also called gross profit in the United States.
[20] EBITDA is an acronym that stands for "earnings before interest, taxes, depreciation, and amortization".

EBITDA = Taxes + Profit as shown in Figure 19, making it equivalent to the first equation given by ICAEW.

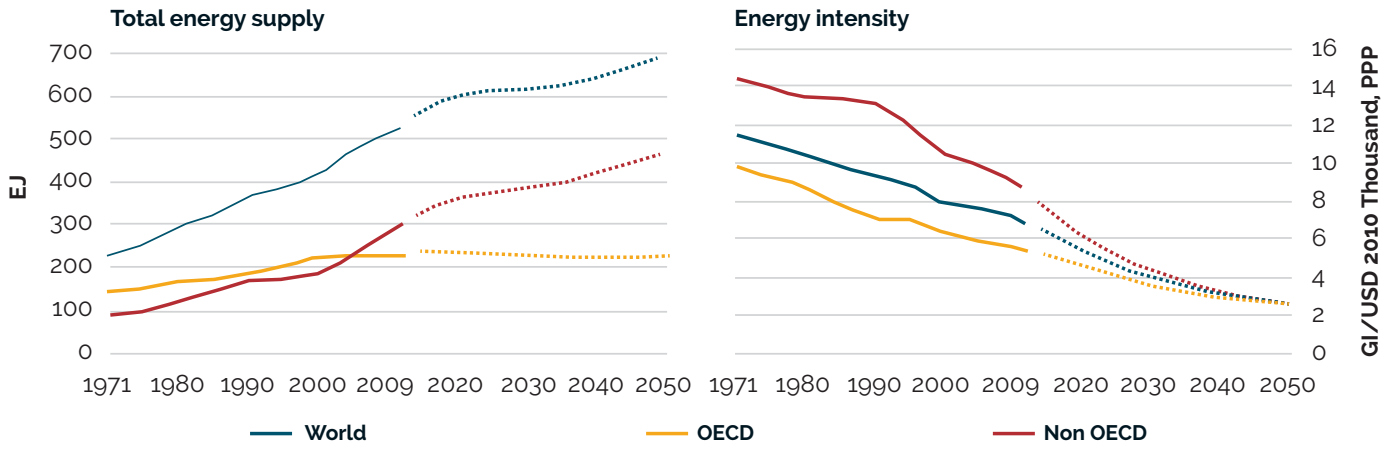
And since,
EBITDA = taxes + profits = turnover - cost of purchases – all personnel costs

VA can also be expressed as:
Value Added = turnover (=revenue) – cost of purchased goods and services

This is equivalent to the second expression given by ICAEW.

In conclusion, all the expressions given above for VA are equivalent and offer different ways of measuring the same value using a variety of frequently used company accounting metrics. If a company within the specified sector, has a method to determine its contribution to GDP that is slightly different, it can be used under this method provided it is consistent with the standard macroeconomic calculations for GDP.

Figure 18. IEA 2DS scenario for world energy supply and energy intensity, 1970 to 2010, with projections to 2050 g

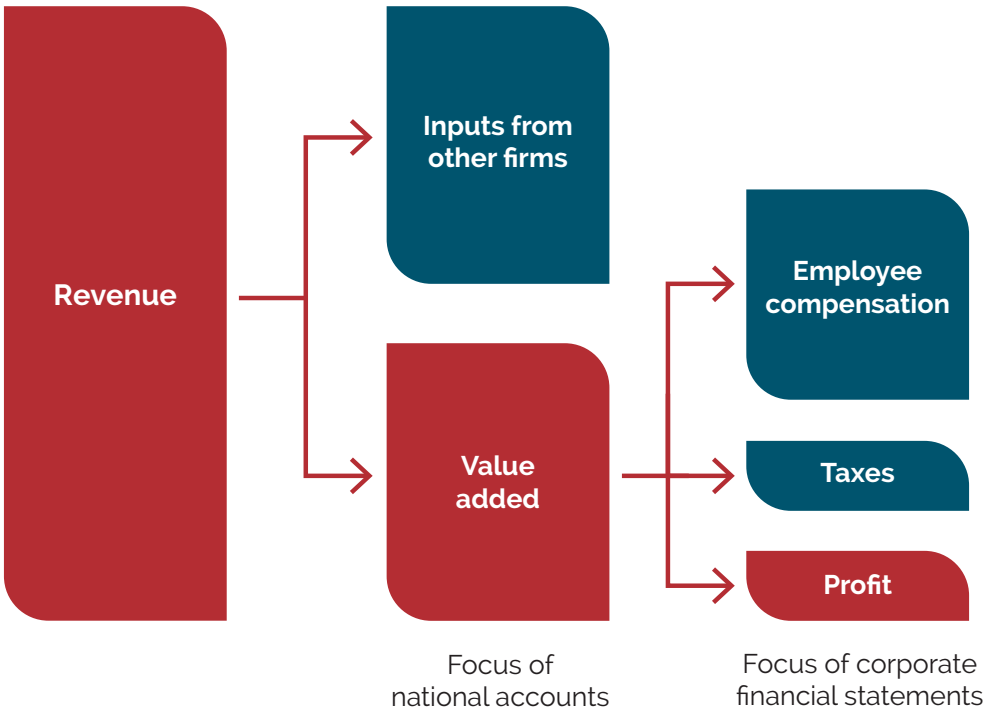


Note GDP = gross domestic product

Note: OECD is the Organization for Economic Co-operation and Development.

Source: IEA (2012a).

Figure 19. Analogy between the concept of value-added in national accounts and corporate financial statements g



Source: ICAEW.

2.4.5. Scope 2 emissions

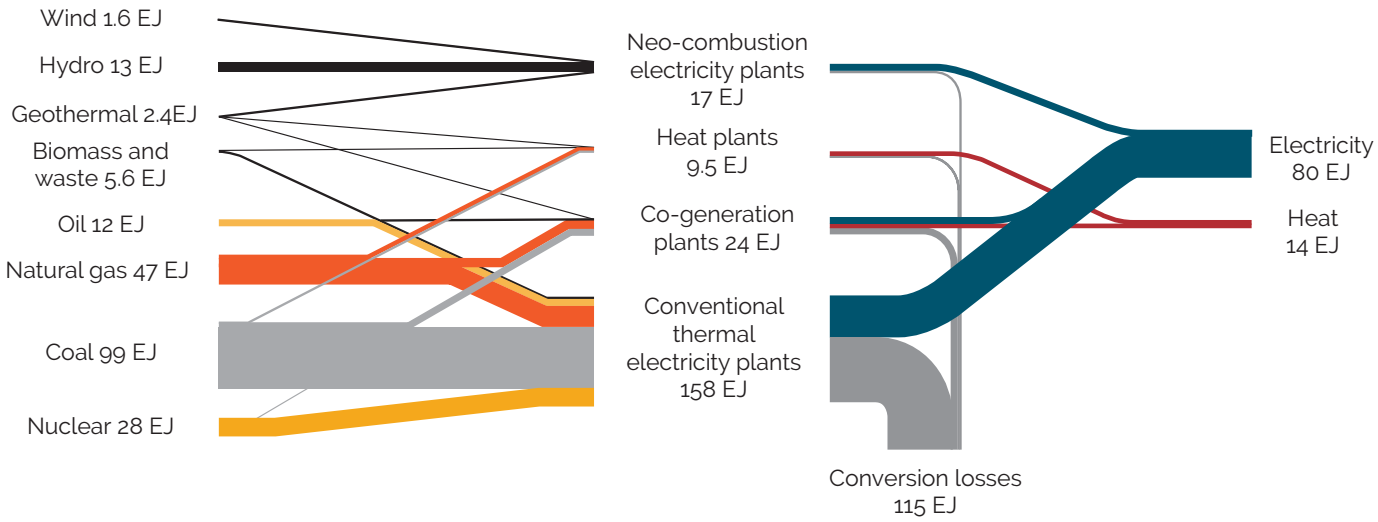
IEA information about heat and power is typically presented in aggregated form, which does not allow differing heat from power production. Target-setting companies will aggregate, as part of their scope 2 emissions, purchased power, heat, steam, and cooling. The absence of publicly available data on heat, steam, and cooling presents a challenge in the application of this method. Despite this lack of data, the relevance of each of these scope 2 emission sources can be understood by looking at the energy balances produced by the IEA on global power and heat generation flows (Figure 20).

The primary input of energy into conventional thermal power production is sixteen times higher than that destined to heat production (combined heat and power is not considered for this calculation because it's a limited portion of energy use and lacks sufficient sector-level data), with coal and gas providing the main fuels for heat and power production. Heat consumes less than 6 percent of the primary energy provided by fossil fuels for heat and power systems. Assuming this is also a good proxy for GHG emissions, the sector-based method assumes that the totality of scope 2 emissions is derived from the consumption of electricity only. For many corporations that consume negligible amounts of heat, cooling, and steam, this is accurate. For some industrial sectors, there might be significant exchanges of heat and steam among neighboring facilities that could complicate scope 2 calculations. The company can isolate its electricity-only scope 2 footprint and use only that portion to apply the sector method.

2.4.6. Passenger vehicles have a lifetime of 15 years

The lifetime of road vehicles is a frequent assumption in modeling. It is used in IEA modeling on transport, energy, and CO_2 (IEA 2009).

Figure 20. Global power and heat generation flows, 2011



Source: IEA (2014).

3. CASE STUDIES

Two cases studies were developed to illustrate implementation of the approach, one in the steel sector with high Scope 1 emissions, and one in the automotive sector with high Scope 3 emissions.

3.1. CASE STUDY OF COMPANY A: STEEL

Company A is a multinational steel company. In 2012, company A produced 70.56 megatons (Mt) of steel. In that same year it used 32,005,276 megawatt hours (MWh) of electricity and steam. Steam is not included in the SDA, therefore of total consumption, only electricity was considered at 31,493,191,200 kWh or 98.4 percent. The most significant emissions for the iron and steel sector fall under Scopes 1 and 2. The company's scope 1 emissions for 2012 were 126,400,000 tons of CO_2 equivalent (tCO_{2e}) and Scope 2 emissions were 13,600,000 tCO_{2e}. The expected annual activity growth is 1.6 percent.

3.1.1. Input data

Input data were retrieved from various sources including the CDP database, from CDP reports, and from annual reports.

3.1.2. 2°C GHG emissions reduction pathway for the iron and steel sector

The iron and steel sector produced 1,482 Mt of steel in 2010 and emitted 2.955 $GtCO_2$ (Scope 1) (IEA, 2014). This implies a carbon intensity of 1.99 tCO_2/ton of steel. Significant activity growth is expected because of the growing demand for steel in emerging economies. Steel production is expected to increase by roughly 25 percent in 2020, and is expected to increase by 50 percent by

TABLE 4. COMPANY A INPUT INFORMATION

Company:	Company A
Sector:	Iron and steel
Base year:	2012
Target year:	2020
Activities in the base year:	70,560,000 tons crude steel
Annual activity growth rate:	1.6% per year
Scope 1 emissions company base year:	126,400,000 tCO2e
Scope 2 emissions company base year (market method):	13,600,000 tCO2e
Electricity consumption base year:	31,493,191,200 kWh
Scope 1 emission intensity base year:	1.79 tCO_2 /ton crude steel
Scope 2 emission intensity base year:	0.19 tCO_2/ton crude steel

2050 compared with 2010, reaching a production of 2,295 Mt (IEA, 2014).

The 2˚C GHG emissions reduction pathway for iron and steel shows that the total Scope 1 emissions of the sector will increase until 2020, despite a decreasing carbon intensity compared with 2010 (-10 percent) (IEA, 2014). In 2050, the total Scope 1 emissions will decrease by 31 percent and the intensity will decrease by 55 percent compared with 2010 (IEA, 2014).

3.1.3. SDA approach and outcome for company A

Based on the principle of convergence[21], the Scope 1 carbon intensity targets for company A in 2050 is set equal to the sectoral carbon intensity in 2050. The difference between company A's Scope 1 carbon intensity in the base year and the sectoral 2˚C GHG emissions reduction pathway declines toward zero in 2050 (Figure 21).

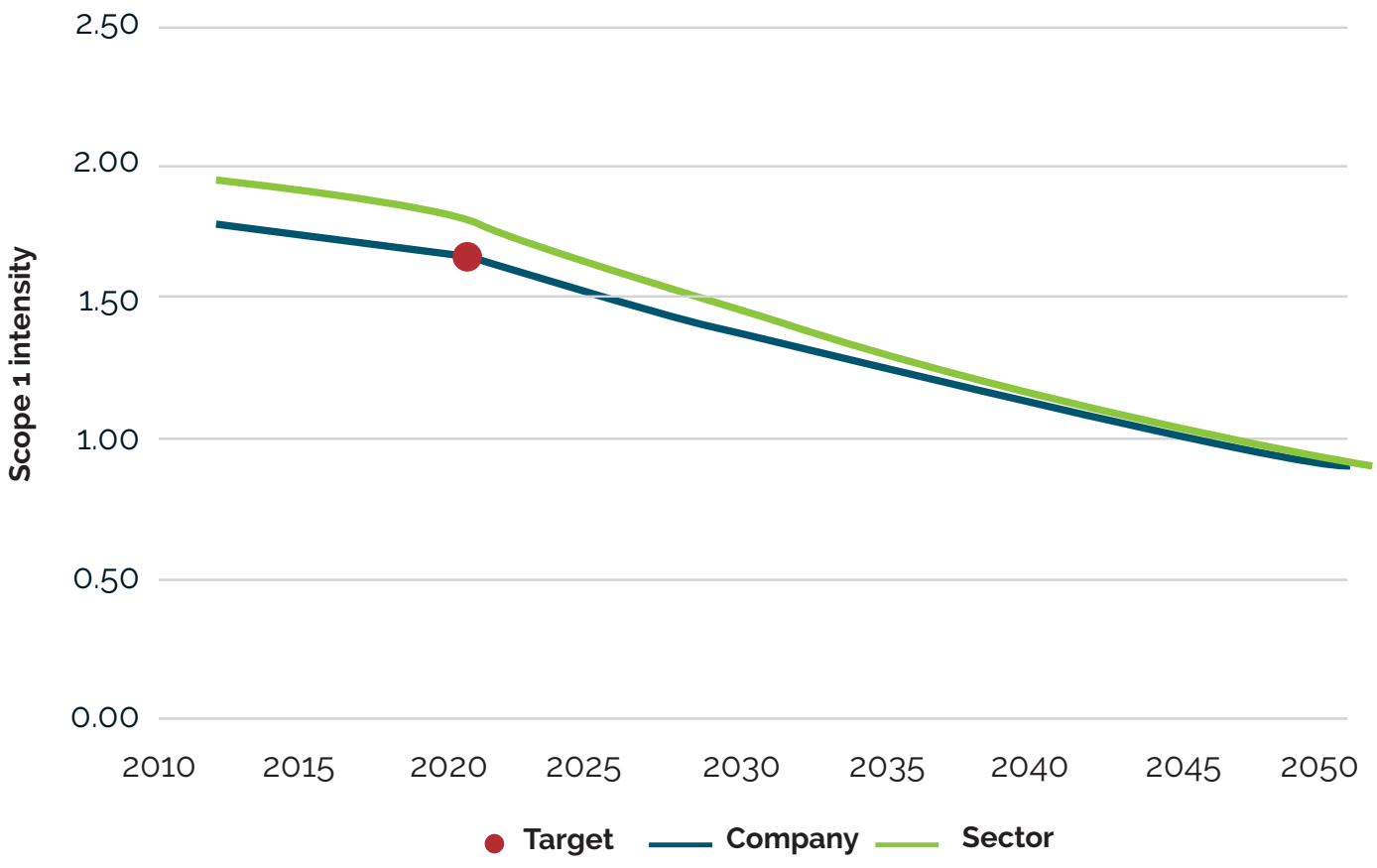
The scope 1 target for company A in 2020 is shown by the red dot in Figure 21. The targets are lower than the development of the sector carbon intensity because company A already has lower carbon intensity in 2012.

Similarly, the principle of convergence is used to create the Scope 2 carbon intensity targets for company A. For 2050, its carbon intensity targets are set equal to the sector's carbon intensity in 2050. The difference between company A's Scope 2 carbon intensity in the base year and the sectoral 2ºC GHG emissions reduction pathway declines linearly toward zero in 2050 (Figure 22).

As with the targets for Scope 1 company A's Scope 2 target for 2020 is significantly lower compared with the sector, since company A's carbon intensity at the base year is already much lower than that of the sector.

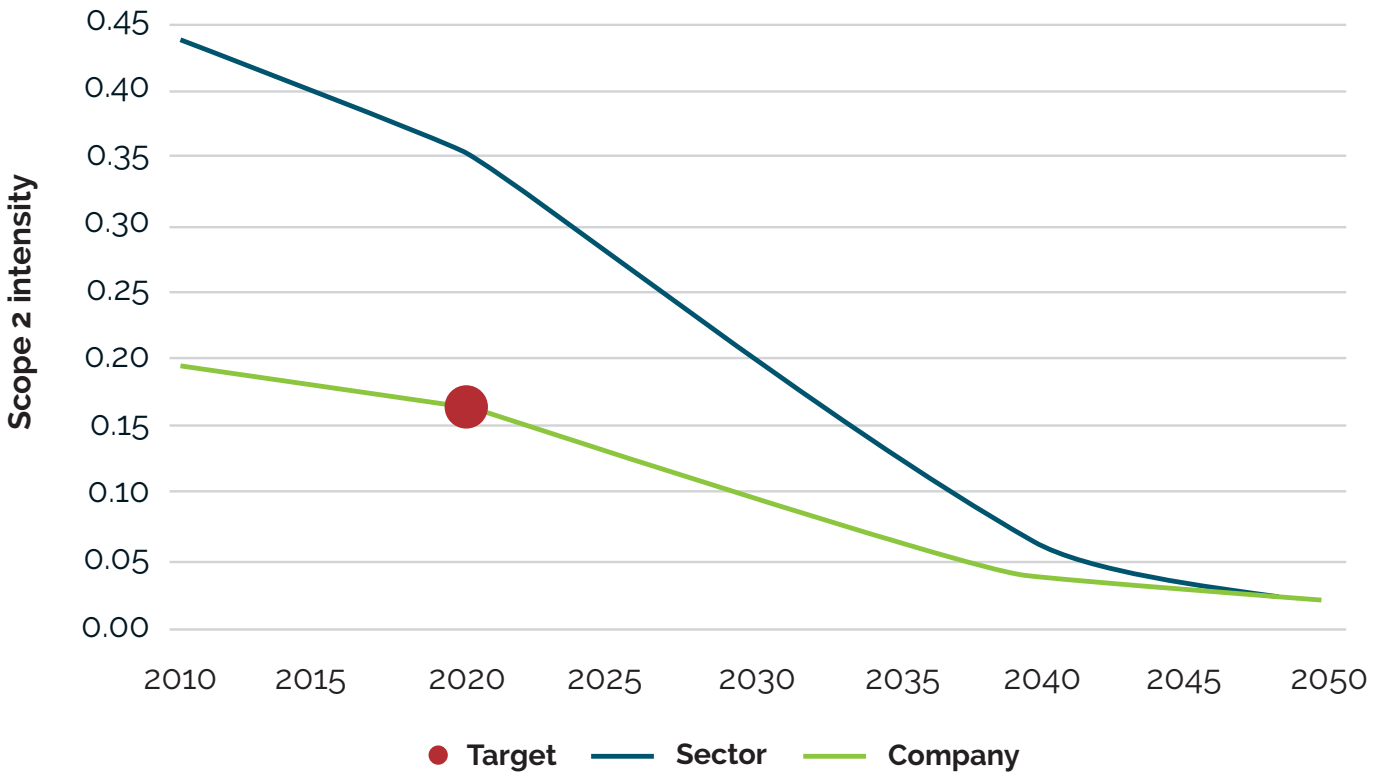
The SDA-derived intensity and absolute targets for company A in 2020 and 2050 are shown in Table 5.

Figure 21. Scope 1 carbon intensity



[21] The intensity of company A in 2050 should be equal to the intensity of the sector in 2050. The difference between company A's carbon intensity and the sector's average carbon intensity at the base year will linearly decrease over the period 2010 to 2050, converging to the same point in 2050. This is referred to as the principle of convergence.

Figure 22. Scope 2 intensity target



Note: Shown in metric tons of CO2 per ton of crude steel

TABLE 5. CARBON INTENSITY AND ABSOLUTE EMISSIONS TARGETS FOR COMPANY A

Iron and steel		Unit of measure	2012	2020	Percent change
Scope 1	Carbon intensity target	tCO_2/t crude steel	1.79	1.67	-7
	Absolute emissions target	tCO_2	126,400,000	133,555,125	6
Scope 2	Carbon intensity target	tCO_2/t crude steel	0.19	0.16	-14
	Absolute emissions target	tCO_2	13,600,000	13,215,418	-3
Scopes 1 and 2	Carbon intensity target	tCO_2/t crude steel	1.98	1.83	-8

3.2. CASE STUDY OF COMPANY B: AUTOMOTIVE

Company B is a multinational automaker. Its total turnover in 2010 was over $100 billion. In 2013, company B produced millions of vehicles. In 2010, company B emitted 1,312,000 tCO2e as Scope 1 emissions and 2,872,000 tCO2e Scope 2 emissions, and it consumed 4,708,981,600 kWh of purchased electricity and steam. Since steam was only a very small fraction of this amount, it will be treated as electricity in terms of emissions. company B anticipates an annual growth of about 2 percent.

3.2.1. Aim of the case study

Company B was chosen for a case study to check the applicability of the method for Scope 3 emissions (use of sold products, in this case the fuel combustion of vehicles) and to check the flexibility of the method to future changes, such as a transition to electric vehicles. Targets for Scopes 1 and 2 for the automotive sector are calculated based on the "other industry" sector, which is based on an absolute reduction from the sector´s budget. Targets for the Scope 3 emissions of the automotive sector (which have a much higher impact than the Scope 1 and Scope 2 emissions) are calculated based on a physical indicator (grams of CO_2 equivalent per revenue passenger kilometer [gCO2e/rpk]).

3.2.2. Input data

The Scope 3 emissions for a new vehicle from company B were estimated as 128 gCO2e per pkm in 2010. A conversion factor needs to be defined for the input data because the activity indicator used in the method is revenue passenger kilometer. Automotive companies are expected to have estimations regarding the average number of passengers per vehicle. For this case study, the factor 1.65 was used, which represents the average number of passengers per vehicle in Europe (Adra, Michaux and André, 2004).
In reality, however, the value for passengers per kilometer is different for different locations. The same holds for the emissions per vehicle kilometer, which differs per region and per vehicle type. Applying location-specific values for passengers per vehicle and using a weighted average for the emissions per vehicle kilometer would provide a better approximation of the new vehicles produced by company B and would lead to more accurate results.

TABLE 6. COMPANY INPUT INFORMATION

Company:	Company B
Sector:	Light road vehicles manufacture
Base year:	2010
Target year:	2020
Activities in the base year:	103,200,000,000 $ value added[a]
Annual activity growth rate:	2% per year
Scope 1 emissions company base year:	1,312,000 tCO2e
Scope 2 emissions company base year:	2,872,000 tCO2e
Scope 3 intensity (g CO_2/rpk):	62.08 gCO2e / rpk
Electricity consumption base year:	4,708,981,600 kWh
Scope 2 emission intensity base year:	0.19 tCO_2/ton crude steel

[a] In this case study, revenue has been a proxy for value added, a more accurate approximation of value added will lead to more accurate results.

3.2.3. 2°C GHG emissions reduction pathway for the automotive sector

The automotive sector produced about 70 million light duty vehicles and was responsible for about 421 Mt of CO_2 emissions (Scopes 1 and 2) in 2010 (Carbon Trust, 2011). However, the most important emissions are emitted during the use of the product that is, driving the car (Scope 3). For this reason, Scope 3 will be the priority carbon indicator for this company.

Scope 3 targets are aligned to the sector emission targets based on a physical indicator (gCO_2/rpk). The Scope 3 pathway for light road vehicles manufacture was constructed for new vehicles based on the pathway for light road passenger transport from the IEA (IEA, 2014). Because this pathway uses revenue passenger kilometers as an indicator, this indicator is also used for the Scope 3 pathway for light road vehicles manufacture, but can be converted to vehicle kilometers by using the number of passengers per vehicle as explained in the section "Input data".

For the automotive sector, much growth in activity is expected, which goes hand in hand with the expected GDP growth in developing countries. This growth results in a larger market for automobiles (IEA, 2012a). However, toward 2050, the growth rate is expected to decrease because of a modal shift (IPCC, 2014a).

The sector's Scope 3 emissions will reach its peak in the coming decades before efficiency improvements and the decarbonization of electricity will gradually lead to lower emissions. "With oil accounting for more than 90 percent of its primary energy, transport remains the end-use sector most dependent on fossil fuels. The electrification of transport offers great opportunities to foster fuel diversification, carbon dioxide (CO_2) mitigation, and increased energy efficiency while contributing to other sustainable transport goals," (IEA, 2014).

By 2050, total Scope 3 emissions will have decreased by 40 percent and the emission intensity by 83 percent compared with 2010 (IEA, 2012a, IEA, 2014)[22]

In line with the "other industries" sector, the Scope 1 emissions should be reduced by 52 percent in 2050 compared with 2010. For Scope 2, the carbon intensity should be reduced by 92 percent in 2050 compared with 2010.

3.2.4. SDA approach and outcome for company B

The following figure shows the scope 3 target for company B, in the year 2020.

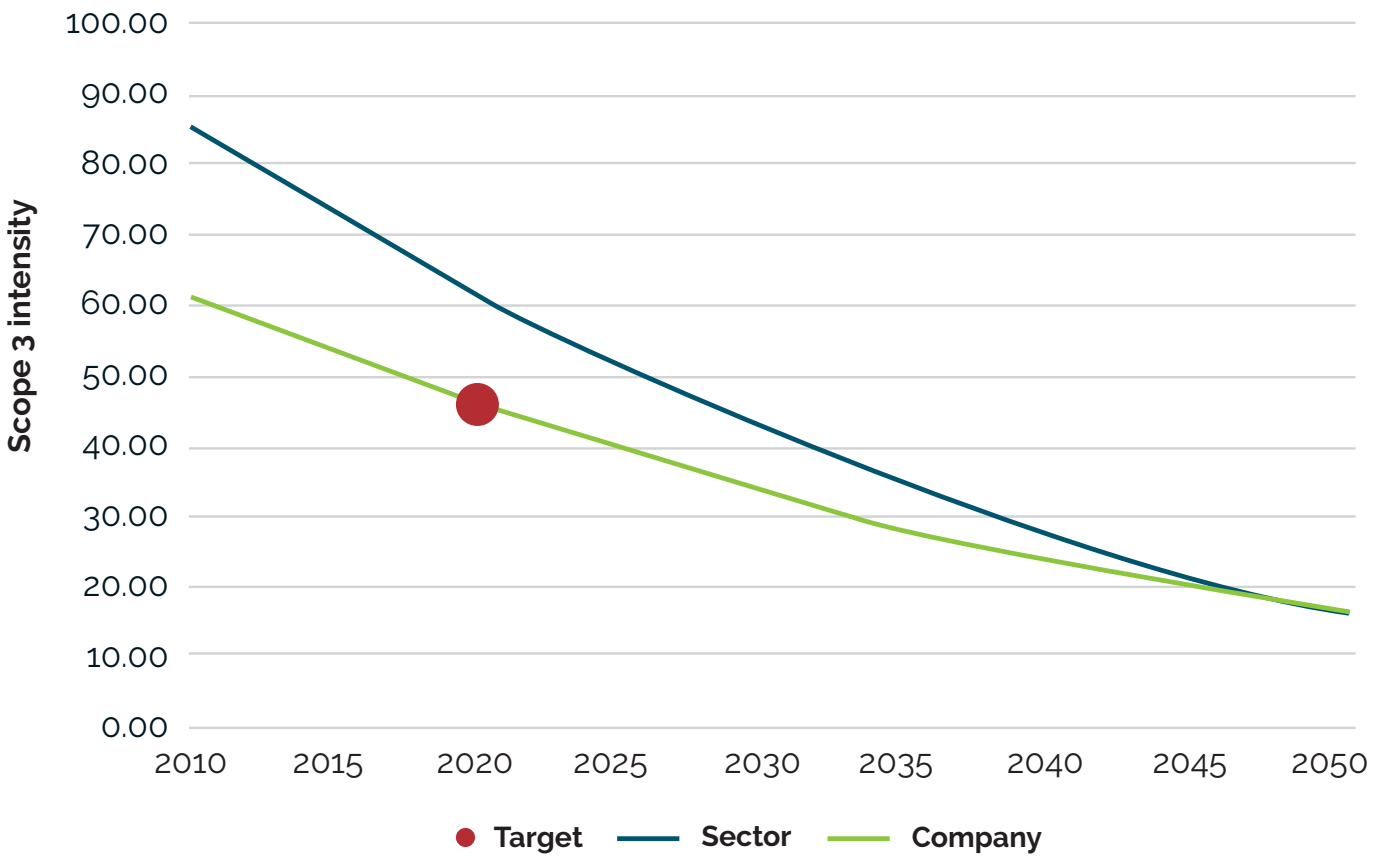
[22] Data for the tank-to-wheel emissions for various transport categories and on the activities of different transport options has been obtained from the IEA, but from different sources. The categories, however, did not match one-on-one. The emissions were given for "Light Duty Vehicles" and the activities for "Light road." It could be that there is a discrepancy between these two categories, which would reduce the accuracy of the results.

As mentioned earlier, the targets for scope 3 were taken from the 2DS scenario of IEA (total emissions decreased by 40 percent and CO_2 intensity by 83 percent in 2050). However, to end up at a Scope 3 carbon intensity target for newly produced cars, the IEA Scope 3 targets for existing stock were corrected based on a stock model, assuming an average lifetime of 15 years for a personal vehicle (IPCC, 2014b)

Based on the principle of convergence, the Scope 3 carbon intensity for company B in 2050 is set equal to the sectoral carbon intensity in 2050 (reduction of carbon intensity of 87 percent in 2050).

Table 7 shows the carbon intensity for scope 3, and absolute reductions for scopes 1 and 2, for 2020. Absolute emissions targets for Scope 3 are not shown because no information is available on the actual vehicle kilometers driven by company B vehicles in 2010 and 2050.

Figure 23. Company B Scope 3 intensity target



Note: The y axis is in gCO_2e / rpk.

TABLE 7. CARBON INTENSITY AND ABSOLUTE EMISSIONS TARGETS FOR BASE YEAR 2010

Light road vehicles manufacture		Unit of measure	2010	2020	Percent change
Scope 1	Absolute emissions target	tCO_2	1,312,000	1,082,092.31	-18
Scope 2	Absolute emissions target	tCO_2	2,872,000	2,774,010.07	-3
Scopes 1 and 2	Absolute emissions target	tCO_2	4,184,000	3,856,102.38	-8
Scope 3	Carbon intensity target	gCO_2/rpk	62	45.95	-26

4. NEXT STEPS

This method provides a first-of-its-kind sector-based approach for companies to set GHG reduction targets consistent with a global 2˚C temperature rise. The SDA method seeks to promote innovative and ambitious approaches to corporate GHG goal setting.

While the SDA method references existing methods and the most applicable available data, it is not a universal approach for all companies wishing to align their emissions reduction targets with the 2-degree pathway described by the IPCC. To address limitations in data availability and restrictions in applying all currently available data, the model may be further developed in future versions. This section discusses how the method may be extended in scope and depth if and when relevant data become available.

4.1. REFINE SECTOR APPROACHES BY INCLUDING STRUCTURAL PARAMETERS

The SDA method uses a high-level approach in describing the development of the carbon intensity of the sectors, based on scenario assumptions about each sector's average structure. For instance, in the pulp and paper sector a scenario assumption for a structural parameter is the shift from wood pulp to recycled paper. Another example is the regional and local differentiation of grid mixes for power generation. The structure of a given company will almost certainly differ from the global average sector structure. Sector-specific benchmarks take these structural parameters into account. For almost all energy-intensive sectors such benchmark approaches have been developed. Unfortunately, this approach and many others are based on proprietary data that are not publicly available. Using elements of sector-specific benchmarks where possible would improve the applicability of the method. The idea is that companies would be able to select some structural parameters that would be taken into account in target setting. These structural parameters could be used in the future to differentiate among regional differences as well.

4.2. EXPAND TO INCLUDE MORE SCOPE 3 EMISSIONS

Guidance on Scope 3 categories is provided in Appendix III. When more data are available, scope 3 will be included in the method. Including scope 3 categories could make the method more appealing to companies that have potential to reduce upstream or downstream emissions. As with the vehicle manufacturing case study above, companies may be able to achieve the largest reductions by changing the qualifications of their products. This can be a challenge, since (1) setting these targets along a 2˚C decarbonization pathway is not straightforward; and (2) the reporting of Scope 3 emissions by companies is still under development as more and more value chain data become available.

A next step would be to analyze which scope 3 emissions can be included for each sector, assuming that a target can be set and that reporting is possible. This approach could be gradually expanded when the method is taken to the next level.

4.3. EXTEND TO MORE SECTORS

The number of sectors for which the method has been developed at a detailed level is restricted because of limited data availability or missing science-based 2˚C decarbonization pathways. The most carbon-intensive sectors have been developed at a detailed level. However, some key sectors are not covered in detail, such

as the agriculture, forestry and other land use (AFOLU) sector and the oil and gas sector. As more information becomes available and 2˚C decarbonization pathways are constructed for these subsectors, the list can be extended to increase the coverage of large companies. There will be sector-specific issues that need to be addressed.

4.4. EXTEND TO NON-CO_2 GASES

Non-CO_2 gases are not included in the current version of the method (see section 1.1.3). Though the SDA is conservative by allowing CO_{2e} to the CO_2 budgets, using IPCC mitigation scenarios for non-CO_2 gases and distinguishing these at the subsector level could be an area of further improvement, particularly when considering the incorporation of sectors like agriculture, forestry, and other land-use (AFOLU) and oil and gas.

GLOSSARY

2DS. The two degrees scenario is the focus of the ETP 2014. It describes an energy system consistent with an emissions trajectory that would give at least a 50 percent chance of limiting average global temperature increase to 2˚C.

Absolute emission target. The level of absolute emissions that has to be achieved in a certain year.

Absolute emission reduction target. The magnitude of change of the absolute emissions in a certain year compared to a base year, expressed in percentages.

Activity. The main economic activity of a company for which the activity indicator is used.

AR. Assessment report, published materials by the IPCC composed of the full scientific and technical assessment of climate change, generally one for each Working Group.

BAU. Business As Usual, the unchanged development of the situation without any interference, for example through policy.

Carbon intensity reduction target. The magnitude of change of the carbon intensity in a certain year compared to a base year, expressed in percentages.

Carbon intensity target. The level of carbon intensity that has to be achieved in a certain year.

CCS. Carbon capture and storage, the process of capturing CO2 (usually from large point sources), transporting it to a storage site and depositing it, usually in a geological formation, so it does not enter the atmosphere.

CH_4. Methane.

CO_2. Carbon dioxide.

CO_{2e}: CO_2 equivalent is a unit used to express the global warming potential of (a mix of) greenhouse gases as a single figure, namely the equivalent amount or concentration of carbon dioxide.

ETP. Energy Technology Perspectives is published by IEA. The ETP provides scenarios that set out pathways to a sustainable energy future in which optimal technology choices are driven by costs, energy security, and environmental factors.

GDP. Gross domestic product.

GEVA. Greenhouse gas emissions per value added.

GHG. Greenhouse gas, a gas that absorbs and emits radiation in the atmosphere, contributing to the greenhouse effect. GHGs include (among others) water vapor, carbon dioxide, methane, nitrous oxide, ozone, and CFCs.

Global Warming Potential. Global warming potential, or GWP, is a relative measure of how much heat a greenhouse gas traps in the atmosphere. It relates this heat to the amount of heat trapped by a similar mass of carbon dioxide.

Heterogeneous sectors. Sectors that can't be described using a single physical indicator. For example, the chemical sector is heterogeneous because it produces a diverse array of chemicals that each have unique characteristics and traits and are difficult to compare to one another.

Homogeneous sectors. Sectors that can be described using a single physical indicator.

IEA. International Energy Agency.

IPCC. Intergovernmental Panel on Climate Change.

KPI. Key performance indicator.

kWh. Kilowatt hour.

MWh. Megawatt hour.

NGO. Nongovernmental organization.

Ppm. Parts per million.

Ppmv. Parts per million by volume.

RCP. Representative concentration pathway, one of the four GHG concentration trajectories used in the IPCC 5th Assessment Report (AR5). These trajectories are used for climate modeling and research.

Revenue passenger kilometer (rpk). The distance paying customers travel in kilometers.

Sector. A subdivision of businesses and activities in the global economy used in this report to give companies GHG emission targets.

SRES. Special Report on Emissions Scenarios, a report published by the IPCC in 2000 containing greenhouse gas emissions scenarios that have been used to make projections of possible future climate change.

UNEP. United Nations Environment Programme.

UNFCCC. United Nations Framework Convention on Climate Change.

Value-added. Depending on accounting terminology, this is defined as gross profit, operating profit, revenue minus the cost of purchased goods and services, or EBITDA plus all personnel costs.

WEO. World Energy Outlook, published by IEA, is a comprehensive and authoritative analysis of medium- and longer-term energy trends with energy projections until 2040, providing insights into their meaning for energy security, the economy, and the environment.

Note: Throughout this document all tons are metric tons, all dollars are U.S. dollars.

APPENDIX I. INSIGHTS INTO SECTORAL 2°C DECARBONIZATION PATHWAYS

For homogeneous sectors, we juxtapose the activity level from 2010 projected to 2050 against the actual and projected indexes for scope 1 CO_2 emissions and carbon intensity that show the pathways for each sector to meet their share of reductions to keep global warming to 2°C.

These sectoral activity-level projections and the 2°C decarbonization pathways are based on the IEA ETP 2014 2DS scenario. The 2DS scenario corresponds to an emission pathway to limit global warming to 2°C with a probability of more than 50 percent and is consistent with the IPCC's RCP 2.6 pathway. If sources other than the IEA ETP 2014 2DS are used, they are noted.

The expected activity and emissions targets are combined to create sectoral carbon intensity pathways. Figures for each sector show 2010–2050 activity levels, and indexes for emissions and carbon intensity. The text explains the underlying assumptions and where there is potential for reducing emissions in that sector. The emissions and pathways cover only scope 1 emissions for most sectors, but where relevant scope 2 emissions covered by IEA ETP 2014 2DS will be described qualitatively in this appendix. For heterogeneous sectors, the activity level and emissions reduction potential are described below.

1. POWER GENERATION

The power generation sector is responsible for the generation of electricity. This encompasses generation using fossil fuels (oil, natural gas and coal), renewable energy sources (such as solar and wind), and nuclear. Because about two-thirds of electricity is generated by the combustion of fossil fuels, this sector emits large quantities of greenhouse gases (GHGs).

1.1. Activity level

The activity indicator for the power generation sector is the number of terawatt hours (TWh) generated. In 2010, the global total was about 21,500 TWh. It is expected to rise to roughly 40,000 TWh in 2050, an increase of about 87 percent. The growth is driven by rising demand from non-OECD countries and increased electrification of transport and buildings. This results in an increasing share of electricity in the overall global energy mix.

1.2. Emission reduction potential

In 2010, the power generation sector emitted about 13 gigatons (Gt) of CO_2. In 2050, the target for CO_2 emissions is roughly 1 Gt, a decrease of almost 91 percent compared with 2010 levels. This can be achieved only through a global effort.

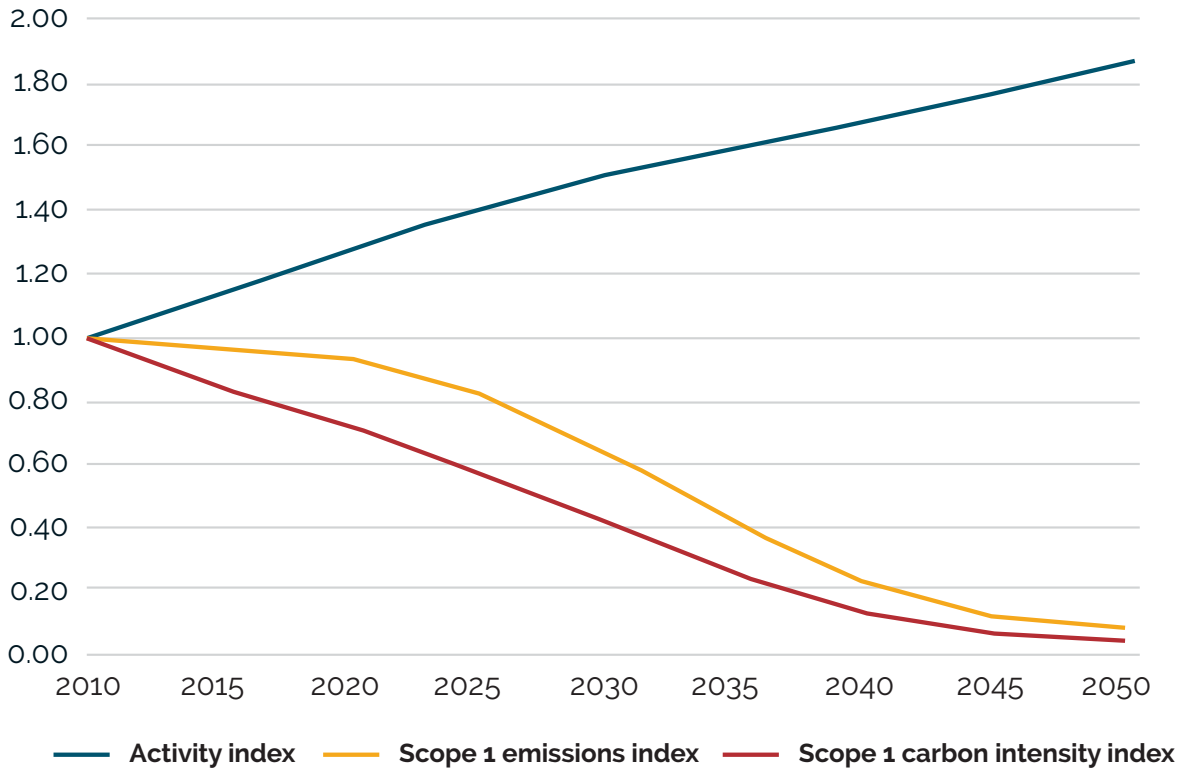
A wide variety of mitigation options are available in electricity generation, and therefore most mitigation scenarios assign a major GHG reduction to this sector (IPCC 2014a). As electricity generation shifts from centralized to decentralized and from fossil fuels to renewables, the carbon intensity from power generation is expected to decline significantly. To a lesser extent, the gradually increasing role of nuclear power (in the 2DS scenario, from 12 percent in 2010 to 17 percent in 2050) also contributes to a reduction in carbon intensity. Scenarios with similar activity levels, albeit a different technology mix, show that it is technologically possible to reduce the carbon emissions from power generation to zero by using only zero-emission technologies for power generation (WWF & Ecofys 2011). Similarly, in the IPCC AR5 Working Group III report on the mitigation of climate change, emissions from the power generation sector are expected to decrease, approaching zero between 2040 and 2050 (IPCC 2014b). However, this assumes that new technologies (e.g.,

carbon capture and storage or smart grids) are technically feasible. Studies show that a low-carbon power sector is technologically viable at an acceptable cost (IEA 2013c; McKinsey & Company n.d.).

1.3. Carbon intensity pathway

While the amount of electricity generated almost doubles from 2010 to 2050, CO_2 emissions must gradually decline until 2050, with an increased decline after 2020. This leads to a steady decline in the carbon intensity of electricity, with the amount of GHG per kWh reduced by more than 95 percent compared with 2010 levels in 2050 as shown in Figure I.1 .

Figure I.1 The carbon intensity of electricity must decline steadily as the GHG per kilowatt hour is reduced by 95 percent over 2010 levels in 2050



Source: based on IEA (2014).

2. CEMENT

Cement is made from clinkers and a mix of other minerals. This production process is energy intensive because it involves the heating of ingredients to 1,450 ˚C. Most of the fossil fuels used in the industry are required for this purpose. As a consequence, large quantities of GHG emissions are generated. The calcination reaction that takes place in cement production also produces CO_2 as an inherent process emission separate from energy use. Therefore, part of the emissions from this sector cannot be avoided (IPCC 2014a) if the sector sticks to the conventional production processes.

2.1. Activity level

In 2010, the cement industry produced 3,551 Mt of cement. In 2050, this is expected to increase to 4,475 Mt, an increase of almost 26 percent. Cement is the main ingredient for various building materials, the economic growth in developing countries (IEA 2012a)—accompanied by an increase in buildings—is expected to increase demand for cement. This will only hold if no new building technologies or fabrications are found with equivalent properties as a building material (e.g., steel, glass, wood).

2.2. Emission reduction potential

The cement sector directly emitted 2.1 gigatons of CO_2 in 2010. By 2050, it would need to decrease emissions to 1.7 gigatons, a reduction of about 20 percent. Fuel-related emissions can be brought down through fuel switching, using biofuels instead of fossil fuels, and assuming there would be sufficient access to biofuels for the cement sector. Emissions can be brought down even further by implementing best available technologies including energy efficiency measures.

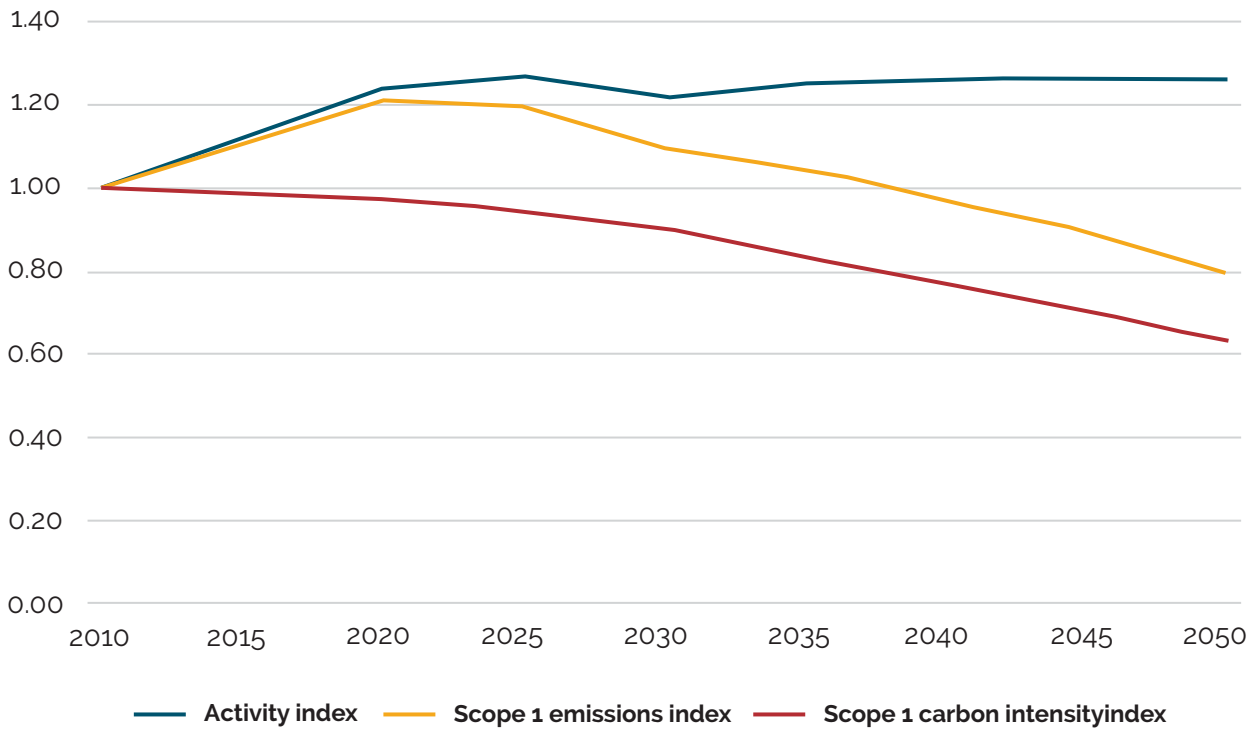
Energy efficiency improvement options have limited potential because about 50 percent of the 2010 emissions

were process emissions from the calcination reaction, which are difficult to reduce cost-effectively given current technology (IPCC 2014a). These emissions can be partially reduced by reducing the share of clinkers or using clinker substitutes in the mix of input minerals. However, the largest reductions in CO_2 emissions from the calcination reaction can be made by capturing and storing these emissions. By combining these measures, the emissions per ton of cement can be brought down by around 50 percent without carbon capture and storage (CCS) and around 80 percent with the use of CCS (IPCC 2014a).
According to IEA, fuel switching and the use of clinker substitutes can contribute 29 percent to emission reductions in the cement sector in 2050 (+/- 265 $MtCO_2$), whereas CCS could be responsible for 63 percent of the emission reductions (+/- 575 $MtCO_2$). The largest emission reduction potential is found in India and China (IEA 2012a).

2.3. Carbon intensity pathway

Figure I.2 shows the projected activity and emissions, and the resulting intensity pathway for the cement sector. Emissions peak in 2020 because of the growing activity, and then decline toward 2050 due to the effect of mitigation measures. In 2050, emission levels will be reduced by 20 percent compared with 2010, while the carbon intensity of cement production in 2050 decreases by 37 percent compared with 2010.

Figure I.2 Cement manufacture GHG emissions peak in 2020 because of activity growth, then decline toward 2050 because of mitigation measures to meet their target



Source: based on IEA (2014).

3. IRON AND STEEL

In primary steelmaking, the iron and steel sector uses iron ore as an input to make iron, and the latter to make steel. The primary steelmaking process involves smelting the iron ore, which requires a high amount of heat and conventionally uses emission-intensive coking coal. Steel can also be made from scrap (secondary steelmaking), which is generally very electricity-intensive.

3.1. Activity level

In 2010, the sector produced 1,482 Mt of crude steel. In 2050, global steel production is expected to increase to 2,295 Mt, an increase of almost 55 percent. This growth will be driven mainly by an increased demand for steel in emerging economies. Demand is expected to increase partly because of its use as a building material for a growing population.

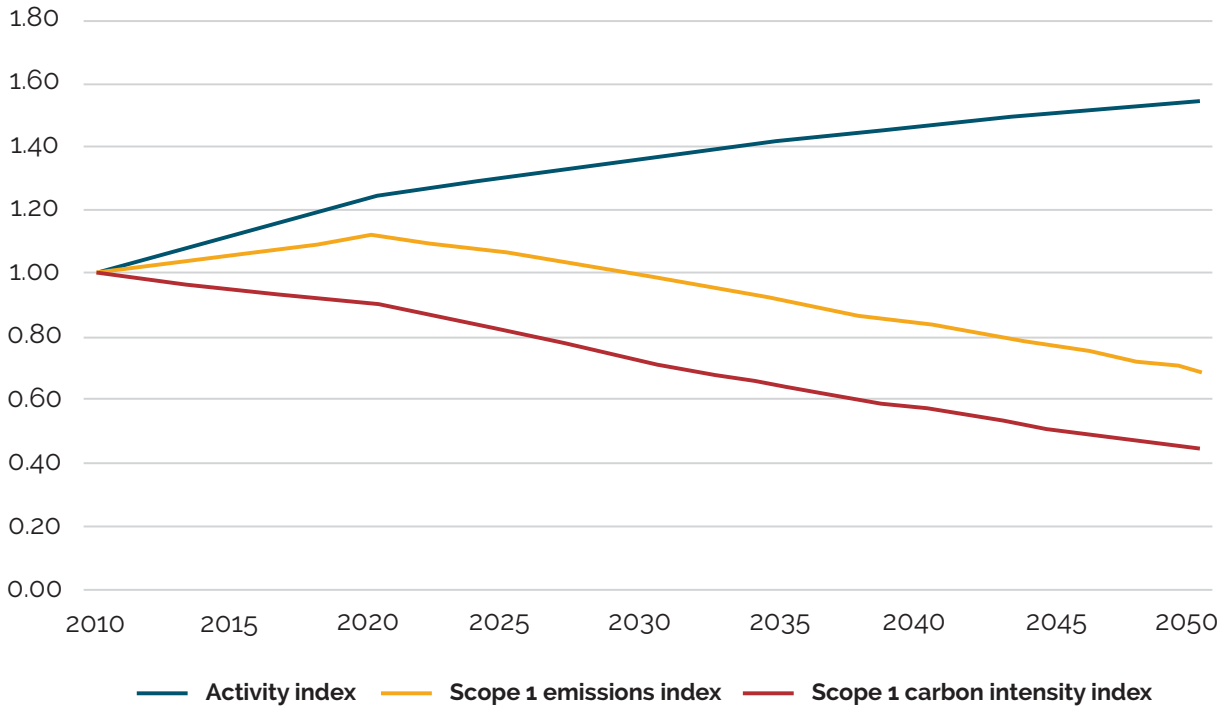
3.2. Emission reduction potential

The iron and steel sector directly emitted 2,955 gigatons of CO_2 in 2010. In 2050, emissions would need to decrease to 2,044 gigatons, a reduction of almost 31 percent. Possible technologies to reduce the amount of CO_2 emitted per ton of steel are to use natural gas, hydrogen, or oil instead of coal. Also, efficiency measures can be implemented. Nearly half of the CO_2 reductions in the iron and steel sector are expected to be from energy efficiency improvements. The greatest potential for efficiency increases comes from "phasing out open-hearth furnaces in countries such as Ukraine and Russia, and from blast furnace improvements in India, China, and Ukraine" (ETP 2014). In addition, CCS can be used to further reduce CO_2 emissions. IEA expects the iron and steel sector to capture 812 Mt of CO_2 in 2050. Emissions can be further reduced through increased secondary steelmaking, which has primarily scope 2 emissions (limited by scrap availability), in combination with electricity decarbonization.

3.3. Carbon intensity pathway

Because of this activity growth, the sector's emissions will increase slightly until 2020, even when the carbon intensity decreases by 10 percent compared with 2010. By 2050, the total emissions will need to decrease by 31 percent and the carbon intensity by 55 percent compared with 2010, as shown in Figure I.3.

Figure I.3 Iron and steel sector emissions will increase slightly because of activity growth, but the total emissions need to decrease by 31 percent and intensity by 55 percent by 2050



Source: based on IEA (2014).

4. ALUMINUM

The aluminum sector makes aluminum out of raw materials (like bauxite, primary aluminum) or out of recycled aluminum (secondary aluminum). Most of the recycling takes place in the industry itself (IPCC 2014a). In primary aluminum making, an electrolysis reaction is necessary, requiring a large amount of electricity (IPCC 2014a).

4.1. Activity level

In 2010, aluminum production amounted to 87 Mt (neglecting industry internal recycling to avoid double counting). In 2050, this is expected to increase to 234 Mt (IEA 2014), an increase of almost 169 percent. The demand for aluminum is expected to grow significantly because of its increased application in transport, construction and engineering, in particular in developing countries because of expected economic growth.

4.2. Emission reduction potential

In 2010, the scope 1 CO_2 emissions from the aluminum sector were 141 Mt. By 2050, emissions are expected to increase to 333 Mt (IEA 2014), up to 136 percent, because of the large increase in production.

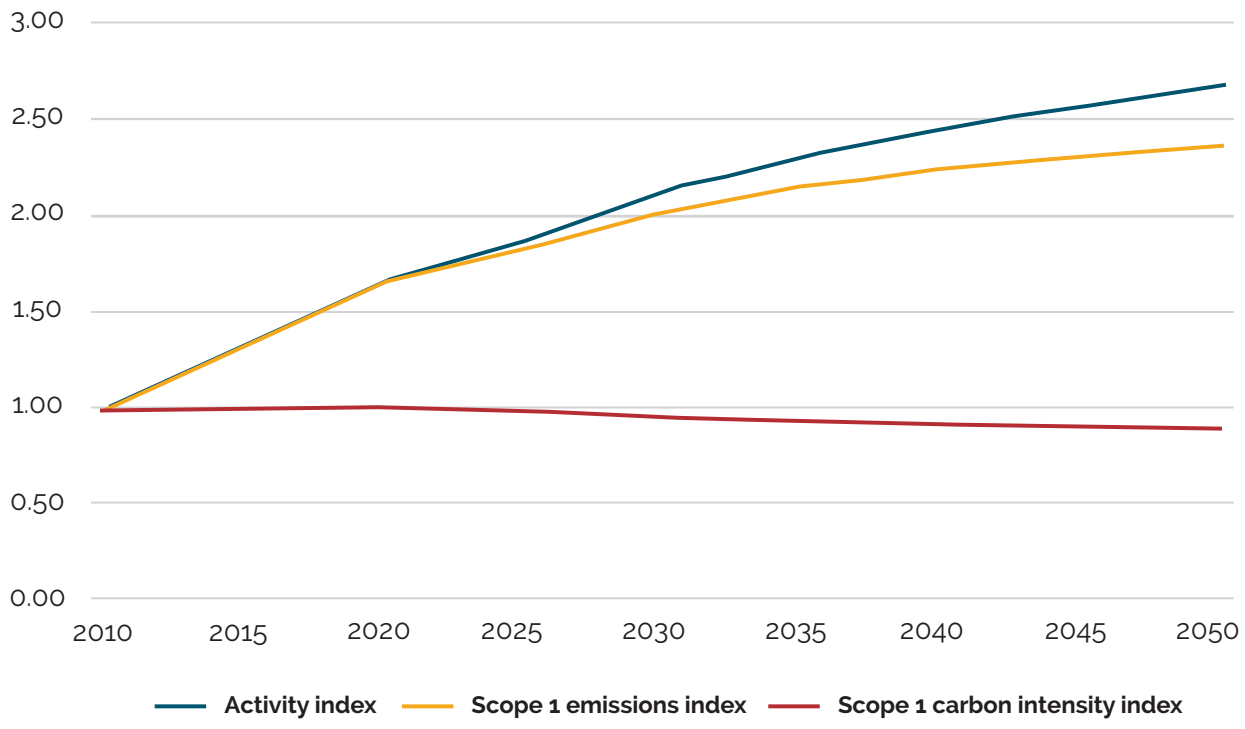
Even though the emissions from aluminum are only a small share of global emissions, the expected increase in activity and the current energy intensity allow for a high reduction potential, with Asia holding more than half of the global reduction potential (IEA 2012a). The quality of the ore used is an important factor in the emission intensity, but there is also potential for technical abatement measures (IEA 2012a). The implementation of best available technologies can reduce energy use for aluminum production by about 10 percent (IPCC 2014a). Recycling more aluminum can also reduce emissions significantly.

4.3. Carbon intensity pathway

Figure I.4 shows the sector's intensity pathway. The activity index steadily increases up to more than 2.5 from 2010 to 2050. Emissions are allowed to increase, but at a declining pace. The result is that the carbon intensity needs to be reduced by 88 percent from the 2010 intensity.

For indirect emissions (scope 2), decarbonization of electricity can reduce the carbon intensity even further (IEA 2012a). With the increasing decarbonization of the power sector, scope 2 emissions are expected to drop significantly from 2011 to 2050 (from 4.47 tons of CO_2 to 0.16 tons of CO_2 per ton of aluminum).

Figure I.4 Aluminum manufacturing activity steadily increases to more than 2.5 times the 2010 activity by 2050, but carbon intensity needs to decline by 88 percent



Source: based on IEA (2014).

5. CHEMICALS AND PETROCHEMICALS

The chemicals and petrochemicals sector produces plastics, fertilizers, and other chemicals. GHG emissions in the sector come mainly from two sources: the combustion of fossil fuels for heat demand, and emissions from chemical processes.

5.1. Activity level

Because this sector produces a wide range of different intermediate and end products, a monetary rather than a physical indicator is used to model activity. However, the predicted activity, in contribution to GDP, is not given for this sector. Instead, the predicted global economic growth rate of the IEA ETP 2014 2DS pathway—roughly 3.3 percent per year—is used because chemicals and petrochemicals permeate all levels of industry.

5.2. Emission reduction potential

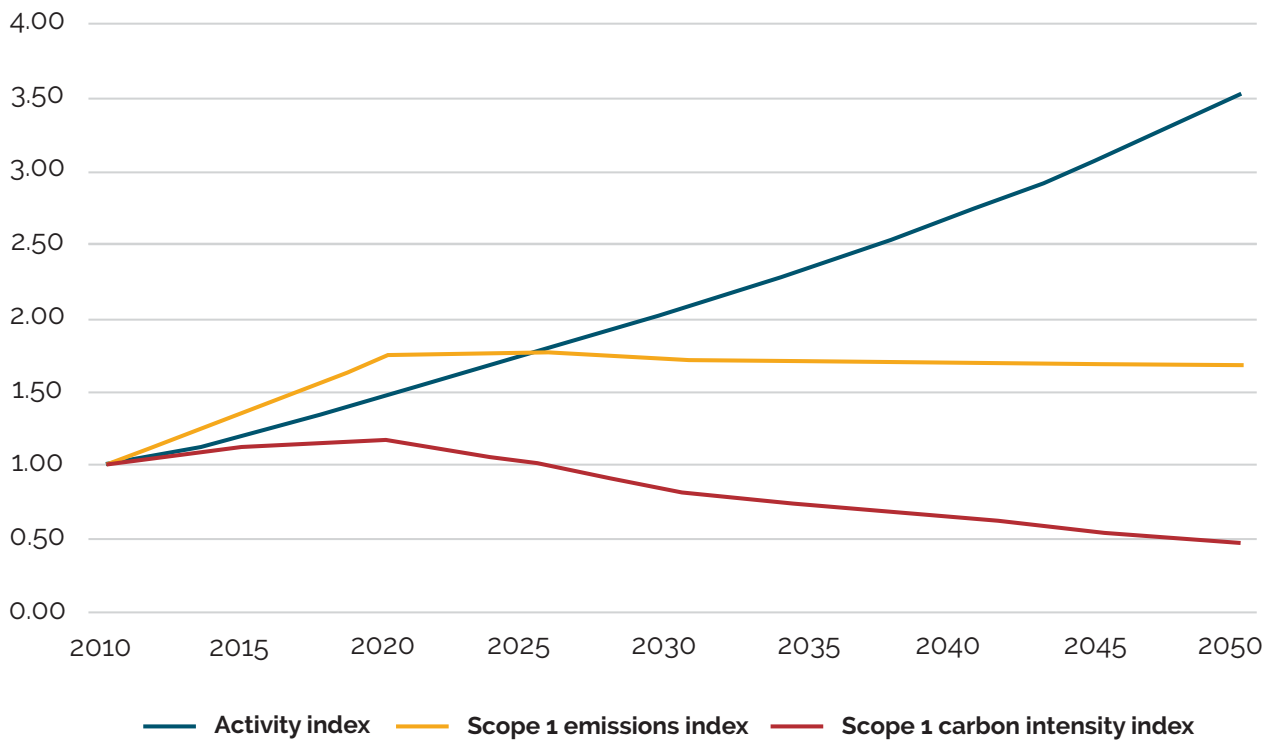
In 2010, global CO_2 emissions from the chemical and petrochemical sector were 1.2 Gt. Global CO_2 emissions would be expected to increase to 2 Gt by 2050, an increase of almost 68 percent. China, Africa, and the Middle East account for more than half the emission reduction potential (IEA 2012a).

More efficient or less emission-intensive alternatives are available for many processes required to make products in the chemical and petrochemical sector (IPCC 2014a). Improvements in efficiency can be achieved by increased process integration, waste heat recovery and utilization, the use of efficient electrical equipment, and the implementation of captive cogeneration units. Also, substantial opportunities exist (up to 50 percent emissions reduction) in using less material (IPCC 2014a). Low-carbon technologies—including the deployment of bio-based chemical facilities and improved performance of catalysts and related process technologies—can also reduce emissions. In addition, CCS can be used to meet the sector's targets. IEA estimates that CCS could be responsible for 551 Mt of CO_2 captured in 2050 in the sector.

5.3. Carbon intensity pathway

The required emissions pathway for the chemical and petrochemical industry is given in the 2DS scenario, and the relative growth in the emissions scenario is divided by the economic growth over the same period. The final carbon intensity pathway shows a small increase in carbon intensity because of the higher uptake of carbon-intensive special chemicals until 2020, and then a decline in carbon intensity by 52 percent in 2050 (Figure I.5).

Figure I.5. Although activity will grow in the chemical and petrochemical sector, carbon intensity would peak in 2020, then decline by 52 percent by 2050



Source: based on IEA (2014).

6. PULP AND PAPER

The pulp and paper sector produces all types of paper and cardboard. Fuel and energy use are the main sources of GHG emissions during forestry, pulping, and manufacturing of paper (IPCC 2014b).

6.1. Activity level

During recent decades, global pulp and paper production has increased steadily, mostly because of increased demand from developing countries. This trend is expected to continue and total production is expected to increase from 392 Mt in 2010 to 755 Mt in 2050, an increase of 93 percent.

6.2. Emission reduction potential

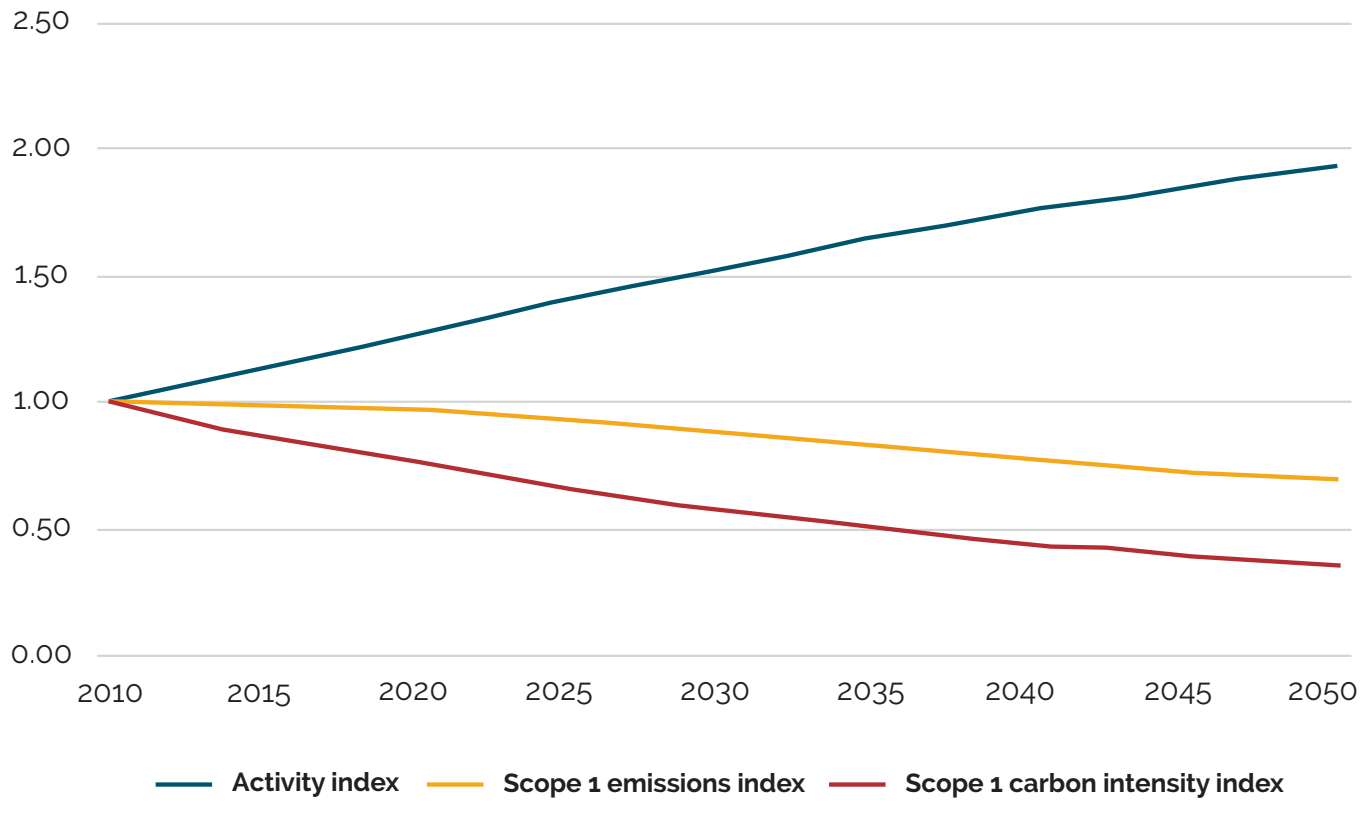
The global direct CO_2 emissions from pulp and paper production are expected to decrease from 238 Mt to 164 Mt by 2050, roughly 31 percent. These emission reductions would predominantly originate from the OECD region, closely followed by China, the second largest contributor. A wide range of energy efficiency technologies are available for this sector, including more efficient heat use for drying paper, increasing the energy efficiency of the pulp and paper mills and waste-to-energy technologies.

According to the IEA, energy efficiency measures would be responsible for 47 percent of the emission reductions, and fuel switching would be responsible for 38 percent of the emission reductions. The latter includes the increased use of biomass and shifting to less-intensive conventional fuels. Higher material efficiency, for example through printing on demand or paper reuse, also can also reduce emissions (IPCC 2014b).

6.3. Carbon intensity pathway

The sectoral scope 1 carbon intensity pathway decreases from 0.61 ton of CO_2 per ton of paper in 2010 to 0.22 ton of CO_2 per ton of paper in 2050. This is a decrease of almost 64 percent, as shown in Figure I.6.

Figure I. 6 As pulp and paper manufacturing activity grows, its carbon intensity would need to decline by 64 percent by 2050



Source: based on IEA (2014).

7. OTHER INDUSTRY

The "other industry" sector includes all industries that cannot be allocated in one of the six industry sectors above. It includes industries such as food, beverage, and tobacco processing; manufacturing of other non-ferrous metals (e.g., copper, lead, nickel, tin, titanium, zinc, gold, silver, platinum) and other non-metals (e.g., glass, ceramics); manufacturing of textiles, wearing apparel, leather, and related products; manufacturing of computers, electronics, optical products, and electrical equipment; manufacturing of machinery and equipment; and the construction industry.

7.1. Activity level

For the other industry sector no specific information was found at the sector or subsector level in IPCC and IEA ETP 2DS on their activities in 2010 or toward 2050. For that reason, they are measured using value added as the activity indicator. The relative activity growth of the sector was modeled by using the predicted global economic growth rate from the IEA ETP 2014 2DS pathway, roughly 3.3 percent per year.

7.2. Emission reduction potential

Because no data are available for these industries, the emission budget of this sector was determined by the total industry IEA ETP 2014 2DS emission pathway minus the emission budgets of the five energy-intensive industry sectors described above. In that way, the emissions pathway of the other industry sector can be determined for 2010 till 2050. CO_2 emissions in 2010 were 2,140 Mt, targeted to decrease to 903 Mt in 2050, a decrease of 58 percent.

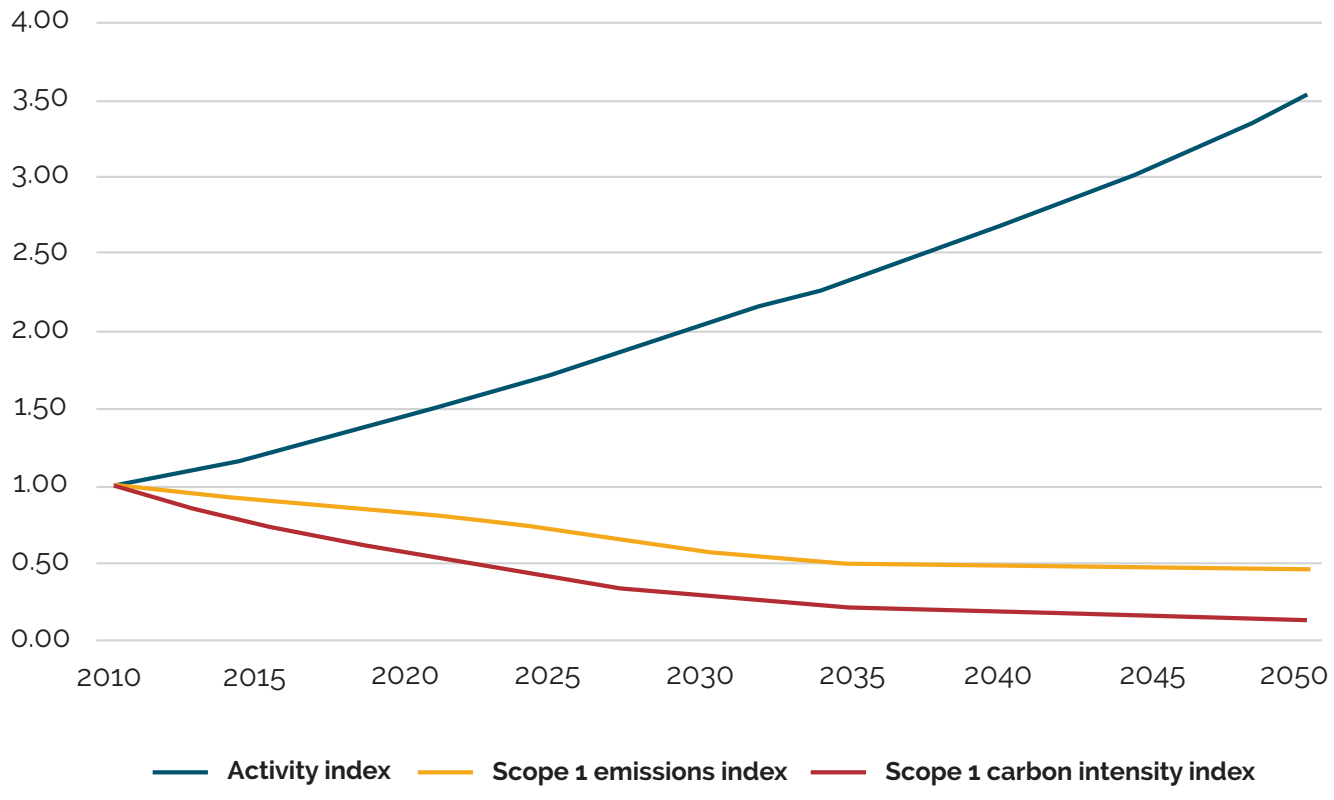
A steep decline of the emission intensity is needed in this sector with its many and diverse small- and medium-size enterprises (SMEs). SMEs typically have larger reduction potential than the large energy-intensive companies (Saygin, Patel, & Gielen 2010); this potential can be approximated with generic efficiency improvements. There is also potential to reduce scope 2 emissions, such as more efficient motor systems and decarbonizing electricity.

7.3. Carbon intensity pathway

With increasing activities and decreasing emissions from 2010 to 2050, the carbon intensity of the sector declines steeply. The carbon intensity index of the sector goes from 1 in 2010 to 0.14 in 2050, a decrease of around 87 percent.

The carbon intensity of a company in this sector is calculated by dividing the emissions of the company by the value-added of the company. The company's carbon intensity and the sector's intensity in the base year are linearly reduced at the same rate to the target year. This means that companies in this sector will have an intensity target that should decline about 87 percent by 2050.

Figure I.7 Other industries will grow, but have a target of reducing carbon intensity by 87 percent by 2050



Source: based on IEA (2014).

8. LIGHT-DUTY ROAD PASSENGER TRANSPORT

This category includes passenger vehicles up to nine persons per vehicle and 3.5 tons of gross vehicle weight (IEA 2012a). Most of the GHG emissions in this sector are caused by combustion of fossil fuels either directly in an internal combustion engine, or indirectly through the generation of electricity in electric vehicles.

8.1. Activity level

The transport sector will grow significantly by 2050 in terms of revenue passenger kilometers, especially in non-OECD regions, where increasing wealth is driving motorization. In 2010, the revenue passenger kilometers of light-road passenger vehicles were almost 28 trillion. In 2050, it is expected to increase to 50 trillion revenue passenger kilometers, an increase of roughly 79 percent.

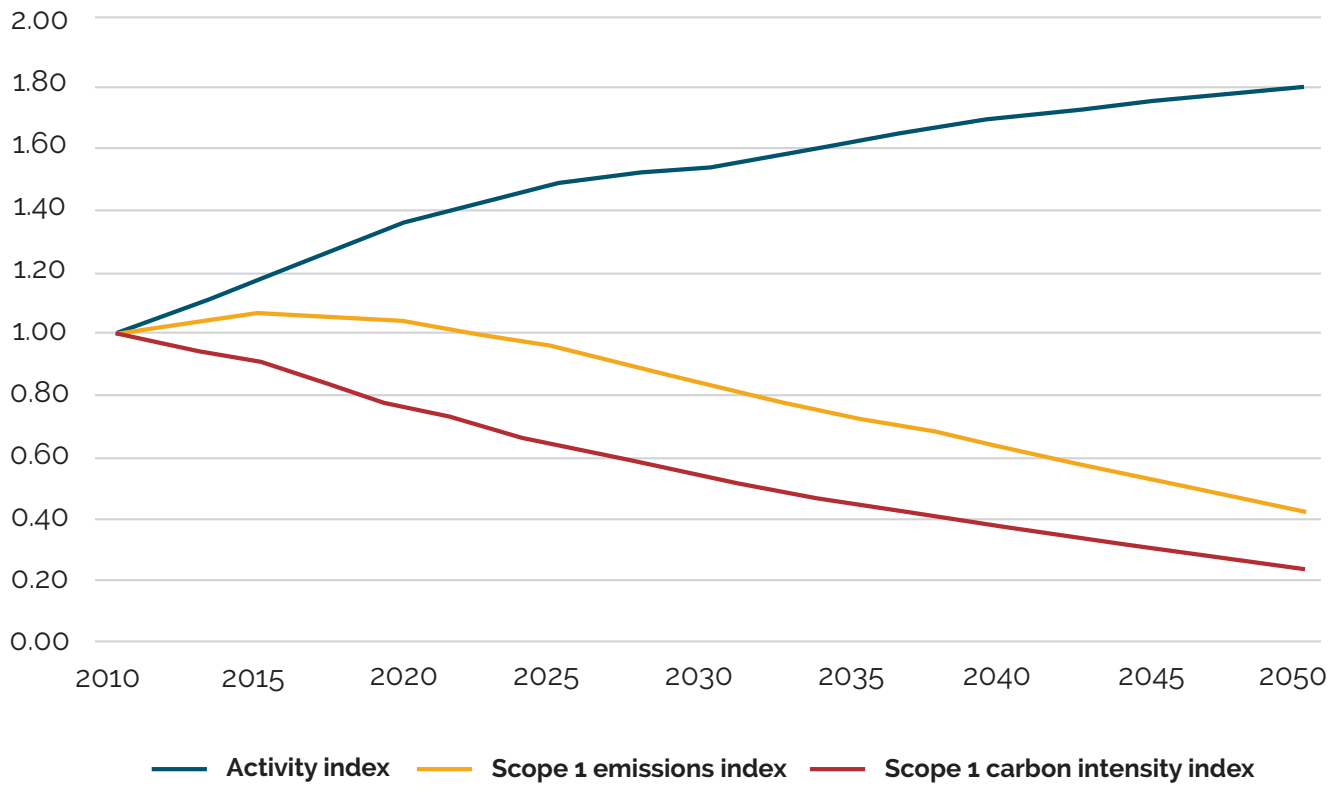
8.2. Emission reduction potential

The CO_2 emissions from the use of light-duty vehicles were just below 2.9 Gt in 2010 and are targeted to decrease to 1.2 Gt in 2050, a decrease of roughly 58 percent. This decrease is in line with the 60 percent reduction potential decrease from 2010 to 2050 estimated by the IPCC (IPCC 2014a). A wide range of reduction technologies are available (e.g. hybrid drive trains, increased aerodynamics, weight reduction, fuel cell vehicles, biofuels, eco-driving, full electric battery vehicles) (IPCC 2014a). To help unlock this potential, IEA describes three reduction strategies in the IEA ETP 2014 2DS scenario: avoid, shift, and improve. Avoid - slows individual travel growth via city planning and demand management. Shift - enables people and business to shift to more efficient modes, such as rail. Improve - encourages the adoption of new technologies and fuels.

8.3. Carbon intensity pathway

Figure I.8 shows the absolute emissions from light-duty vehicle use first having a small increase of 4 percent up to 2015 due to increased activity. In 2050, the emissions are modeled to decline to 42 percent of 2010 levels. This means that the intensity in 2050 needs to be 76 percent lower than in 2010 to remain in line with this sector's 2°C decarbonization pathway.

Figure I.8 Cars and light trucks will continue growth in activity, but need to reduce carbon intensity by 76 percent by 2050



Source: based on IEA (2014).

9. HEAVY-DUTY ROAD PASSENGER TRANSPORT

Heavy-duty road passenger transport includes motorized passenger vehicles with more than nine seats such as buses and minibuses. It does not include freight transport.

9.1. Activity level

In 2010, the global activity of the heavy-duty road passenger transport sector amounts to 7.2 trillion revenue passenger kilometers. This is expected to rise to more than 18 trillion revenue passenger kilometers by 2050, an increase of 157 percent. The increase is driven by a rise in world population and the drive to avoid slow individual travel.

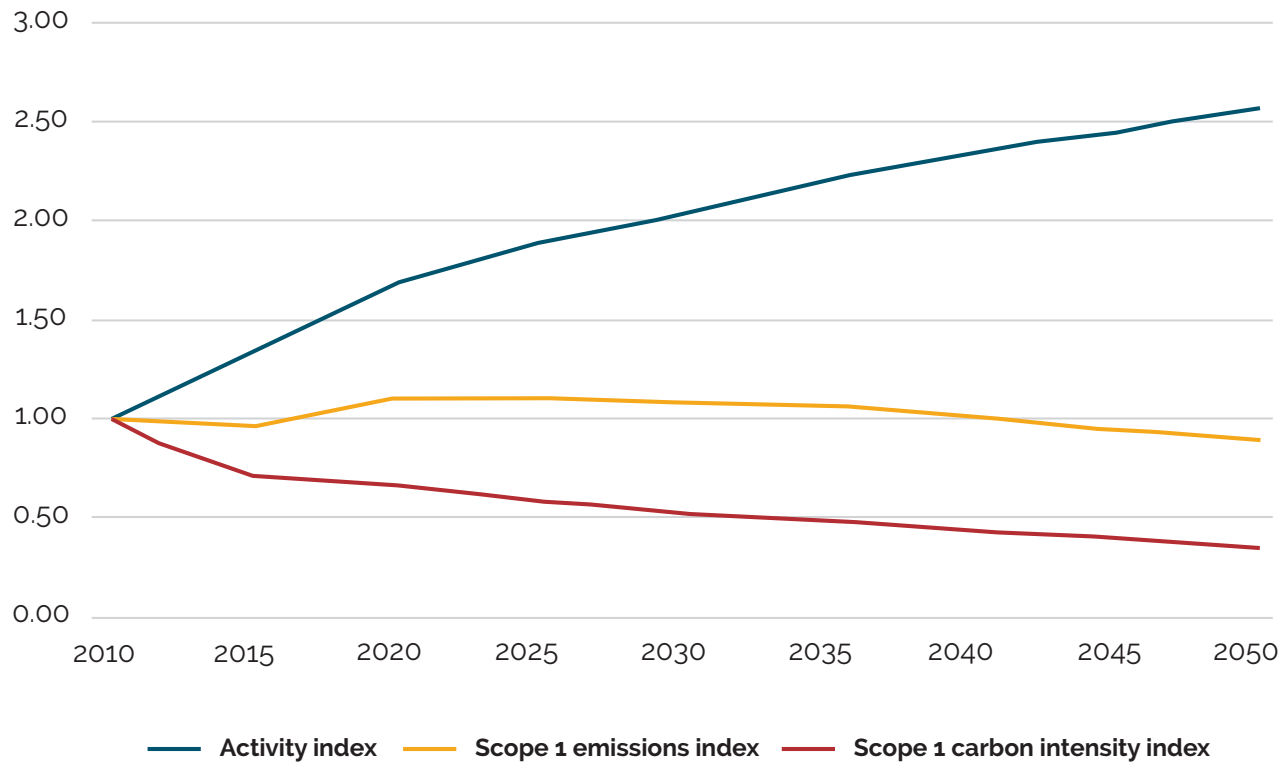
9.2. Emission reduction potential

In 2010, the heavy-duty road passenger transport sector emitted 356 Mt of CO_2. In 2050, this is expected to decrease to 315 Mt, a decrease of 12 percent. With an activity increase of 157 percent, a large reduction in emission intensity is needed to achieve these emission reductions. The potential to bring down the emission intensity of heavy-duty passenger vehicles is large. It can be done by technological innovation incentivized by policies like fuel-economy standards for heavy-duty vehicles, as well as by technological development (e.g. hybrid drive-trains, increased aerodynamics, weight reduction, fuel cell vehicles, biofuels, eco-driving, full electric battery vehicles, etc.), improved consumer information schemes, fuel taxation, or implementation of bus rapid transit (BRT) systems or other mass transit schemes.

9.3. Carbon intensity pathway

As shown in Figure I.9, the number of 2050 revenue passenger kilometers is expected to be more than 2.5 times the 2010 revenue passenger kilometers. Despite this growth in activity, the reduction potential could bring down the 2050 carbon intensity by 65 percent compared with 2010.

Figure I.9 While revenue passenger kilometers traveled in heavy-duty road passenger vehicles will more than double, carbon intensity is targeted to decline by 65 percent



Source: based on IEA (2014).

10. RAIL PASSENGER TRANSPORT

This sector includes passenger trains, but not freight transport. Rail passenger transport has one of the lowest emission intensities per passenger kilometer. With an increasing amount of electric trains and an increasing amount of renewable energy share in the power generation sector, this mode of transport will continue to be an important option to reduce emissions from the transport sector.

10.1. Activity level

In 2010, 2.6 trillion revenue passenger kilometers were traveled by rail. This number is expected to increase to 9.2 trillion revenue passenger kilometers in 2050, an increase of 254 percent. The increase in world population and shift of travel and transport to more efficient modes drive the growth in rail revenue passenger kilometers.

10.2. Emission reduction potential

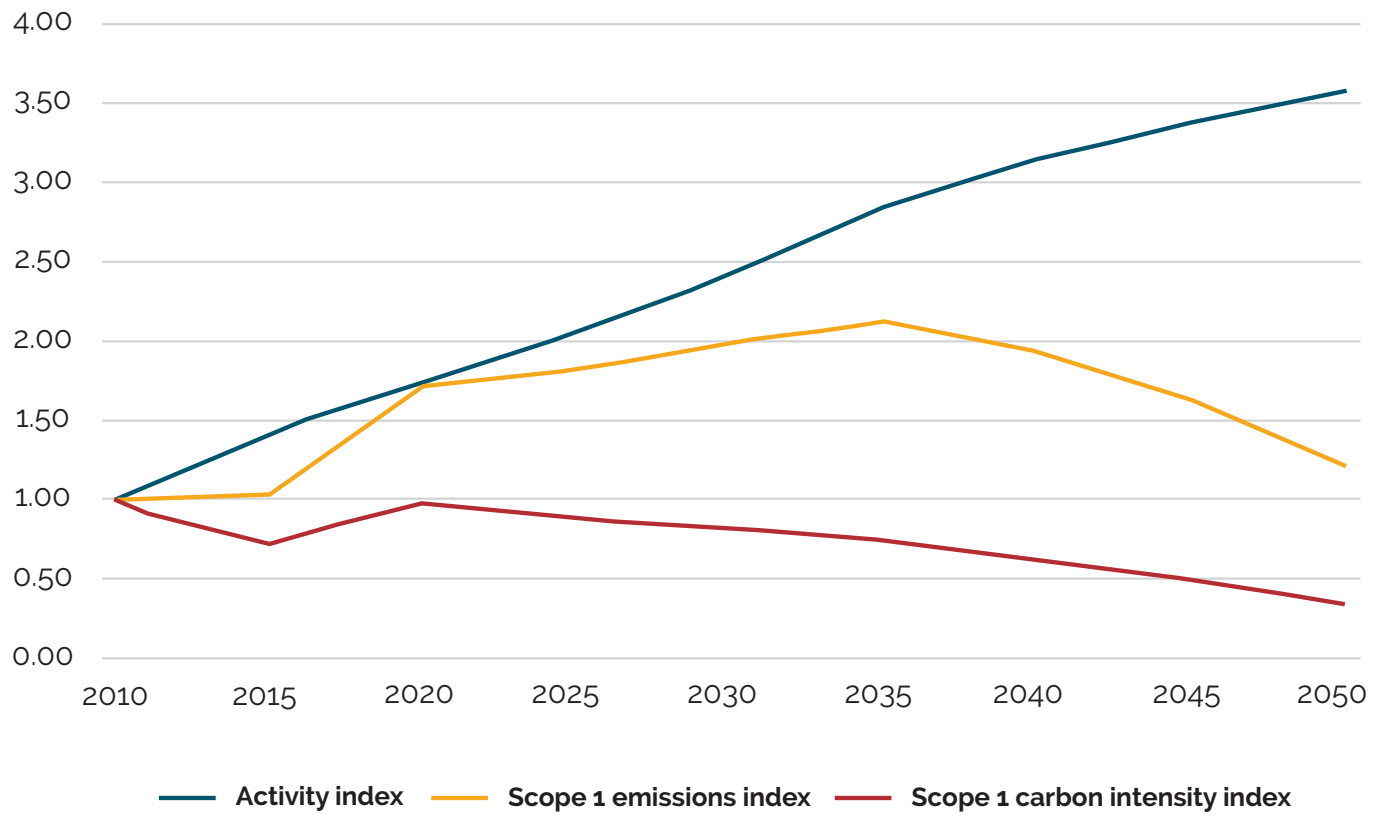
CO_2 emissions from rail passenger transport are expected to increase from 19 Mt in 2010 to 23 Mt in 2050, an increase of about 21 percent. Despite the increase in emissions, the direct emissions remain around 1 percent of the total transport sector.

10.3. Carbon intensity pathway

Due to the large increase in activity compared to the increase in emissions, the carbon intensity of scope 1 emissions is expected to decrease 65 percent by 2050 compared with 2010.

The carbon intensity pathway in Figure I.10 only covers scope 1 emissions. However, since rail transport almost exclusively uses electricity, the rail passenger transport sector also has a high reduction potential in scope 2 emissions as the share of renewable energy in electricity generation increases. Taking the 2°C decarbonization pathway of the power sector into account, the carbon intensity of scope 1 and 2 combined is expected to decrease from 21.27 gCO_2/passenger km to 3.07 gCO_2/passenger km, a decrease of around 86 percent.

Figure I.10 Rail passenger transport activity will grow, but carbon intensity is expected to decline by 65 percent



Source: based on IEA (2014).

11. AVIATION PASSENGER TRANSPORT

This sector encompasses the transportation (both domestic and international) of passengers only. Cargo by plane is included in the other transport sector. The main source of GHGs for this sector is the combustion of fossil fuels in airplane engines.

11.1. Activity level

The activities of the aviation passenger sector were about 4.3 trillion revenue passenger kilometers in 2010. Significant growth is expected because of rising wealth in emerging economies and an increase in aviation tourism transport (IPCC 2014a; IEA 2012a). Activities in the passenger aviation sector are expected to increase to 7.8 trillion revenue passenger kilometers by 2050, up to 82 percent.

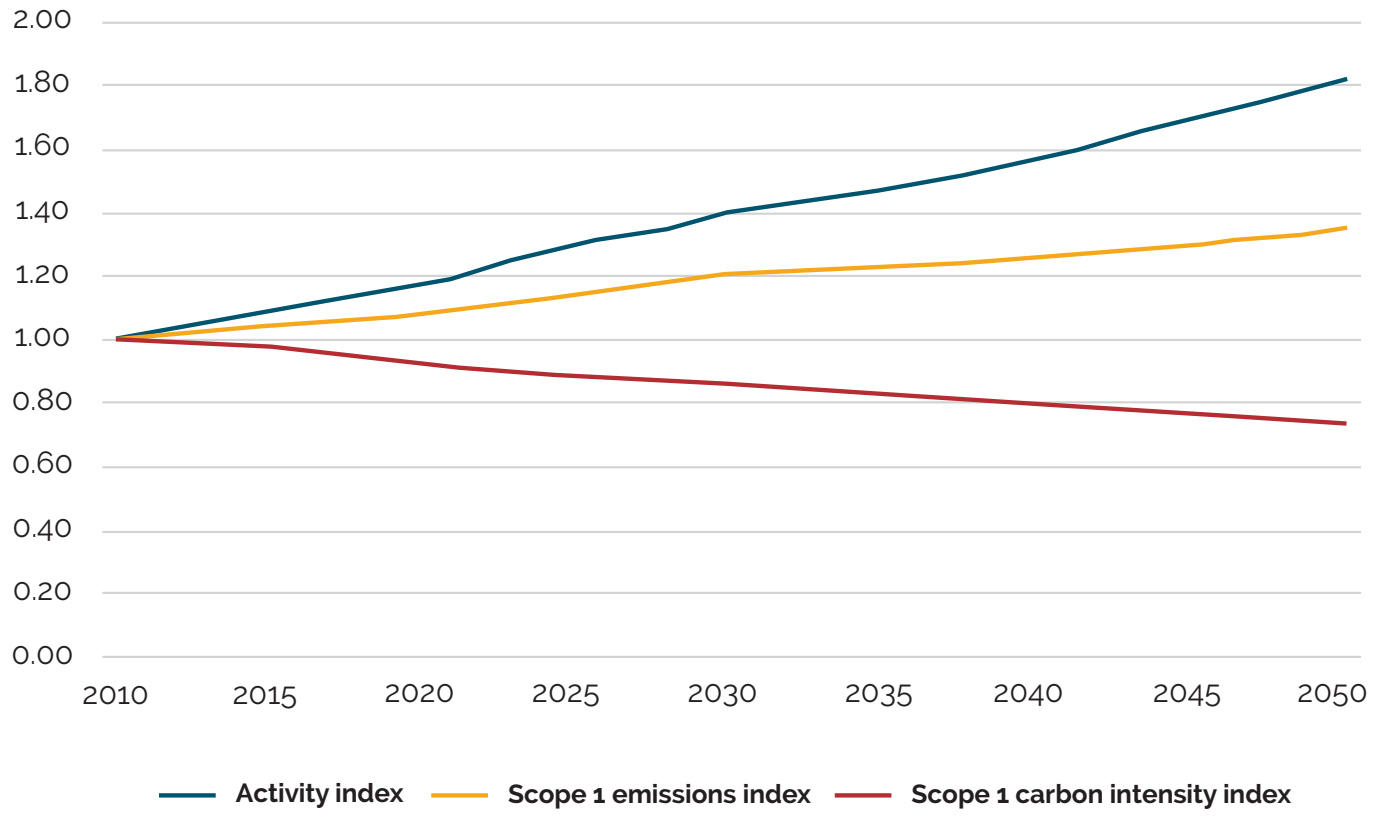
11.2. Emission reduction potential

In 2010, the aviation sector emitted about 755 Mt of CO_2 (tank to wheel). In 2050, this is expected to increase to 1,020 Mt, an increase of 35 percent. For large aircraft, there is currently no serious alternative to jet engines. Therefore, biofuels are expected to play an important part in reducing the carbon intensity of aviation (IPCC 2014a). However, since airplanes emit greenhouse gases at high altitudes, the impact of biofuels on global warming cannot be considered zero. Taking this into account and due to limitations of reduction options, the aviation sector is expected to have an increased share in global GHG emissions in the future (IEA 2012a).

11.3. Carbon intensity pathway

As can be seen in Figure I.13, the number of revenue passenger kilometers in aviation is expected to almost double between 2011 and 2050. Total emissions increase as well, though at a lower rate, resulting in a carbon intensity pathway of 26 percent lower in 2050 compared to 2010.

Figure I.11 Air passenger transport will increase by 82 percent in kilometers traveled, but with a carbon intensity pathway of 26 percent



Source: based on IEA (2014).

12. OTHER TRANSPORT

The other transport sector includes all freight transport.

12.1. Activity level

For the other transport sector, no activity information was found in IPCC and IEA 2DS on activities and emissions in 2010 and toward 2050. Therefore, method III was used, with a monetary carbon intensity indicator. The relative activity growth of the sector is modeled by using the predicted global economic growth rate from the IEA for the ETP 2DS pathway, which equals roughly 3.3 percent per year.

12.2. Emission reduction potential

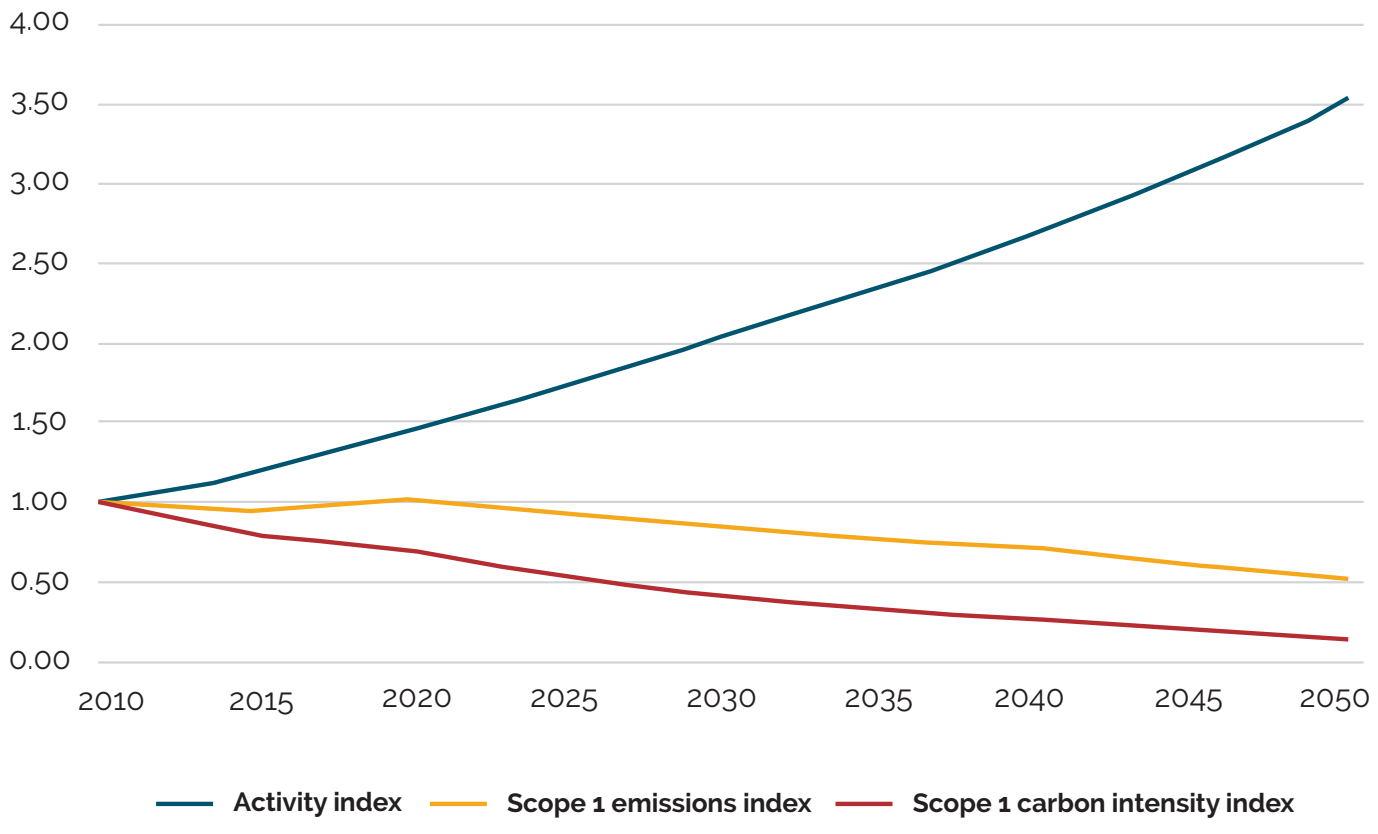
The reduction potential was determined by the overall reduction potential of the whole transport sector in the ETP 2014 2DS pathway. The pathway of the specified transport sectors above were subtracted from the pathway of the whole transport sector. The residue of this subtraction was used as the emission pathway for the other transport sector for 2010 to 2050. CO_2 emissions in 2010 were 2,788 Mt and need to decrease to 1,445 Mt by 2050, a decrease of 48 percent.

Reduction measures include fuel economy policies, fuel replacement options, load optimization and efficiency strategies, and vehicle technology improvements.

12.3. Carbon intensity pathway

The activity level in terms of monetary value continues to increase while emissions show a decreasing trend, resulting in an expected decline in carbon intensity of 85 percent by 2050. Value-added (as a proxy for contribution to GDP) was used for company targets. The company's carbon intensity and the sector's intensity in the base year are linearly reduced at the same rate to the target year.

Figure I.12 Freight (other) transit will grow, but both emissions and carbon intensity can decline with new fuels



Source: based on IEA (2014).

13. SERVICE BUILDINGS

All service companies are included in this sector, but most of their CO_2 emissions emanate from buildings. This category is also known as commercial buildings, and excludes residential buildings. Examples are trade, finance, real estate, public administration, health, food, lodging, education, and commercial services. Energy use in this sector includes space heating and cooling, water heating, lighting, appliances (HVAC is the technical term), and miscellaneous equipment (such as office equipment and other small plug loads in the service sectors). Heating and cooling has the largest contribution to GHG emissions (Girod et al. 2014).

13.1. Activity level

Since heating and cooling are the sources of GHG emissions in the service building sector, the square meter was used as the activity parameter. In 2010, this sector entailed about 38 billion square meters, and is expected to grow by 66 percent by 2050, reaching 63 billion square meters.

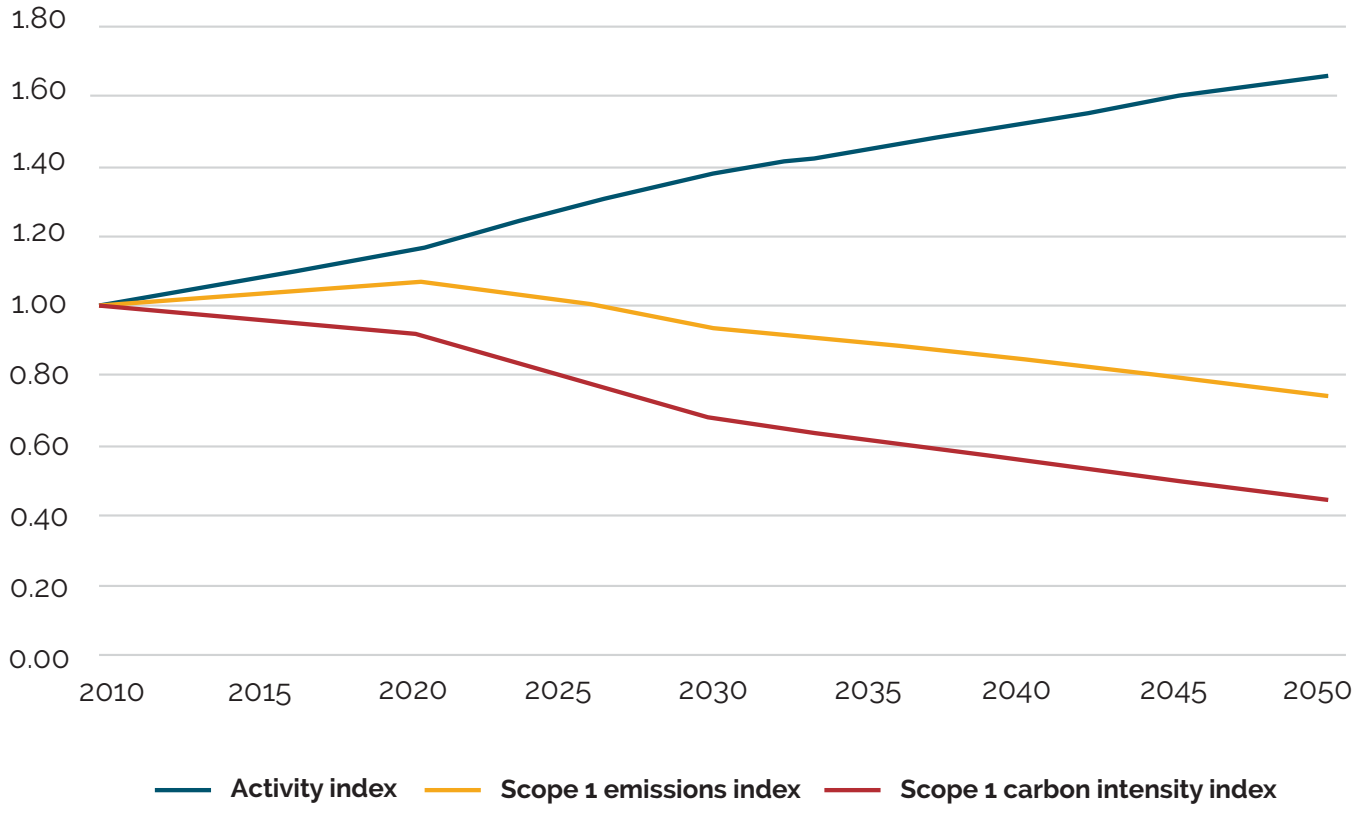
13.2. Emission reduction potential

CO_2 emissions are expected to decrease from 870 Mt in 2010 to 645 Mt in 2050, a reduction of 26 percent. There is a large potential to reduce emissions in this sector without changing the comfort level of the buildings or requiring businesses to reduce the number of appliances and electronic equipment. Most reductions will be due to increased insulation, electrification of the offices, more energy efficient appliances, and an increase in the use of renewable energy. Tapping into this potential will be different for developed and developing countries (IEA 2012a). In developed countries, retrofitting existing building stock can significantly reduce CO_2 emissions. In developing countries, many new buildings are being built, which offers opportunities to reduce emissions through improved efficiency standards.

13.3. Carbon intensity pathway

The emission pathway shows a small increase up to 2020, but a reduction of a quarter is expected over 2010 to 2050. Over the same period, the square meters of service buildings increase by two-thirds. The latter results in a carbon intensity decrease of 55 percent by 2050 compared with 2010.

Figure I.13 The space in service and office buildings will increase by two-thirds, but the carbon intensity is modeled to decline by 55 percent because of more efficient fuels for heating, cooling, and electricity



Source: based on IEA (2014).

APPENDIX II. HOW SECTOR BUDGETS WERE DERIVED

Data were retrieved from IEA ETP 2014 in order to determine sectoral CO_2 budgets as described in the table below. With the purchase of a license, the EIA spreadsheets from which these carbon budgets were derived are available at: <http://www.iea.org/etp/etp2014/restrictedaccessarea/>.

TABLE II.1 HOW SDA CO_2 BUDGETS WERE DERIVED FROM ETP 2DS

ETP Source	SDA sectors	SDA Subsector	How SDA Sector pathways were derived from ETP 2DS sectors
Power summary	Power Generation	N/A	Budget is the same in the SDA and ETP
Industry summary	Industry	Iron & steel	Budget is the same in the SDA and ETP
		Cement	Budget is the same in the SDA and ETP
		Aluminum	Budget is the same in the SDA and ETP
		Pulp & paper	Budget is the same in the SDA and ETP
		Chemicals & petrochemicals	Budget is the same in the SDA and ETP
		Other processing & manufacturing industries	Total emissions in the ETP industry sector minus the emissions covered under iron & steel, cement, aluminum, pulp & paper, and chemicals & petrochemicals
This spreadsheet is not accessible from the link above. The ETP spread-sheets included emissions from well to tank, which are not covered under the SDA. The data used are not publicly available.	Transport services	Passenger transport – Air	Directly from IEA "Tank to Wheel" modeling data covering air, light road, heavy road, and rail (not publicly available)
		Passenger transport – Light road	
		Passenger transport – Heavy road	
		Passenger transport – Rail	
		Other transport	Total emissions minus the sum of the air, light road, heavy road, and rail ETP subsectors
Buildings, agriculture, fishing, and non-specified other summary	Services / Commercial buildings	Trade / Retail	Based on ETP's emissions from the services subsec-tor
		Finance	
		Real estate	
		Public administration	
		Health	
		Food and lodging	
		Education	
		Other commercial services	
Residential buildings Agriculture, fishing, non-specified other transformation	Non-included sectors		These subsectors do not have sufficient information to be covered by the SDA—they were subtracted from the ETP's buildings, agriculture, fishing, and non-specified other budgets

APPENDIX III. SCOPE 3

This section provides background on how scope 3 emissions should be treated under this version 1.0 of the SDA method. Further details and improvements regarding scope 3 are expected to be developed for the next version of the method.

The GHG Protocol scopes were designed to prevent double counting of emissions among different companies within scope 1 and 2 (as long as consistent consolidation approaches are used). Therefore, scope 1 and/or 2 emissions of companies—excluding the scope 1 emissions of utilities— can be aggregated to determine a total of a given region, set of companies, etc. Conversely, scope 3 by definition contains emissions occurring in the companies' value chain, which are scope 1 and 2 emissions of other companies and value chain players (like consumers). Therefore, double counting can occur and emissions should not be aggregated over companies (see also section 2.1.7 on double counting).

In contrast to scopes 1 and 2, target setting on scope 3 is more complex, because less information on (the most relevant) corporate scope 3 emissions is available. A recent CDP report on the GHG reports of the 500 largest public companies states that, "Most companies (97 percent) disclose scope 1 and 2 emissions from their operations. However, while companies are able to identify the most carbon intensive activities from their value chains, the emissions of nearly half (47 percent) of these activities are yet to be quantified." The report concludes that "companies often focus on relatively insignificant opportunities for carbon reductions" (CDP 2013).

Figure III.1 highlights this conclusion by showing that while "use of sold products" is reported by 25 percent of companies, it accounts for 76 percent of reported scope 3 emissions. Meanwhile, 72 percent of companies report emissions from business travel, which accounts for only 0.2 percent of total reported scope 3 emissions.
In addition, scope 3 emission calculations often show higher uncertainty levels as the activity data and emission factors used may be less specific. For example, while the emission factors for combustion of fuels (scope 1) are fixed and fuel use is often measured in detail, the exact carbon footprint of purchased materials can be less straightforward. This footprint can depend largely on the supplier and production process used, thus generic and average emission factors are often used. The same often occurs with transport-related emissions where an average emission factor per ton kilometer is used because fuel use is not separately tracked per customer (yet) by large logistical companies.

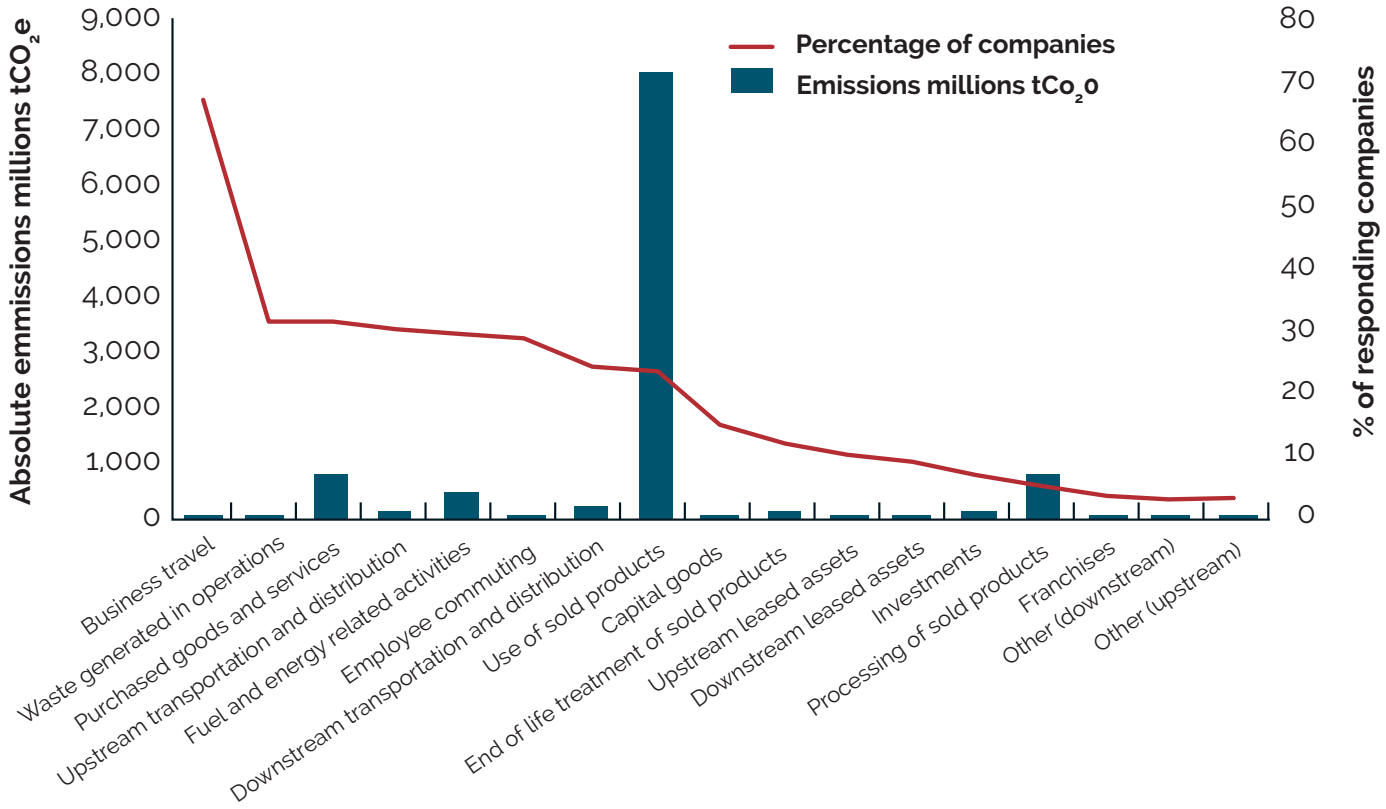
For many companies, insight into their value chain or scope 3 emissions is relevant. Many companies have or want to set scope 3 targets. For companies in energy-intensive industries (like material production), scopes 1 and 2 emissions are often most significant. But, for example, for companies selling energy-using products (e.g., equipment, cars) or purchasing materials from energy-intensive sectors, scope 3 emissions are more relevant. The GHG Protocol scope 3 standard states: "Scope 3 emissions can represent the largest source of emissions for companies and can present the most significant opportunities to influence GHG reductions and achieve a variety of GHG-related business objectives. Developing a full corporate GHG emissions inventory enables companies to understand their full emissions impact across the value chain and focus efforts where they can have the greatest impact" (GHG Protocol 2011).

The current method contains information to assist companies in setting scope 3 targets in line with a 2°C pathway. In fact, many scope 3 emissions are caused

by suppliers or other value chain partners from sectors currently covered by the method. The target setting for those sectors could be translated to specific company scope 3 targets.

An overview of the way the current method can cover some of the scope 3 categories is shown in Table III.1.

Figure III.1 Scope 3 reporting of Global 500 companies to CDP



Source: CDP (2013).

TABLE II.1 HOW SDA CO_2 BUDGETS WERE DERIVED FROM ETP 2DS

Scope 3 category	Direction to set targets in line with a 2°C pathway
Category 1: Purchased goods and services	Set target based on the 2 °C pathway of the applicable supplier sector (e.g. the chemical sector for companies purchasing chemical compounds).
Category 2: Capital goods	Set target based on the 2°C pathway of the applicable supplier sector.
Category 3: Fuel- and energy-related activities	Not covered in current method.
Category 4: Upstream transportation and distribution	Set target based on 2°C pathway of light passenger transport sector.
Category 5: Waste generated in operations	Parts of the waste disposal process, like transport and waste management services, can be covered by the method. Incineration or landfill emissions are not covered by the current method.
Category 6: Business travel	Set target based on the 2°C pathway of the light passenger transport and aviation sector.
Category 7: Employee commuting	Set target based on the 2°C pathway of the light passenger transport sector.
Category 8: Upstream leased assets	Set target based on the 2°C pathway of the service buildings sector.
Category 9: Downstream transportation and distribution	Set target based on the 2°C pathway of the light passenger transport and aviation sector.
Category 10: Processing of sold products	Not covered in current method.
Category 11: Use of sold products	Besides the use of light duty vehicles, scope 3 emissions of other sold products are not covered in current method, and target setting is not yet possible. However some aspects related to the emissions of sold products are included in the background of the method: - General energy efficiency improvements will reduce the impact per sold product and are included in the scenario's for final energy demand per year; - Increased renewable energy production will in time reduce the emissions per sold product.
Category 12: End-of-life treatment of sold products	Not covered in current method.
Category 13: Downstream leased assets	Set target based on the 2°C pathway of applicable sector of the leased asset (like for instance service/ commercial buildings).
Category 14: Franchises	Set target based on the 2°C pathway of applicable sector of the franchisee (like for instance service/ commercial buildings).
Category 15: Investments	This category is specifically targeted toward financial institutions where the majority of emissions are related to their investing and lending activities. Targets can be set based on the 2°C pathway of the applicable sector of the investee.

APPENDIX IV. REPRESENTATIVE CONCENTRATION PATHWAY 2.6 (RCP 2.6) SCENARIO

The representative concentration pathway 2.6 scenario (RCP 2.6) was developed by a scientific team at the PBL Netherlands Environmental Assessment Agency, headed by scientist Detlef van Vuuren.

The scenario was created using the IMAGE model (Bouwman, Kram, & Goldewijk 2006), an assessment framework consisting of a set of linked and integrated submodels.

The framework describes important elements in the long-term dynamics of global environmental change such as air pollution, climate change, and land-use change.

Three major steps can be distinguished in the IMAGE method (Figure IV.1):

1. First, the baseline emission scenario was constructed based on the energy and land use submodels of IMAGE. Other inputs are information on the abatement potential and costs of GHG emissions from the energy and land-use systems.

2. Second, pathways were developed toward long-term stabilization of the atmospheric greenhouse gas concentration. This was done by the FAIR-SiMCaP model. As part of this step, the FAIR model determined the abatement cost and global emission reduction from the baseline scenario, assuming a cost-optimal implementation of available reduction options over the different regions.

3. Third, the full IMAGE model framework implemented the changes in emission levels resulting from the abatement actions and the carbon price to develop the final mitigation scenario.

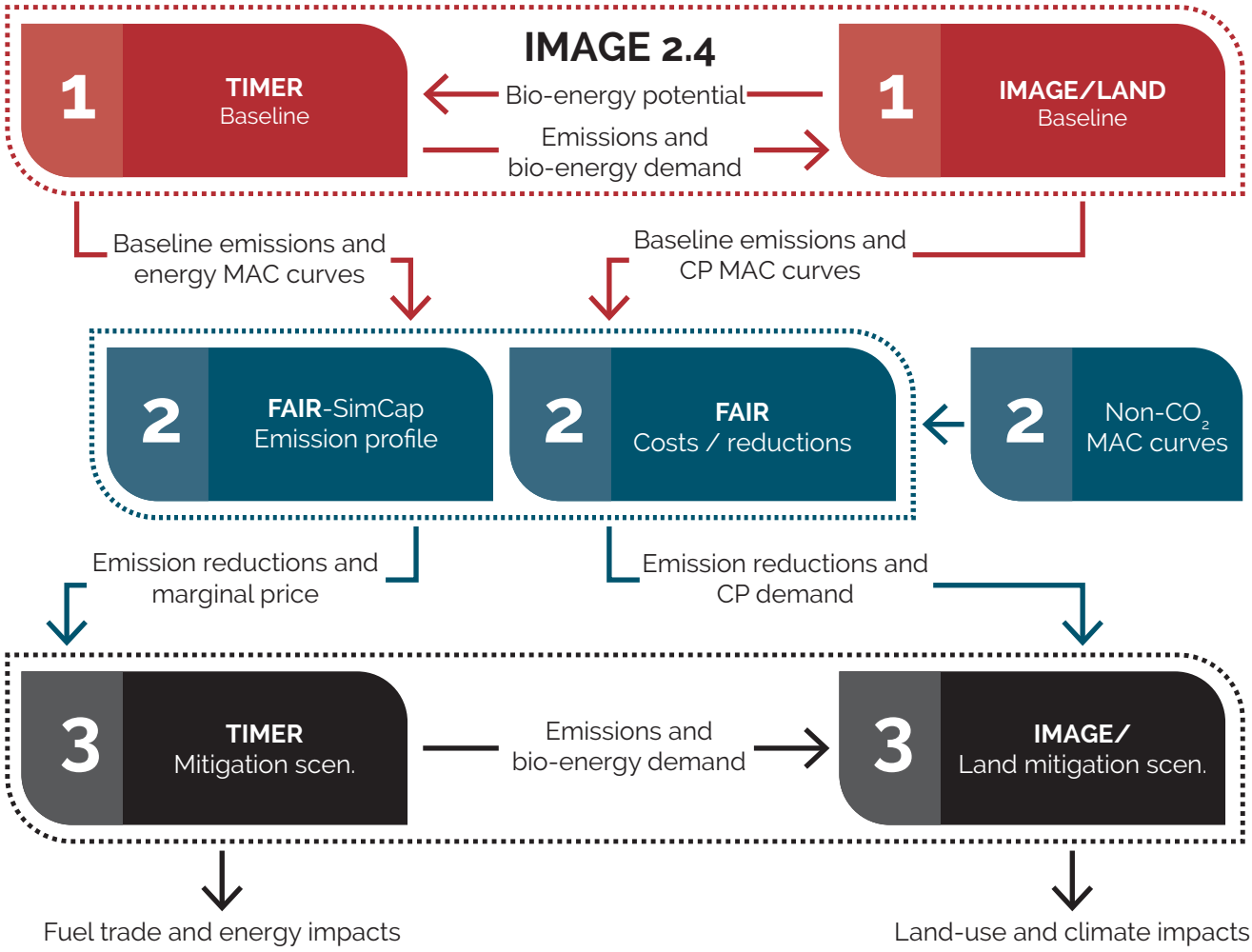
Main characteristics and assumptions:

- It is representative of the literature on mitigation scenarios aiming to limit the increase of global mean temperature to 2˚C.
- It is the representative concentration pathway scenario with the highest likelihood to reach this goal.
- It is technically feasible based on the IMAGE integrated assessment modeling framework from a medium emission baseline scenario, assuming broad participation of countries and sectors.
- It uses marginal abatement costs to ensure least-cost optimization. These are direct costs and do not capture any macroeconomic feedback.
- A cost-optimal implementation of available reduction options over the different regions is assumed.
- The model framework includes both the energy system and land-use change.
- Bioenergy and carbon capture and storage are assumed to be viable technological solutions in the future.
- It includes abatement through climate policy frameworks.
- It models CO_2 emissions and other greenhouse gases.

- The energy demand is modeled using the TIMER submodel, which makes a distinction among five sectors: industry, transport, residential, services, and other.

  The scenario gives annual outcomes until 2100 and uses the year 2000 as its base year.

Figure IV.1 Overall method for creating RCP2.6



APPENDIX V. ENERGY TECHNOLOGY PERSPECTIVES (ETP) -2 DEGREE SCENARIO (2DS)

The International Energy Agency (IEA) developed a similar low-carbon scenario in its Energy Technology Perspectives (ETP) report (IEA 2014). This extensive scenario shows a pathway consistent with the representative concentration pathway 2.6 (RCP 2.6) scenario (Schaeffer & van Vuuren 2012). ETP's 2DS scenario includes roadmaps for specific sectors and energy-intensive industries to reach the goals in the scenario and translates the findings of the ETP into policies and technology focus areas (IEA 2012b, 2013a, 2013b, 2013c).

The scenario was created using the ETP-TIMES model (IEA 2014). It was used to determine the least-cost technology mix needed to meet the final demand for three sectors: industry, transport, and buildings. Figure IV.1 shows the structure of the ETP-model.

ETP-TIMES represents the state-of-the-art in modeling energy technologies. It is used by more than 250 groups in 70 countries. Both TIMES and its predecessor MARKAL were developed through the IEA's Energy Technology Systems Programme (ETSAP) set up more than 30 years ago. The ETP-TIMES model starts from primary energy supply and conversion to final energy demand up to 2075. It models the current situation in the conversion sectors (e.g. existing capacity stock, operating costs, and conversion efficiencies) and then integrates the technical and economic characteristics of existing technologies that can be added to the energy system. In this way it can then determine the least-cost technology mix needed to meet the final demand. This final demand is determined by the submodels of the specific end-use sectors.

Main characteristics and assumptions:

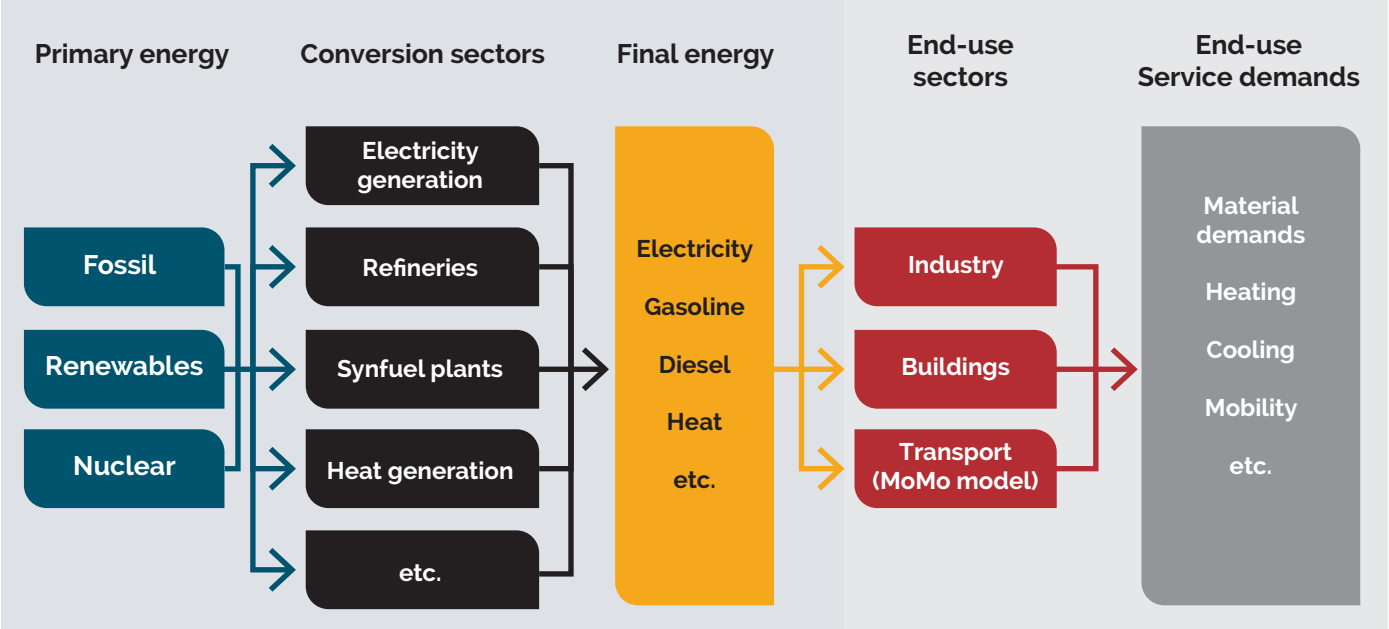
- The ETP2014 pathway and the RCP 2.6 scenario provide a similar CO_2 budget over time.
- IEA ETP 2DS scenario was created using the ETP-TIMES model, which is state-of-the-art in modeling energy technologies, peer reviewed, used by more than 250 groups in 70 countries, and is revised and updated regularly by a large network of collaborators.
- The ETP model enables a technology-rich, bottom-up analysis of the global energy system and covers 28 regions.
- The model is designed for a cost-effective transition to a sustainable energy system using marginal abatement costs.
- All technology options introduced in the ETP 2014 pathway are commercially available or at a stage of development that makes commercial-scale deployment possible within the scenario period.
- The sectors "industry", "buildings", and "transport" are modeled in more detail to determine the final demand (bottom-up). Industry is modeled in five energy-intensive subsectors (cement, steel, paper, chemicals, and aluminum) using stock accounting spreadsheets. This method is also used for modeling the buildings sector. The transport sector is modeled with the Mobility Model (MoMo). These sector models determine the end-use service demands (e.g. material demands, heating, cooling).
- Subtleties— like political preferences, feasible ramp-up rates, capital constraints and public acceptance—are not and cannot be captured in the cost optimization framework. To increase the robustness of the model, a portfolio of technologies is analyzed within a framework of cost minimization.
- The 2DS scenario was built on the assumption that economic growth is decoupled from demand

for energy and materials. This is possible through technological developments and behavioral change (e.g. consumption of services substituting for consumption of physical goods) (IEA 2012a, 2014).

- The model works in five-year time steps and uses 2011 as its base year.

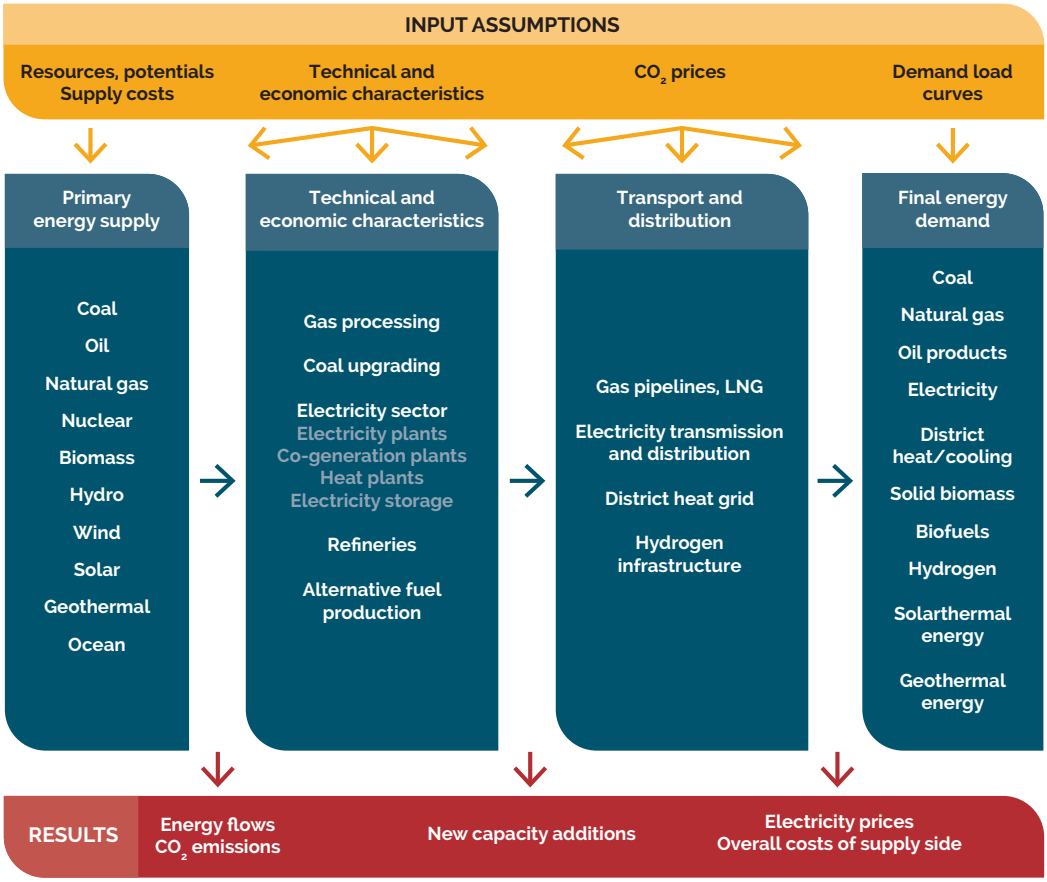
The SDA assumes that value-added of individual heterogeneous sectors is assumed to grow proportional to GDP growth. Figure V.3 displays the IEA's ETP 2014 GDP growth rate predictions.

Figure V.1. Structure of the ETP model



ETP - Times model

Figure V.2 The model ETP-TIMES



Source: IEA (2014).

Figure V.3 ETP 2014 real GDP growth rate predictions

CAAGR (%)	2011-20	2020-30	2030-50	2011-50
World	4,0	3,4	2,7	3,2
OECD	2,2	2,1	1,7	1,9
Non-OECD	5,8	4,5	3,2	4,2
ASEAN	5,5	4,2	3,5	4,1
Brazil	3,6	3,8	2,7	3,2
China	8,1	4,9	2,9	4,6
European Union	1,3	1,8	1,5	1,5
India	6,4	6,5	5,1	5,7
Mexico	3,4	3,1	2,3	2,8
Russia	3,6	3,2	1,7	2,5
South Africa	3,0	2,6	2,2	2,5
United States	2,8	2,2	1,9	2,2

Notes: CAAGR - compounded average annual growth rate; ASEAN - Association of Southeast Asian Nations; growth rates based on GDP in 2012 USD using purchasing power parity terms. Unless otherwise noted, all tables and figures in this chapter derive from IEA data and analysis.

Source: IMF, 2013; IEA analysis.

APPENDIX VI. SECTOR DEFINITIONS

IEA Sector	SDA Sector	Description	Global Industry Classification Standard subindustry		Global Industry Classification Standard descriptions
Power Generation		Includes power and heat generation when primary business activity and their own energy use and losses.	55101010	Electric Utilities	Companies that produce or distribute electricity; includes both nuclear and non-nuclear facilities.
			55103010	Multi-Utilities	Utility companies with significantly diversified activities in addition to core electric utility, gas utility, and/or water utility operations.
			55105010	Independent Power Producers & Energy Traders	Companies that operate as independent power producers (IPPs), gas and power marketing and trading specialists, and/or integrated energy merchants. Excludes producers of electricity using renewable sources, such as solar power, hydropower, and wind power. Also excludes electric transmission companies and utility distribution companies classified in the electric utilities sub-industry.
			55105020	Renewable Electricity	Companies that engage in the generation and distribution of electricity using renewable sources, including, but not limited to, companies that produce electricity using biomass, geothermal energy, solar energy, hydropower, and wind power. Excludes companies manufacturing capital equipment used to generate electricity using renewable sources, such as manufacturers of solar power systems, installers of photovoltaic cells, and companies involved in the provision of technology, components, and services mainly to this market.

Industry	Iron & Steel Industry	Includes basic transformation of iron ore to iron as well as foundry processes such as iron casting and molding. ISIC codes 241, manufacture of basic iron and steel, and 2431, casting of iron and steel, apply to this category.	15104050	Steel	Producers of iron and steel and related products, including metallurgical (coking) coal mining used for steel production.
	Cement	Includes activities related to the production of clinker, cement, and cementitious materials by the mixture of ground clincker with specific additives. ISIC code 2394, manufacture of cement, lime and plaster, apply with exclusion of dedicated/exclusive production of lime and plaster.	15102010	Construction Materials	Manufacturers of construction materials, including sand, clay, gypsum, lime, aggregates, cement, concrete, and bricks. Other finished or semifinished building materials are classified in the building products sub-industry.
	Chemical and Petrochemical Industry	Includes all major industrial chemical production, with the exception of oil and gas refineries for energy purposes. ISIC Division 20, manufacture of chemicals and chemical products, apply. Certain activities of ISIC division 21, manufacture of pharmaceuticals, medicinal chemical and botanical products, can also apply (agricultural chemicals).	15101010	Commodity Chemicals	Companies that primarily produce industrial chemicals and basic chemicals, including but not limited to plastics, synthetic fibers, films, commodity-based paints and pigments, explosives, and petrochemicals. Excludes chemical companies classified in the diversified chemicals, fertilizers and agricultural chemicals, industrial gases, or specialty chemicals sub-industries.
			15101020	Diversified Chemicals	Manufacturers of a diversified range of chemical products not classified in the industrial gases, commodity chemicals, specialty chemicals or fertilizers and agricultural chemicals sub-industries.
			15101030	Fertilizers and Agricultural Chemicals	Producers of fertilizers, pesticides, potash, or other agriculture-related chemicals not classified elsewhere.
			15101040	Industrial Gases	Manufacturers of industrial gases.
			15101050	Specialty Chemicals	Companies that primarily produce high value-added chemicals used in the manufacture of a wide variety of products, including but not limited to fine chemicals, additives, advanced polymers, adhesives, sealants and specialty paints, pigments, and coatings.
	Aluminum	Includes both production of aluminum from alumina (primary aluminum) and secondary aluminum production and of aluminum alloys. ISIC code 2420, manufacture of basic precious and other nonferrous metals, applies, where aluminum-related activities are concerned. Bauxite mining activities and aluminum casting/ profile production activities are not included.	15104010	Aluminum	Producers of aluminum and related products, including companies that mine or process bauxite and companies that recycle aluminum to produce finished or semifinished products. Excludes companies that primarily produce aluminum building materials classified in the building products sub-industry.

Industry	Pulp & Paper		Includes the production of bleached, semibleached, or unbleached paper pulp by mechanical, chemical, or semichemical processes, as well as production of paper and paperboard intended for further industrial processing. ISIC code 1701, manufacture of pulp, paper, and paperboard, applies.	15105020	Paper Products	Manufacturers of all grades of paper. Excludes companies specializing in paper packaging classified in the paper packaging sub-industry.
	Other Industry	Nonferrous metals basic industries	Includes production of precious metals and their alloys, production of lead, zinc and tin and their alloys, production of copper and its alloys, as well all other non-iron metals and their alloys. ISIC code 2420, manufacture of basic precious and other nonferrous metals, applies, with exception of aluminum activities and code 2432, casting of nonferrous metals.	15104020	Diversified Metals and Mining	Companies engaged in the diversified production or extraction of metals and minerals not classified elsewhere, including, but not limited to, nonferrous metal mining (except bauxite), salt and borate mining, phosphate rock mining, and diversified mining operations. Excludes iron ore mining, classified in the steel sub-industry, bauxite mining, classified in the aluminum sub-industry, and coal mining, classified in either the steel or coal and consumable fuels sub-industries.
				15104030	Gold	Producers of gold and related products, including companies that mine or process gold and the South African finance houses that primarily invest in, but do not operate, gold mines.
				15104040	Precious Metals and Minerals	Companies mining precious metals and minerals not classified in the gold sub-industry. Includes companies primarily mining platinum.
				15104045	Silver	Companies primarily mining silver. Excludes companies classified in the gold or precious metals and minerals sub-industries.
		Manufacture of other non-metallic mineral products	Includes glass, ceramics, and other non-metallic mineral products, including dedicated lime and gypsum production. ISIC division 23, manufacture of other non-metallic mineral products, will apply, with exception of cement production.	15102010	Construction Materials	Manufacturers of construction materials including sand, clay, gypsum, lime, aggregates, cement, concrete and bricks. Other finished or semi-finished building materials are classified in the building products sub-industry.
				15103010	Metal and Glass Containers	Manufacturers of metal, glass, or plastic containers. Includes corks and caps.
				25201050	Housewares and Specialties	Manufacturers of durable household products, including cutlery, cookware, glassware, crystal, silverware, utensils, kitchenware, and consumer specialties not classified elsewhere.

Industry	Other Industry	Manufacture of motor vehicles, trailers, semi-trailers and other transport equipment	General manufacture of transport equipment, including manufacture of motor vehicles for transporting passengers or freight, the manufacture of various parts and accessories, as well as the manufacture of trailers and semi-trailers, transportation equipment such as ship building and boat manufacturing, the manufacture of railroad rolling stock and locomotives, air and spacecraft and the manufacture of parts thereof. ISIC divisions 29, manufacture of motor vehicles, trailers and semi-trailers, and 30, manufacture of other transport equipment, apply.	20106010	Construction Machinery and Heavy Trucks	Manufacturers of heavy duty trucks, rolling machinery, earth-moving and construction equipment, and manufacturers of related parts. Includes non-military shipbuilding.
				20106015	Agricultural and Farm Machinery	Companies manufacturing agricultural machinery, farm machinery, and their related parts. Includes machinery used for the production of crops and agricultural livestock, agricultural tractors, planting and fertilizing machinery, fertilizer and chemical application equipment, and grain dryers and blowers.
				25101010	Auto Parts and Equipment	Manufacturers of parts and accessories for automobiles and motorcycles. Excludes companies classified in the tires & rubber sub-industry.
				25102010	Automobile Manufacturers	Companies that produce mainly passenger automobiles and light trucks. Excludes companies producing mainly motorcycles and three-wheelers classified in the motorcycle manufacturers sub-industry, and heavy duty trucks classified in the construction machinery and heavy trucks sub-industry.
				25102020	Motorcycle Manufacturers	Companies that produce motorcycles, scooters, or three-wheelers. Excludes bicycles classified in the leisure products sub-industry.
		Manufacture of fabricated metal products	Includes ISIC division 25, manufacture of fabricated metal products, except machinery and equipment, which includes the manufacture of "pure" metal products (such as parts, containers, and structures), usually with a static, immovable function, as opposed to divisions 26-30, which cover the manufacture of combinations or assemblies of such metal products (sometimes with other materials) into more complex units that, unless they are purely electrical, electronic or optical, work with moving parts.	15103010	Metal and Glass Containers	Manufacturers of metal, glass, or plastic containers. Includes corks and caps.
				20101010	Aerospace and Defense	Manufacturers of civil or military aerospace and defense equipment, parts or products. Includes defense electronics and space equipment.
				20102010	Building Products	Manufacturers of building components and home improvement products and equipment. Excludes lumber and plywood classified under forest products and cement and other materials classified in the construction materials sub-industry.
		Manufacture of computer, electronic and optical products	Includes the manufacture of computers, computer peripherals, communications equipment, and similar electronic products, as well as the manufacture of components for such products. Also contains the manufacture of consumer electronics, measuring, testing, navigating, and control equipment, irradiation, electromedical and electrotherapeutic equipment, optical instruments and equipment, and the manufacture of magnetic and optical media. Corresponds to ISIC division 26, manufacture of computer, electronic and optical products.	25201010	Consumer Electronics	Manufacturers of consumer electronics products, including TVs, home audio equipment, game consoles, digital cameras, and related products. Excludes personal home computer manufacturers classified in the technology hardware, storage and peripherals sub-industry, and electric household appliances classified in the household appliances sub-industry.

Industry	Other Industry	Manufacture of computer, electronic and optical products		25201040	Household Appliances	Manufacturers of electric household appliances and related products. Includes manufacturers of power and hand tools, including garden improvement tools. Excludes TVs and other audio and video products classified in the consumer electronics sub-industry, and personal computers classified in the technology hardware, storage, and peripherals sub-industry.
				45201020	Communications Equipment	Manufacturers of communication equipment and products, including LANs, WANs, routers, telephones, switchboards, and exchanges. Excludes cellular phone manufacturers classified in the technology hardware, storage, and peripherals sub-industry.
				45202030	Technology Hardware, Storage, and Peripherals	Manufacturers of cellular phones, personal computers, servers, electronic computer components and peripherals. Includes data storage components, motherboards, audio and video cards, monitors, keyboards, printers, and other peripherals. Excludes semiconductors classified in the semiconductors sub-industry.
				45203010	Electronic Equipment, and Instruments	Manufacturers of electronic equipment and instruments, including analytical, electronic test and measurement instruments, scanner/barcode products, lasers, display screens, point-of-sales machines, and security system equipment.
				45203015	Electronic Components	Manufacturers of electronic components. Includes electronic components, connection devices, electron tubes, electronic capacitors and resistors, electronic coil, printed circuit board, transformer and other inductors, and signal processing technology/ components.
				45203020	Electronic Manufacturing Services	Producers of electronic equipment mainly for the OEM (Original Equipment Manufacturers) markets.
				45301010	Semiconductor Equipment	Manufacturers of semiconductor equipment, including manufacturers of the raw material and equipment used in the solar power industry.
				45301020	Semiconductors	Manufacturers of semiconductors and related products, including manufacturers of solar modules and cells.

Industry	Other Industry	Manufacture of electrical equipment	Includes the manufacture of products that generate, distribute, and use electrical power, as well as manufacture of electrical lighting, signaling equipment, and electric household appliances. Corresponds to ISIC division 26, manufacture of electrical equipment.	20104010	Electrical Components & Equipment	Companies that produce electric cables and wires, electrical components or equipment not classified in the heavy electrical equipment sub-industry.
				20104020	Heavy Electrical Equipment	Manufacturers of power-generating equipment and other heavy electrical equipment, including power turbines, heavy electrical machinery intended for fixed-use and large electrical systems. Excludes cables and wires, classified in the electrical components & equipment sub-industry.
				20106020	Industrial Machinery	Manufacturers of industrial machinery and industrial components. Includes companies that manufacture presses, machine tools, compressors, pollution control equipment, elevators, escalators, insulators, pumps, roller bearings, and other metal fabrications.
				25201010	Consumer Electronics	Manufacturers of consumer electronics products including TVs, home audio equipment, game consoles, digital cameras, and related products. Excludes personal home computer manufacturers classified in the technology hardware, storage & peripherals sub-industry, and electric household appliances classified in the household appliances sub-industry.
				25201040	Household Appliances	Manufacturers of electric household appliances and related products. Includes manufacturers of power and hand tools, including garden improvement tools. Excludes TVs and other audio and video products classified in the consumer electronics sub-industry and personal computers classified in the technology hardware, storage & peripherals sub-industry.
		Manufacture of machinery and equipment	Includes the manufacture of machinery and equipment that act independently on materials either mechanically or thermally or perform operations on materials (such as handling, spraying, weighing or packing), including their mechanical components that produce and apply force, and any specially manufactured primary parts. This includes the manufacture of fixed and mobile or hand-held devices, regardless of whether they are designed for industrial, building and civil engineering, agricultural or home use. Corresponds to ISIC division 28, manufacture of machinery and equipment n.e.c.	20106020	Industrial Machinery	Manufacturers of industrial machinery and industrial components. Includes companies that manufacture presses, machine tools, compressors, pollution control equipment, elevators, escalators, insulators, pumps, roller bearings, and other metal fabrications.

Industry	Other Industry	Manufacture of machinery and equipment		25201010	Consumer Electronics	Manufacturers of consumer electronics products, including TVs, home audio equipment, game consoles, digital cameras, and related products. Excludes personal home computer manufacturers classified in the technology hardware, storage & peripherals sub-industry, and electric household appliances classified in the household appliances sub-industry.
				25201040	Household Appliances	Manufacturers of electric household appliances and related products. Includes manufacturers of power and hand tools, including garden improvement tools. Excludes TVs and other audio and video products classified in the consumer electronics sub-industry and personal computers classified in the technology hardware, storage & peripherals sub-industry.
		Mining and quarring	Includes the extraction of minerals occurring naturally as solids (coal and ores). Extraction can be achieved by different methods such as underground or surface mining, seabed mining, etc. Includes supplementary activities aimed at preparing the crude materials for marketing, for example, crushing, grinding, cleaning, drying, sorting, concentrating ores and agglomeration of solid fuels. These operations are often carried out by the units that extracted the resource and/or others located nearby. ISIC ddivisions 05, mining of coal and lignite; 07, mining of metal ores; and 08, other mining and quarrying.	15104010	Aluminum	Producers of aluminum and related products, including companies that mine or process bauxite and companies that recycle aluminum to produce finished or semi-finished products. Excludes companies that primarily produce aluminum building materials classified in the building products sub-industry.
				15104020	Diversified Metals & Mining	Companies engaged in the diversified production or extraction of metals and minerals not classified elsewhere. Including, but not limited to, nonferrous metal mining (except bauxite), salt and borate mining, phosphate rock mining, and diversified mining operations. Excludes iron ore mining, classified in the steel sub-industry, bauxite mining, classified in the aluminum sub-industry, and coal mining, classified in either the steel or coal & consumable fuels sub-Industries.
				15104030	Gold	Producers of gold and related products, including companies that mine or process gold and the South African finance houses that primarily invest in, but do not operate, gold mines.
				15104040	Precious Metals & Minerals	Companies mining precious metals and minerals not classified in the gold sub-industry. Includes companies primarily mining platinum.
				15104045	Silver	Companies primarily mining silver. Excludes companies classified in the gold or precious metals & minerals sub-industries.

Industry	Other Industry	Manufacture of food products	Includes the processing of the products of agriculture, forestry, and fishing into food for humans or animals, and includes the production of various intermediate products that are not directly food products. Corresponds to ISIC division 10, manufacture of food products.	30202030	Packaged Foods & Meats	Producers of packaged foods, including dairy products, fruit juices, meats, poultry, fish, and pet foods.
		Manufacture of beverages	Includes the manufacture of beverages, such as nonalcoholic beverages and mineral water, manufacture of alcoholic beverages mainly through fermentation, beer and wine, the manufacture of distilled alcoholic beverages and the production of fruit and vegetable juices (ISIC class 1030). ISIC division 11, manufacture of beverages, applies.	30201010	Brewers	Producers of beer and malt liquors. Includes breweries not classified in the restaurants sub-industry.
				30201020	Distillers & Vintners	Distillers, vintners and producers of alcoholic beverages not classified in the brewers sub-industry.
				30201030	Soft Drinks	Producers of non-alcoholic beverages including mineral waters. Excludes producers of milk classified in the packaged foods sub-industry.
		Manufacture of tobacco products	Includes the processing of tobacco into a form suitable for final consumption. Corresponds to ISIC sivision 12, manufacture of tobacco products.	30203010	Tobacco	Manufacturers of cigarettes and other tobacco products.
		Manufacture of paper-derived products	Includes production of paper and paper products, including corrugated paper and paperboard, paper containers, solid board, sacks and bags of paper, office boxes, household and personal hygiene paper and other cellulose products. Excludes activities already described in "pulp & paper." ISIC division 17, manufacture of paper and paper products, with exclusion of code 1701, manufacture of pulp, paper, and paperboard, applies.	15103020	Paper Packaging	Manufacturers of paper and cardboard containers and packaging.
		Manufacture of wood and cork products	Includes the manufacture of wood products, such as lumber, plywood, veneers, wood containers, wood flooring, wood trusses, and prefabricated wood buildings. The production processes include sawing, planing, shaping, laminating, and assembling of wood products starting from logs that are cut into bolts, or lumber that may then be cut further, or shaped by lathes or other shaping tools. The lumber or other transformed wood shapes may also be subsequently planed or smoothed, and assembled into finished products, such as wood containers. Corresponds to ISIC division 16, manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials.	15105010	Forest Products	Manufacturers of timber and related wood products. Includes lumber for the building industry.

Industry	Other Industry	Construction industry	Includes general construction and specialized construction activities for buildings and civil engineering works. It includes new work, repair, additions and alterations, the erection of prefabricated buildings or structures on the site and also construction of a temporary nature. General construction is the construction of entire dwellings, office buildings, stores and other public and utility buildings, farm buildings etc., or the construction of civil engineering works such as motorways, streets, bridges, tunnels, railways, airfields, harbors and other water projects, irrigation systems, sewerage systems, industrial facilities, pipelines and electric lines, sports facilities etc. Also included is the repair of buildings and engineering works. Corresponds to ISIC divisions 41, construction of buildings; 42, civil engineering; and 43, specialized construction activities .	20102010	Building Products	Manufacturers of building components and home improvement products and equipment. Excludes lumber and plywood classified under forest products and cement and other materials classified in the construction materials sub-industry.
				20103010	Construction & Engineering	Companies engaged in primarily non-residential construction. Includes civil engineering companies and large-scale contractors. Excludes companies classified in the homebuilding sub-industry.
				25201030	Homebuilding	Residential construction companies. Includes manufacturers of prefabricated houses and semi-fixed manufactured homes.
		Manufacture of textiles	Includes preparation and spinning of textile fibers as well as textile weaving, finishing of textiles and wearing apparel, manufacture of made-up textile articles, except apparel (e.g. household linen, blankets, rugs, cordage etc.). Growing of natural fibers is not included as well as manufacturing of synthetic fibers (which is a chemical process). Corresponds to ISIC division 13, manufacture of textiles.	25203030	Textiles	Manufacturers of textile and related products not classified in the apparel, accessories & luxury goods, footwear or home furnishings sub-industries.
				25201020	Home Furnishings	Manufacturers of soft home furnishings or furniture, including upholstery, carpets, and wall-coverings.
		Manufacture of wearing apparel	Includes all tailoring (ready-to-wear or made-to-measure), in all materials (e.g. leather, fabric, knitted and crocheted fabrics etc.), of all items of clothing (e.g. outerwear, underwear for men, women or children; work, city or casual clothing etc.) and accessories. Corresponds to division 14, manufacture of wearing apparel.	25203010	Apparel, Accessories and Luxury Goods	Manufacturers of apparel, accessories & luxury goods. Includes companies primarily producing designer handbags, wallets, luggage, jewelry and watches. Excludes shoes classified in the footwear sub-industry.
				25203020	Footwear	Manufacturers of footwear. Includes sport and leather shoes.
				25201020	Home Furnishings	Manufacturers of soft home furnishings or furniture, including upholstery, carpets and wall-coverings.
				25203030	Textiles	Manufacturers of textile and related products not classified in the apparel, accessories and luxury goods, footwear or home furnishings sub-industries.
		Manufacture of leather and related products	Includes dressing and dyeing of fur and the transformation of hides into leather by tanning or curing and fabricating the leather into products for final consumption. It also includes the manufacture of similar products from other materials (imitation leathers or leather substitutes), such as rubber footwear, textile luggage etc. The products made from leather substitutes are included here, since they are made in ways similar to those in which leather products are made (e.g. luggage) and are often produced in the same unit. Corresponds to ISIC division 15, manufacture of leather and related products.	25203030	Textiles	Manufacturers of textile and related products not classified in the apparel, accessories, and luxury goods, footwear or home furnishings sub-industries.

Industry	Other Industry	Manufacture of rubber and plastics products	Includes the manufacture of rubber products (such as tires, inner tubes, rubber plates, tubes, pipes, hoses, fittings, balloons, brushes, etc) and plastics products (such as plates, sheets, blocks foil, windows, frames, tanks, reservoirs, flooring materials, etc). This does not imply that the manufacture of all products made of these materials is under this sector. Corresponds to ISIC division 22, manufacture of rubber and plastics products.	25101020	Tires & Rubber	Manufacturers of tires and rubber.
		Manufacture of furniture	Includes the manufacture of furniture and related products of any material except stone, concrete, and ceramic. Corresponds to ISIC division 31, manufacture of furniture.	25201020	Home Furnishings	Manufacturers of soft home furnishings or furniture, including upholstery, carpets, and wall-coverings.
		Other manufacturing / processing	Includes all other industrial activities not included in the other industry sectors. Includes activities of ISIC division 32, other manufacturing.	20101010	Aerospace and Defense	Manufacturers of civil or military aerospace and defense equipment, parts or products. Includes defense electronics and space equipment.
				20102010	Building Products	Manufacturers of building components and home improvement products and equipment. Excludes lumber and plywood classified under forest products and cement and other materials classified in the construction materials sub-industry.
				25201040	Household Appliances	Manufacturers of electric household appliances and related products. Includes manufacturers of power and hand tools, including garden improvement tools. Excludes TVs and other audio and video products classified in the consumer electronics sub-industry and personal computers classified in the technology hardware, storage and peripherals sub-industry.
				25201050	Housewares and Specialties	Manufacturers of durable household products, including cutlery, cookware, glassware, crystal, silverware, utensils, kitchenware and consumer specialties not classified elsewhere.
				25202010	Leisure Products	Manufacturers of leisure products and equipment including sports equipment, bicycles, and toys.
				30301010	Household Products	Producers of nondurable household products, including detergents, soaps, diapers, and other tissue and household paper products not classified in the paper products sub-industry.
				30302010	Personal Products	Manufacturers of personal and beauty care products, including cosmetics and perfumes.
				35101010	Health Care Equipment	Manufacturers of health care equipment and devices. Includes medical instruments, drug delivery systems, cardiovascular , and orthopedic devices, and diagnostic equipment.

Industry	Other Industry	Other manufacturing / processing		35101020	Health Care Supplies	Manufacturers of health care supplies and medical products not classified elsewhere. Includes eye care products, hospital supplies, and safety needle, and syringe devices.
				35202010	Pharmaceuticals	Companies engaged in the research, development or production of pharmaceuticals. Includes veterinary drugs.
Transport Services	Passenger transport - Air		Includes transport of passengers by air over regular routes and on regular schedules; charter flights for passengers; scenic and sightseeing flights; renting of air-transport equipment with operator for the purpose of passenger transportation; general aviation activities, such as transport of passengers by aero clubs for instruction or pleasure. National as well as international flights are included. Corresponds to ISIC code 5110, passenger air transport. This also includes combined and dedicated freight transport by air. Energy consumption of transport-related infrastructure is not included here but in the service/ buildings sector.	20302010	Airlines	Companies providing primarily passenger air transportation.
	Passenger transport - Light Road		All passenger transport made by light-duty vehicles, including transportation by own vehicles. ISIC codes 4921, urban and suburban passenger land transport and 4922, other passenger land transport will generically apply.	20304020	Trucking	Companies providing primarily goods and passenger land transportation. Includes vehicle rental and taxi companies.
	Passenger transport - Heavy Road		All passenger transport made by non-light-duty vehicles. ISIC codes 4921, urban and suburban passenger land transport and 4922, other passenger land transport will generically apply. Energy consumption of transport-related infrastructure is not included here but in the service/ buildings sector.	20304020	Trucking	Companies providing primarily goods and passenger land transportation. Includes vehicle rental and taxi companies.
	Passenger transport – Rail		Includes rail transportation of passengers and/or freight using railroad rolling stock on mainline networks, usually spread over an extensive geographic area, such as passenger transport by inter-urban railways; operation of sleeping cars or dining cars as an integrated operation of railway companies. Excludes tramways and elevated railways and other suburban railway passenger transport. Corresponds to ISIC code 4911, passenger rail transport, interurban. Energy consumption of transport-related infrastructure is not included here but in the service/ buildings sector.	20304010	Railroads	Companies providing primarily goods and passenger rail transportation.

Transport Services	Other transport		All other transport, in particular freight transport by land, water, and air. This excludes combined and dedicated freight transport by air, since this is already included in passenger transport - air. Corresponds to ISIC codes 5120, freight air transport; 5022, inland freight water transport; 5012, sea and coastal freight water transport; 4923, freight transport by road; and 4912, freight rail transport.	20301010	Air Freight and Logistics	Companies providing air freight transportation, courier and logistics services, including package and mail delivery and customs agents. Excludes those companies classified in the airlines, marine or trucking sub-industries.
				20303010	Marine	Companies providing goods or passenger maritime transportation. Excludes cruise ships classified in the hotels, resorts, and cruise lines sub-industry.
				20304020	Trucking	Companies providing primarily goods and passenger land transportation. Includes vehicle rental and taxi companies.
Services / Commercial Buildings		Trade / Retail	Includes wholesale and retail sale (i.e. sale without transformation) of any type of goods and the rendering of services incidental to the sale of these goods. Wholesaling and retailing are the final steps in the distribution of goods. Corresponds to ISIC section G, wholesale and retail trade; repair of motor vehicles and motorcycles.	20201010	Commercial Printing	Companies providing commercial printing services. Includes printers primarily serving the media industry.
				25501010	Distributors	Distributors and wholesalers of general merchandise not classified elsewhere. Includes vehicle distributors.
				25502010	Catalog Retail	Mail order and TV home shopping retailers. Includes companies that provide door-to-door retail.
				25502020	Internet Retail	Companies providing retail services primarily on the internet, not classified elsewhere.
				25503010	Department Stores	Owners and operators of department stores.
				25503020	General Merchandise Stores	Owners and operators of stores offering diversified general merchandise. Excludes hypermarkets and large-scale super centers classified in the hypermarkets and super centers sub-industry.
				25504010	Apparel Retail	Retailers specialized mainly in apparel and accessories.
				25504020	Computer and Electronics Retail	Owners and operators of consumer electronics, computers, video, and related products retail stores.
				25504030	Home Improvement Retail	Owners and operators of home and garden improvement retail stores. Includes stores offering building materials and supplies.
				25504040	Specialty Stores	Owners and operators of specialty retail stores not classified elsewhere. Includes jewelry stores, toy stores, office supply stores, health and vision care stores, and book and entertainment stores.
				25504050	Automotive Retail	Owners and operators of stores specializing in automotive retail. Includes auto dealers, gas stations, and retailers of auto accessories, motorcycles and parts, automotive glass, and automotive equipment and parts.

Services / Commercial Buildings		Trade / Retail	Includes wholesale and retail sale (i.e. sale without transformation) of any type of goods and the rendering of services incidental to the sale of these goods. Wholesaling and retailing are the final steps in the distribution of goods. Corresponds to ISIC section G, wholesale and retail trade; repair of motor vehicles and motorcycles.	25504060	Home furnishing Retail	Owners and operators of furniture and home furnishings retail stores. Includes residential furniture, home furnishings, housewares, and interior design. Excludes home and garden improvement stores, classified in the home improvement retail sub-industry.
				25504060	Home furnishing Retail	Owners and operators of furniture and home furnishings retail stores. Includes residential furniture, home furnishings, housewares, and interior design. Excludes home and garden improvement stores, classified in the home improvement retail sub-industry.
				30101010	Drug Retail	Owners and operators of primarily drug retail stores and pharmacies.
				30101020	Food Distributors	Distributors of food products to other companies and not directly to the consumer.
				30101030	Food Retail	Owners and operators of primarily food retail stores.
				30101040	Hypermarkets and Super Centers	Owners and operators of hypermarkets and super centers selling food and a wide range of consumer staple products. Excludes food and drug retailers classified in the food retail and drug retail sub-industries, respectively.
				35102010	Health Care Distributors	Distributors and wholesalers of health care products not classified elsewhere.
				45203030	Technology Distributors	Distributors of technology hardware and equipment. Includes distributors of communications equipment, computers & peripherals, semiconductors, and electronic equipment and components.
		Finance	Includes financial service activities, including banking, insurance, reinsurance, pension funding activities, activities to support financial services, activities of holding assets and the activities of trusts, funds and similar financial entities. Corresponds to ISIC section K, financial and insurance activities	40101010	Diversified Banks	Large, geographically diverse banks with a national footprint whose revenues are derived primarily from conventional banking operations, have significant business activity in retail banking and small and medium corporate lending, and provide a diverse range of financial services. Excludes banks classified in the regional banks and thrifts and mortgage finance sub-industries. Also excludes investment banks classified in the investment banking and brokerage sub-industry.

Services / Commercial Buildings		Finance		40101015	Regional Banks	Commercial banks whose businesses are derived primarily from conventional banking operations and have significant business activity in retail banking and small and medium corporate lending. Regional banks tend to operate in limited geographic regions. Excludes companies classified in the diversified banks and thrifts and mortgage banks sub-industries. Also excludes investment banks classified in the investment banking and brokerage sub-industry.
				40102010	Thrifts and Mortgage Finance	Financial institutions providing mortgage and mortgage-related services. These include financial institutions whose assets are primarily mortgage related, savings and loans, mortgage lending institutions, building societies and companies providing insurance to mortgage banks.
				40201020	Other Diversified Financial Services	Providers of a diverse range of financial services and/ or with some interest in a wide range of financial services including banking, insurance, and capital markets, but with no dominant business line. Excludes companies classified in the regional banks and diversified banks sub-industries.
				40201030	Multi-Sector Holdings	A company with significantly diversified holdings across three or more sectors, none of which contributes a majority of profit and/ or sales. Stakes held are predominantly of a non-controlling nature. Includes diversified financial companies where stakes held are of a controlling nature. Excludes other diversified companies classified in the industrials conglomerates sub-industry.
				40201040	Specialized Finance	Providers of specialized financial services. Includes credit agencies, stock exchanges and specialty boutiques. Companies in this sub-industry derive a majority of revenue from one, specialized line of business.
				40202010	Consumer Finance	Providers of consumer finance services, including personal credit, credit cards, lease financing, travel-related money services and pawn shops. Excludes mortgage lenders classified in the thrifts and mortgage finance sub-industry.

Services / Commercial Buildings		Finance		40203010	Asset Management and Custody Banks	Financial institutions primarily engaged in investment management and/or related custody and securities fee-based services. Includes companies operating mutual funds, closed-end funds, and unit investment trusts. Excludes banks and other financial institutions primarily involved in commercial lending, investment banking, brokerage and other specialized financial activities.
				40203020	Investment Banking and Brokerage	Financial institutions primarily engaged in investment banking and brokerage services, including equity and debt underwriting, mergers and acquisitions, securities lending and advisory services. Excludes banks and other financial institutions primarily involved in commercial lending, asset management, and specialized financial activities.
				40203030	Diversified Capital Markets	Financial institutions primarily engaged in diversified capital markets activities, including a significant presence in at least two of the following areas: large/major corporate lending, investment banking, brokerage and asset management. Excludes less diversified companies classified in the asset management and custody banks or investment banking and brokerage sub-industries. Also excludes companies classified in the banks or insurance industry groups or the consumer finance sub-industry.
				40301010	Insurance Brokers	Insurance and reinsurance brokerage firms.
				40301020	Life and Health Insurance	Companies providing primarily life, disability, indemnity or supplemental health insurance. Excludes managed care companies classified in the managed health care sub-industry.
				40301030	Multi-line Insurance	Insurance companies with diversified interests in life, health, and property and casualty insurance.
				40301040	Property and Casualty Insurance	Companies providing primarily property and casualty insurance.
				40301050	Reinsurance	Companies providing primarily reinsurance.

Services / Commercial Buildings		Real Estate	Includes acting as lessors, agents and/or brokers in one or more of the following: selling or buying real estate, renting real estate, providing other real estate services such as appraising real estate, or acting as real estate escrow agents. Activities in this section may be carried out on owned or leased property and may be done on a fee or contract basis. Also included is the building of structures, combined with maintaining ownership or leasing of such structures and real estate property managing activities. Corresponds to ISIC section L, real estate activites.	40402010	Diversified REITs	A company or trust with significantly diversified operations across two or more property types.
				40402020	Industrial REITs	Companies or trusts engaged in the acquisition, development, ownership, leasing, management and operation of industrial properties. Includes companies operating industrial warehouses and distribution properties.
				40402030	Mortgage REITs	Companies or trusts that service, originate, purchase and/or securitize residential and/or commercial mortgage loans. Includes trusts that invest in mortgage-backed securities and other mortgage related assets.
				40402035	Hotel and Resort REITs	Companies or trusts engaged in the acquisition, development, ownership, leasing, management and operation of hotel and resort properties.
				40402040	Office REITs	Companies or trusts engaged in the acquisition, development, ownership, leasing, management and operation of office properties.
				40402045	Health Care REITs	Companies or trusts engaged in the acquisition, development, ownership, leasing, management and operation of properties serving the health care industry, including hospitals, nursing homes, and assisted living properties.
				40402050	Residential REITs	Companies or trusts engaged in the acquisition, development, ownership, leasing, management and operation of residential properties including multifamily homes, apartments, manufactured homes, and student housing properties.
				40402060	Retail REITs	Companies or trusts engaged in the acquisition, development, ownership, leasing, management and operation of shopping malls, outlet malls, neighborhood and community shopping centers.
				40402070	Specialized REITs	Companies or trusts engaged in the acquisition, development, ownership, leasing, management and operation of properties not classified elsewhere. Includes trusts that operate and invest in storage properties. It also includes REITs that do not generate a majority of their revenues and income from real estate rental and leasing operations.

Services / Commercial Buildings		Real Estate		40403010	Diversified Real Estate Activities	Companies engaged in a diverse spectrum of real estate activities including real estate development and sales, real estate management, or real estate services, but with no dominant business line.
				40403020	Real Estate Operating Companies	Companies engaged in operating real estate properties for the purpose of leasing and management.
				40403030	Real Estate Development	Companies that develop real estate and sell the properties after development. Excludes companies classified in the homebuilding sub-industry.
				40403040	Real Estate Services	Real estate service providers such as real estate agents, brokers, and real estate appraisers.
		Public Administration	Includes activities of a governmental nature, normally carried out by the public administration such as administration of justice, taxation, public order, defence, foreign affairs and public administration services, including social security. Excludes health and education services provided by the state. Corresponds to ISIC section O, public administration and defense; compulsory social security.	35102015	Health Care Services	Providers of patient health care services not classified elsewhere. Includes dialysis centers, lab testing services, and pharmacy management services. Also includes companies providing business support services to health care providers, such as clerical support services, collection agency services, staffing services and outsourced sales and marketing services
		Health	Includes the provision of health and social work activities. Activities include a wide range of activities, starting from health care provided by trained medical professionals in hospitals and other facilities, over residential care activities that still involve a degree of health care activities to social work activities without any involvement of health care professionals. Corresponds to ISIC section Q, human health and social work activities.	35102020	Health Care Facilities	Owners and operators of health care facilities, including hospitals, nursing homes, rehabilitation centers, and animal hospitals.
				35102030	Managed Health Care	Owners and operators of health maintenance organizations (HMOs) and other managed plans.
				35103010	Health Care Technology	Companies providing information technology services primarily to health care providers. Includes companies providing application, systems and/or data processing software, internet-based tools, and IT consulting services to doctors, hospitals or businesses operating primarily in the health care sector.
		Food and lodging	Includes the provision of short-stay accommodation for visitors and other travelers and the provision of complete meals and drinks fit for immediate consumption. The amount and type of supplementary services provided can vary widely. Excludes the preparation of food or drinks that are either not fit for immediate consumption or that are sold through independent distribution channels, i.e. through wholesale or retail trade activities. Corresponds to ISIC section I, accommodation and food service activities.	25301020	Hotels, Resorts and Cruise Lines	Owners and operators of hotels, resorts and cruise ships. Includes travel agencies, tour operators and related services not classified elsewhere. Excludes casino-hotels classified in the casinos and gaming sub-industry.
				25301040	Restaurants	Owners and operators of restaurants, bars, pubs, fast-food or take-out facilities. Includes companies that provide food catering services.

Services / Commercial Buildings		Education	Includes education at any level or for any profession, oral or written as well as by radio and television or other means of communication. It includes education by the different institutions in the regular school system at its different levels as well as adult education, literacy programs, etc. Also included are military schools and academies, prison schools etc. at their respective levels. The section includes public as well as private education. Corresponds to ISIC section P, education.	25302010	Education Services	Companies providing educational services, either on-line or through conventional teaching methods. Includes private universities, correspondence teaching, providers of educational seminars, educational materials, and technical education. Excludes companies providing employee education programs classified in the human resources and employment services sub-industry
		Other commercial services	All other commercial activities that have not been specified elsewhere.	20201050	Environmental and Facilities Services	Companies providing environmental and facilities maintenance services. Includes waste management, facilities management, and pollution control services. Excludes large-scale water treatment systems classified in the water utilities sub-industry.
				20201060	Office Services and Supplies	Providers of office services and manufacturers of office supplies and equipment not classified elsewhere.
				20201070	Diversified Support Services	Companies primarily providing labor-oriented support services to businesses and governments. Includes commercial cleaning services, dining and catering services, equipment repair services, industrial maintenance services, industrial auctioneers, storage and warehousing, transaction services, uniform rental services, and other business support services.
				20201080	Security and Alarm Services	Companies providing security and protection services to business and governments. Includes companies providing services such as correctional facilities, security and alarm services, armored transportation and guarding. Excludes companies providing security software classified under the systems software sub-industry and home security services classified under the specialized consumer services sub-industry. Also excludes companies manufacturing security system equipment classified under the electronic equipment and instruments sub-industry.
				20202010	Human Resource and Employment Services	Companies providing business support services relating to human capital management. Includes employment agencies, employee training, payroll and benefit support services, retirement support services and temporary agencies.

Services / Commercial Buildings		Other commercial services		20202020	Research and Consulting Services	Companies primarily providing research and consulting services to businesses and governments not classified elsewhere. Includes companies involved in management consulting services, architectural design, business information or scientific research, marketing, and testing and certification services. Excludes companies providing information technology consulting services classified in the IT consulting and other services sub-industry.
				20305010	Airport Services	Operators of airports and companies providing related services.
				20305020	Highways and Rail tracks	Owners and operators of roads, tunnels, and rail tracks.
				20305030	Marine Ports and Services	Owners and operators of marine ports and related services.
				25301010	Casinos and Gaming	Owners and operators of casinos and gaming facilities. Includes companies providing lottery and betting services.
				25301030	Leisure Facilities	Owners and operators of leisure facilities, including sport and fitness centers, stadiums, golf courses and amusement parks not classified in the movies and entertainment sub-industry.
				25302020	Specialized Consumer Services	Companies providing consumer services not classified elsewhere. Includes residential services, home security, legal services, personal services, renovation and interior design services, consumer auctions and wedding and funeral services.
				25401010	Advertising	Companies providing advertising, marketing, or public relations services.
				25401020	Broadcasting	Owners and operators of television or radio broadcasting systems, including programming. Includes, radio and television broadcasting, radio networks, and radio stations.
				25401025	Cable and Satellite	Providers of cable or satellite television services. Includes cable networks and program distribution.
				25401030	Movies and Entertainment	Companies that engage in producing and selling entertainment products and services, including companies engaged in the production, distribution and screening of movies and television shows, producers and distributors of music, entertainment theaters and sports teams.
				25401040	Publishing	Publishers of newspapers, magazines and books, and providers of information in print or electronic formats.

Services / Commercial Buildings		Other commercial services		35201010	Biotechnology	Companies primarily engaged in the research, development, manufacturing and/or marketing of products based on genetic analysis and genetic engineering. Includes companies specializing in protein-based therapeutics to treat human diseases. Excludes companies manufacturing products using biotechnology but without a health care application.
				35203010	Life Sciences Tools and Services	Companies enabling the drug discovery, development and production continuum by providing analytical tools, instruments, consumables and supplies, clinical trial services and contract research services. Includes firms primarily servicing the pharmaceutical and biotechnology industries.
				45101010	Internet Software and Services	Companies developing and marketing internet software and/or providing internet services including online databases and interactive services, as well as companies deriving a majority of their revenues from online advertising. Excludes companies classified in the internet retail sub-industry.
				45102010	IT Consulting and Other Services	Providers of information technology and systems integration services not classified in the data processing and outsourced services or internet software and services sub-industries. Includes information technology consulting and information management services.
				45102020	Data Processing and Outsourced Services	Providers of commercial electronic data processing and/or business process outsourcing services. Includes companies that provide services for back-office automation.
				45103010	Application Software	Companies engaged in developing and producing software designed for specialized applications for the business or consumer market. Includes enterprise and technical software. Excludes companies classified in the home entertainment software sub-industry. Also excludes companies producing systems or database management software classified in the systems software sub-industry.
				45103020	Systems Software	Companies engaged in developing and producing systems and database management software.
				45103030	Home Entertainment Software	Manufacturers of home entertainment software and educational software used primarily in the home.

Services / Commercial Buildings		Other commercial services		50101010	Alternative Carriers	Providers of communications and high-density data transmission services primarily through a high bandwidth/fiber-optic cable network.
				50101020	Integrated Telecommunication Services	Operators of primarily fixed-line telecommunications networks and companies providing both wireless and fixed-line telecommunications services not classified elsewhere.
				50102010	Wireless Telecommunication Services	Providers of primarily cellular or wireless telecommunication services, including paging services.
				55104010	Water Utilities	Companies that purchase and redistribute water to the end consumer. Includes large-scale water treatment systems.
	Sectors and activities not covered by the method	Coal mining	Includes the extraction of solid mineral fuels through underground or open-cast mining and includes operations (e.g. grading, cleaning, compressing and other steps necessary for transportation etc.) leading to a marketable product. Corresponds to ISIC division 05, mining of coal and lignite.	10102050	Coal and Consumable Fuels	Companies primarily involved in the production and mining of coal, related products and other consumable fuels related to the generation of energy. Excludes companies primarily producing gases classified in the industrial gases sub-industry and companies primarily mining for metallurgical (coking) coal used for steel production.
		Oil and Gas refining	Includes the manufacture of liquid or gaseous fuels or other products from crude petroleum, bituminous minerals or their fractionation products. Petroleum refining involves one or more of the following activities: fractionation, straight distillation of crude oil, and cracking. Includes also gas refining. ISIC code 1920, manufacture of refined petroleum products, will generically apply to this category.	10102010	Integrated Oil and Gas	Integrated oil companies engaged in the exploration and production of oil and gas, as well as at least one other significant activity in either refining, marketing and transportation, or chemicals.
				10102030	Oil and Gas Refining and Marketing	Companies engaged in the refining and marketing of oil, gas and/or refined products not classified in the integrated oil and gas or independent power producers and energy traders sub-industries.
		Energy industry own use and loss	This is included within power generation sector, but not included as a specific sector.			
		Land use change				
		Agriculture	Includes the exploitation of vegetal and animal natural resources, comprising the activities of growing of crops, raising and breeding of animals, harvesting of timber and other plants, animals or animal products from a farm or their natural habitats. Corresponds to ISIC section A, agriculture.	30202010	Agricultural Products	Producers of agricultural products. Includes crop growers, owners of plantations and companies that produce and process foods but do not package and market them. Excludes companies classified in the forest products sub-industry and those that package and market the food products classified in the packaged foods sub-industry.
				30202020	Meat, Poultry and Fish (discontinued, effective March 28 2002)	Companies that raise livestock or poultry, fishing companies and other producers of meat, poultry or fish products.

Sources:
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Note: This table has been developed to clarify which activities are included within the sector method. For easier reference, we have tried to establish a correspondence with common industrial classification systems, such as ISIC (UN) and GICS (MSCI). This correspondence, however, is prone to error due to interpretation of the different categories and gaps in the information available about exactly which sub-industries would fit into each category. Classification systems are rarely straightforward and often prone to interpretation. Careful interpretation is needed when using this table.

APPENDIX VII. SUMMARY OF PUBLIC STAKEHOLDER CONSULTATION FEEDBACK

SURVEY DISTRIBUTION AND RESPONSE

The final draft of SDA V1.0 was published online on September 23, 2014 for public consultation in order to identify areas that required clarification or may be improved.

Stakeholders were given one month to provide their feedback. Invitations were sent to stakeholders who previously expressed interest in the initiative, were part of an email list of one of the initiative's partner organizations, or were a member of the initiative's Technical Advisory Group. They represented a wide range of companies, NGOs and other organizations that have an interest or expertise in the topic. Though certain stakeholders were invited, the consultation process was open to the general public.

Comments were collected through several avenues. Feedback was primarily received through an online survey that requested comments on specific parts of the method that the authors sought additional evaluation on as well as provided space for general comments. There were 17 or 18 survey questions (depending on responses to multiple choice questions and their follow-up questions). Additionally, feedback was received though emails from and phone discussions with members of the initiative's Steering Committee. Representatives from more than 50 organizations provided comments during the public consultation process. Approximately 40% of respondents were either from a sector that is not included in the SDA or from an organization where sector classification is not applicable. A breakdown of the responders that represented SDA sectors is shown in Figure VII.1. At least one company from every sector in the SDA responded except Iron & steel and Passenger transport – rail.

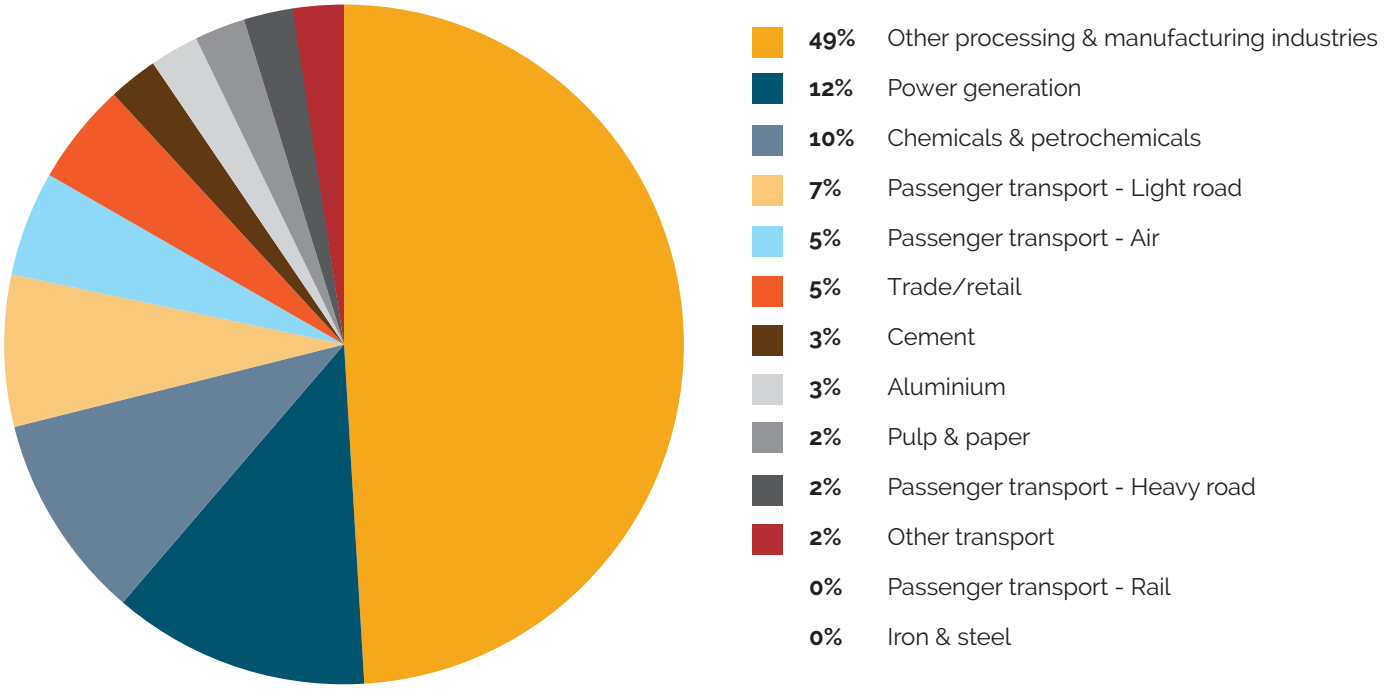
PROCESS TO EVALUATE SURVEY RESULTS

All responses were reviewed thoroughly by the partner organizations. Feedback that was deemed appropriate was either incorporated into SDA V1.0 where feasible, or will be addressed in future versions of the SDA or other project activities. Information deemed not appropriate may have been infeasible to incorporate, not backed by credible sources, and/or already included.

INCORPORATION OF FEEDBACK INTO THE SDA

Aggregated survey results revealed the main issues below, which were brought up by multiple respondents. Less substantial suggestions may have been incorporated in the SDA method, though not explicitly discussed in this summary.

Figure VII.1 Sector representation of respondents to the online survey



EMISSIONS BUDGET

Summary of feedback:

- Approximately 43% of respondents stated that the method was not clearly communicated and the topic that needed the most clarification was the emissions budget. Many respondents raised concerns over whether the SDA's emissions budget is in line with the IPCC's RCP 2.6 budget.

How feedback was addressed:

- Figure 8 and Table 1, which displayed the SDA sectoral CO_2 emissions budgets from 2010 to 2050, now include the IPCC's budget for comparison. They illustrate the conservation of the RCP 2.6 budget.
- A table describing how the IEA ETP 2014 budgets were translated into the SDA sectoral budgets has been added to Appendix II.
- Figure 7, previously titled "Sectoral coverage under the SDA methodology," is now more accurately worded. It now states that emissions shown are all greenhouse gases. (The SDA is based on a CO_2 budget, which considers the radiative forces of other gases.)
- The justification for using the peak and decline model is also explained more clearly in several sub-sections.

ASSUMPTIONS

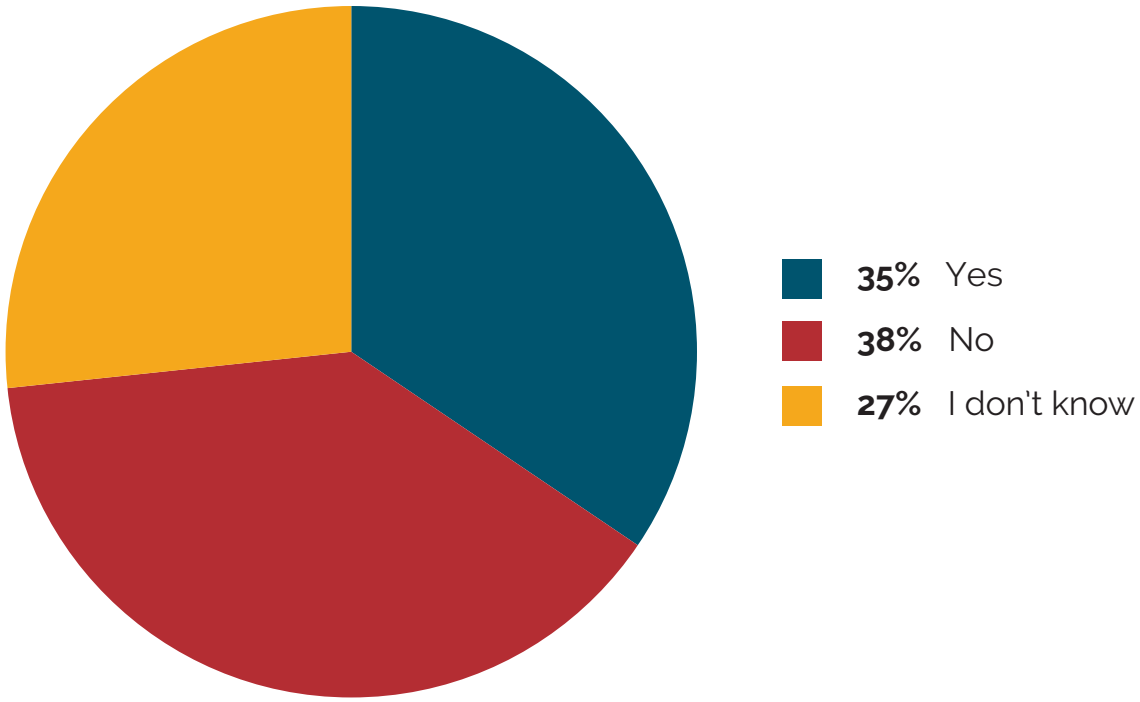
Summary of feedback:

- Approximately 35% of respondents stated that one or more assumptions were unreasonable and suggested modifications or qualifying statements be added in order to make the assumptions more accurate (Figure VII.1).
- Some respondents also suggested methods to improve Assumption #2, which addresses the issue of equity.

How feedback was addressed:

- Assumption #7 was removed and two more were added to more accurately describe the underlying principles of the method.
- Assumption #4, which defines gross profit, was changed from "revenue minus the cost of sold goods and services" to "revenue minus the cost of purchased goods and services" to be in line with other common accounting terms.
- IEA's ETP 2014 GDP growth rate predictions were added to the appendix to improve the transparency of the assumptions.
- Suggestions to account for equity in Assumption #2 either proposed points that had already been considered while developing SDA V 1.0 or will be included in future versions.

Figure VII.2 Percentage of respondents who found the assumptions unreasonable



TERMS AND DEFINITIONS

SCIENCE BASED TARGETS

Summary of feedback:

- Some respondents requested a clear definition of science-based targets to help elucidate what other methods might qualify.

How feedback was addressed:

- The initiative's definition of science-based targets was added to the method. The Technical Advisory Group of corporate sustainability experts was consulted. A more detailed version that discusses the specifics of what qualifies, what does not, and why will be included in future project activities.

VALUE ADDED

Summary of feedback:

- A few respondents suggested that the definition of value added be more easily found in the method.

How feedback was addressed:

- The definition was added to the glossary and is discussed in further detail in several places where it is mentioned in the text.

EQUATIONS

It should be noted that the equations used to calculate company emissions targets have been revised; however, this change originated from an error found by internal revisions and was not prompted by the public consultation process.

The original equations did not account for companies changing their market share. The new equations have replaced those in the draft SDA method and tool. The case studies from Section 3 of the method were subsequently updated. In the first version of the equations these conditions worked only in the case that the growth rate of a company was equal to the growth rate of its sector.

The relationship between the company growth and the sector growth had to be corrected. Previously, if a company grew faster than the sector but also started from a higher intensity than the sector average it led to over budgeting CO_2.

TOPICS TO BE INCLUDED IN FUTURE VERSIONS OF THE SDA OR OTHER RESOURCES

Several recommended topics to include were deemed appropriate but not feasible to address in this version of the SDA:

- Some respondents provided suggestions for alternative activity indicators. These will be considered for SDA V2.0.

- Some respondents said that multiple activity indicators for each sector would make the method more robust by accounting for structural differences between companies. This will be considered for SDA V2.0.

- Some respondents provided suggestions for new sectors to be included. Those that are backed by credible sources will be considered in future versions of the SDA in addition to those already identified in the SDA but not currently included (i.e. Agriculture, Forestry and Other Land Use; Oil and gas; and Residential buildings).

- A few respondents commented that boundaries would be useful in delineating emissions intensities and scopes in target setting. Boundaries will be discussed in the guidance documents the initiative is developing.

- A few respondents commented that additional Scope 3 emissions categories should be included. They will be included in future versions of the SDA when data become available.

- A few respondents requested options for organizations that fit many sectors (e.g. finance companies). This will be further evaluated in future activities.

INTEREST IN SCIENCE-BASED TARGETS

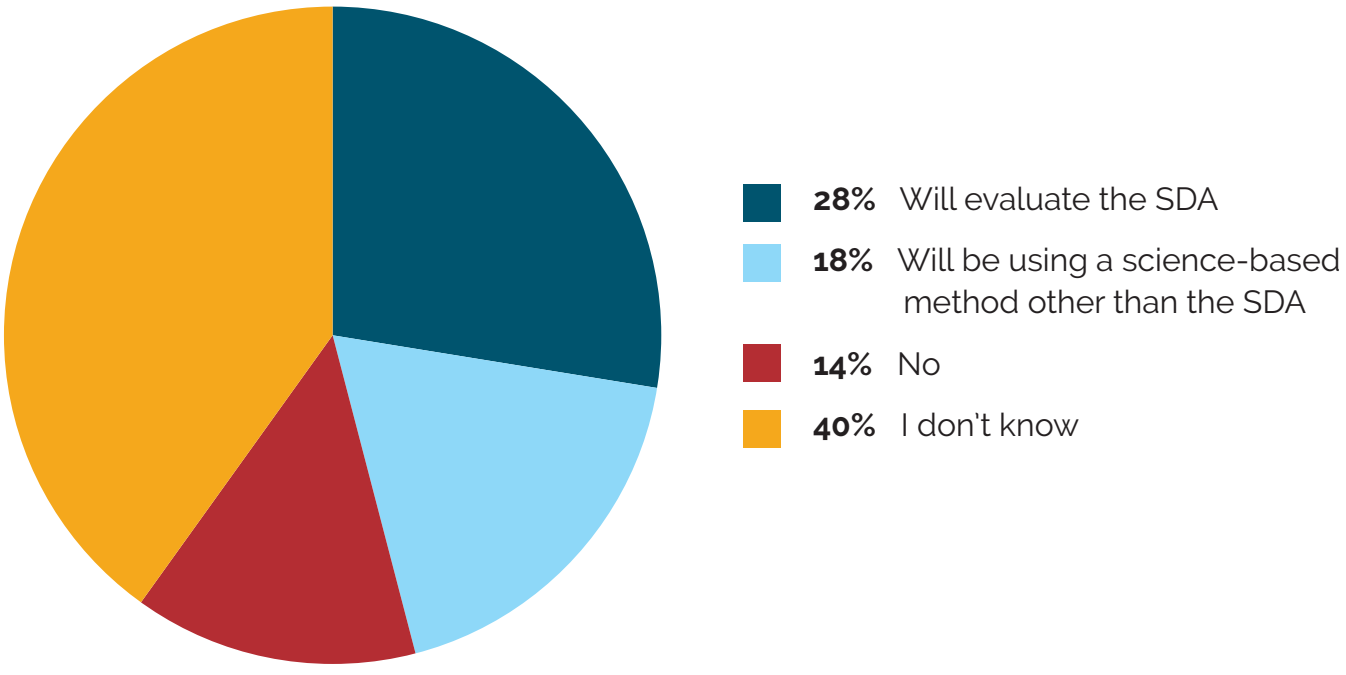
In addition to asking respondents for feedback, the survey also included several questions to gauge the respondents' level of interest in the SDA and other science-based target setting methods (Figure 3). After reviewing SDA method, 28% of respondents said they would evaluate the SDA for future use.

About 18% said they plan to use a science-based target setting method other than the SDA. The other methods were designed by the company internally and/or methods supported by the Science Based Targets initiative. Those that do not plan to implement the SDA stated that they are from an organization that wouldn't necessarily implement it and that they are reviewing it to determine whether it would be appropriate for their clients. Those that were unsure whether they would use the SDA stated concerns in the topics described above.

SURVEY OUTCOME

Following the analysis of the survey results, the Steering Committee of the Science Based Targets initiative edited version 1.0 of the SDA so that it is more clearly communicated and robust, and acquired valuable input that will be taken into consideration in future activities.

Figure VII.3 Over 46% of respondents plan to implement a science-based target



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