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TOWARDS A SCIENCE-BASED APPROACH TO CLIMATE NEUTRALITY IN THE CORPORATE SECTOR

Discussion paper

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ABSTRACT

The Special Report on 1.5°C (SR15) released by the Intergovernmental Panel on Climate Change (IPCC) in 2018 confirmed that, in order to limit global warming to 1.5°C, we need to reach net-zero CO_2 emissions at the global level by mid-century. Since then, the concept of net-zero emissions has been gaining prominence in the climate policy and climate action arena with a number of countries and non-state actors increasingly setting long-term goals to reach net-zero emissions.

According to the Energy and Climate Intelligence Unit (ECIU), by August 2019, nearly 20 countries had agreed to set long-term pathways to reach net-zero emissions, and some of them had already net-zero legislation in place (Norway, Sweden, United Kingdom and France). In the corporate sector, by September, 2019, over 50 companies had committed to reach net-zero emissions by 2050 as part of the Business Ambition for 1.5°C campaign.

To date, the concept of climate neutrality[1] in the corporate sector has been approached in different, and sometimes divergent ways. The various approaches to climate neutrality differ in at least four aspects: (1) the time frame of the target (e.g. short vs long-term targets); (2) the scope of the activities included in the target (e.g. operational emissions vs value-chain emissions); (3) the climate impacts from those activities (e.g. CO_2 emissions vs non-CO_2 radiative forcing) and; (4) the climate mitigation approach used by companies to meet their targets (e.g. decarbonisation, use of offsets, etc.).

These inconsistent approaches to climate neutrality in the corporate sector can send confusing signals to external stakeholders trying to assess the impact and implications of corporate targets. For instance, while a target to neutralise a company's impact on the climate through the purchase of carbon credits can send a strong demand signal to the voluntary carbon market (e.g. standard setters, traders, project developers, etc.), it could be an irrelevant, or worse, a misleading signal to investors trying to mitigate transition risks and to build resilience into their portfolios.

Recognising the challenges of having multiple approaches to climate neutrality in the corporate sector, this paper deconstructs these different approaches and proposes a set of principles to ensure that climate neutrality goals by companies mitigate both, societal and transition climate-related risks. These principles are then used to assess the effectiveness of different approaches to achieve climate neutrality. The proposed principles intend to provide a compass for the development of more detailed guidelines to formulate, implement, and assess climate neutrality targets at the corporate level.

[1] Climate neutrality is used in this context, as a generic term to encompass activities taken by companies to neutralise their impact on the climate. A more specific definition of climate neutrality is presented in Section 2 of this paper.

This discussion paper is structured in five sections:

- **Net-zero in the context of limiting global warming to 1.5°C:** This section condenses relevant excerpts of information from the IPCC Special Report on 1.5°C (IPCC SR15) to facilitate the understanding of net-zero in the context of limiting global warming to 1.5°C. The section intends to act as a mini-summary of the IPCC SR15 for non-technical business audiences. The section preserves, to the extent possible, the original language used in the IPCC SR15;
- **Unpacking climate neutrality in the corporate sector:** This section explores the different approaches used by companies to set and implement climate neutrality targets and to make related claims. The section revises relevant definitions and provides a structured way to untangle corporate climate-neutrality targets;
- **Insights and trends of climate neutrality in the corporate sector:** This section analyses the prevalence of different approaches to climate neutrality in the corporate sector, as well as trends, based on data disclosed to CDP over the past five years (pending section);
- **Principles to guide climate neutrality targets in the corporate sector:** This section proposes a set of principles to inform the formulation, implementation and assessment of corporate climate neutrality targets with a view of effectively mitigating climate-related risks and impacts; and
- **Assessing the effectiveness of different approaches to climate neutrality:** The proposed guiding principles are used to assess the effectiveness of the different approaches used by companies to achieve climate neutrality. A set of recommendations is provided for the formulation and implementation of climate neutrality targets that effectively mitigate climate-related risks.

TABLE OF CONTENTS

1. Net-zero in the context of limiting global warming to 1.5°C

1.1. Key characteristics of 1.5°C pathways with no or limited overshoot

According to the Intergovernmental Panel on Climate Change (IPCC), limiting global temperature increase at any level, requires global CO_2 emissions to reach net-zero at some point in the future and reducing non-CO_2 radiative forcing as much as possible. In pathways that limit warming to 1.5°C, with no or limited overshoot, global net anthropogenic CO_2 emissions decline by about 45% from 2010 levels by 2030, reaching net zero around 2050[1].

Pathways that limit warming to 1.5°C with no or limited overshoot use carbon dioxide removal (CDR) to some extent to neutralize emissions from sources for which no mitigation measures have been identified and, in most cases, also to achieve net negative emissions to return global warming to 1.5°C following a peak[2]. The longer the delay in reducing CO_2 emissions towards zero, the larger the likelihood of exceeding 1.5°C, and the heavier the implied reliance on net negative emissions after mid-century to return warming to 1.5°C.

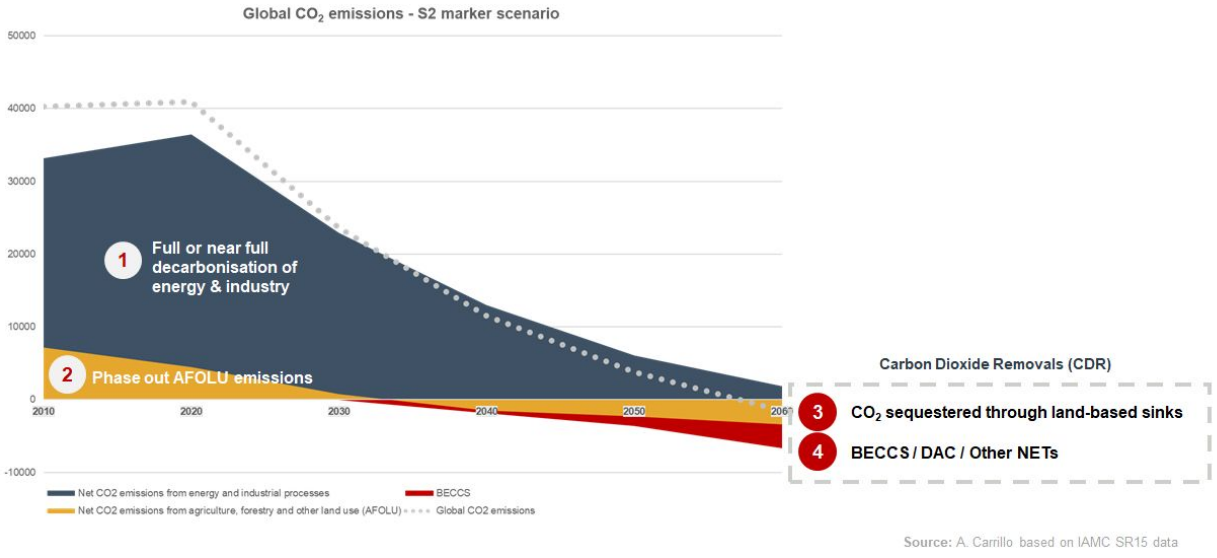


Figure 1. Key characteristics of 1.5°C pathways

[2] IPCC, 2018: Chapter 2 - Mitigation pathways compatible with 1.5°C in the context of sustainable development

1.2. The role of carbon removals in limiting warming to 1.5°C

Carbon dioxide removal (CDR) refers to activities that remove CO_2 from the atmosphere and durably storing it in geological, terrestrial, or ocean reservoirs, or in products[2]. Existing and potential CDR measures include afforestation and reforestation, land restoration and soil carbon sequestration, BECCS, direct air carbon capture and storage (DACCS), enhanced weathering and ocean alkalinization[1].

According to the IPCC SR15, CDR can have two very different functions in 1.5°C-consistent pathways:

A. Carbon removals can help compensate for residual long-lived GHG emissions that accumulate in the atmosphere or;
B. They can create net negative emissions that actively draw down the cumulative amount of CO_2 emissions to return to a level that increases the probability of returning to 1.5°C of warming (if this threshold has already been crossed).

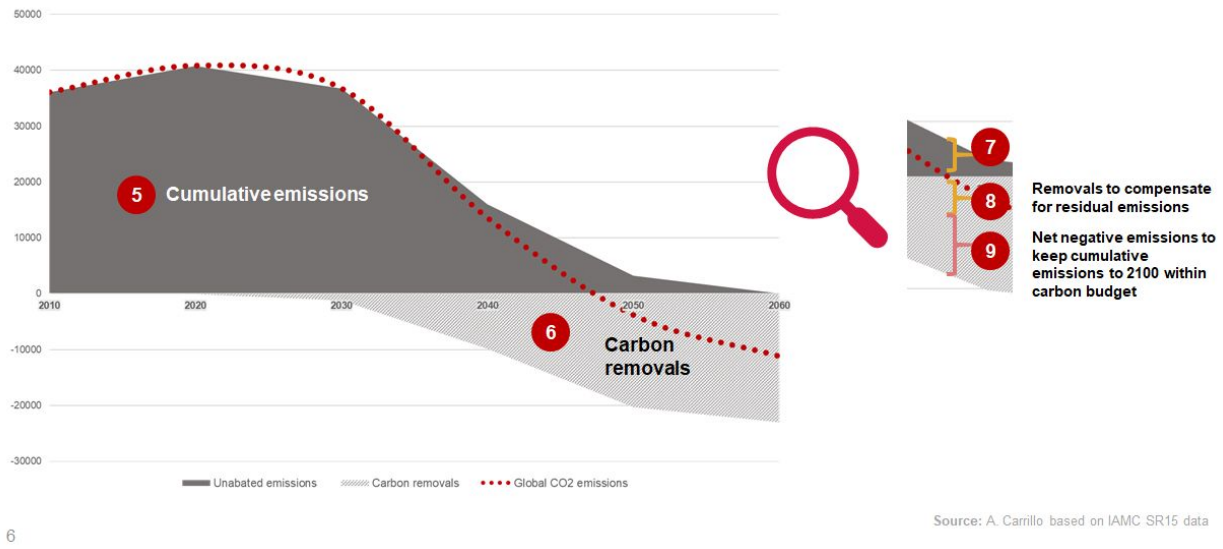
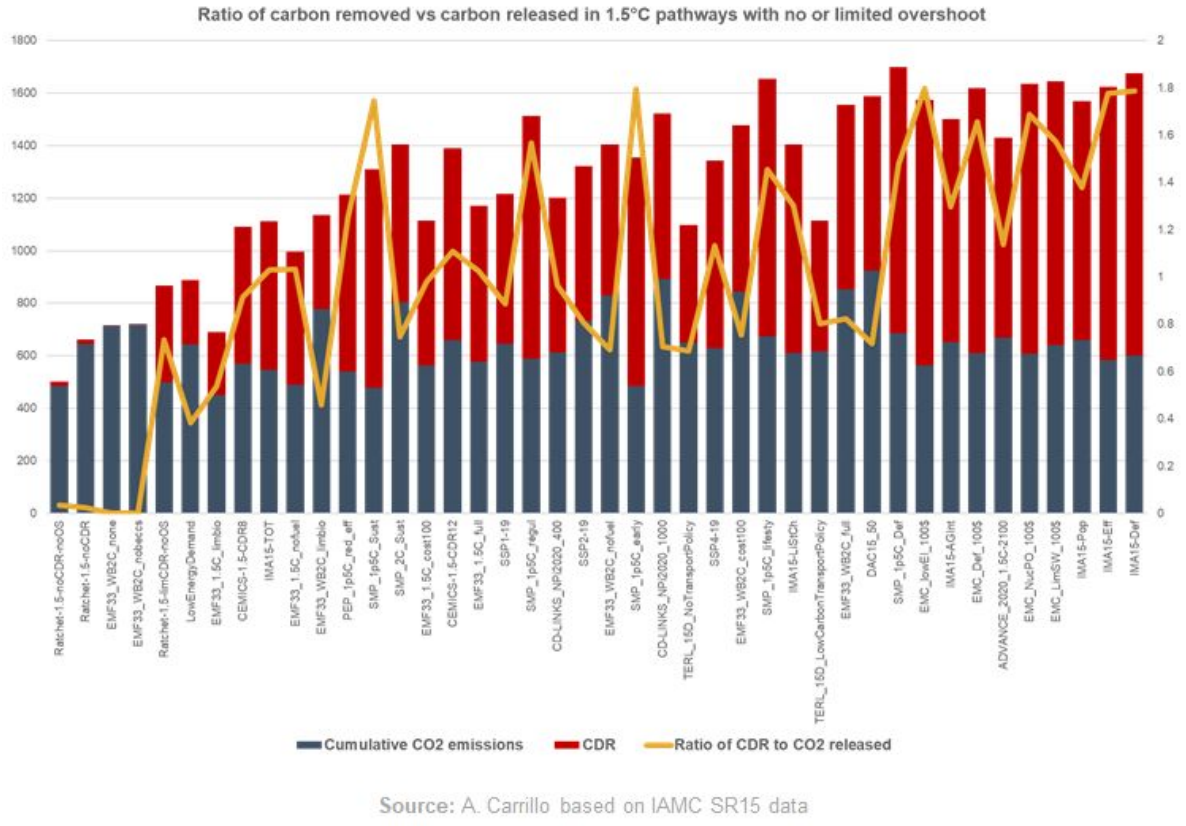


Figure 2. Role of carbon removals in 1.5°C pathways

1.3. Extent of carbon removals in 1.5°C pathways

Nearly all pathways that limit global warming to 1.5°C with limited or no overshoot project the use of carbon dioxide removal (CDR) in the order of 100–1000 $GtCO_2$ over the 21st century. Only 4 out of the 42 pathways that limit warming to 1.5°C, with no or limited overshoot, avoid the use of CDR at scale. This is achieved through a significant reduction in energy and food demand. For the remaining pathways, the ratio between carbon removed (until the end of the century) and carbon released into the atmosphere (before reaching net-zero emissions) ranges from 0.4 to 1.8 (median = 1). This means that, throughout the 21st century, nearly one ton of CO_2 (min 0.4; max 1.8) needs to be removed for every ton of CO_2 released into the atmosphere in order to limit warming to 1.5°C with no or limited overshoot.



Source: A. Carrillo based on IAMC SR15 data

Figure 3. Ratio between carbon removed and carbon released into the atmosphere in 1.5°C pathways

1.4. Risks of delaying near-term mitigation

The faster reduction of net CO_2 emissions in 1.5°C pathways is predominantly achieved by measures that result in less CO_2 being produced and emitted, and only to a smaller degree through additional CDR. Literature shows that rapid and stringent mitigation as well as large-scale CDR deployment occur simultaneously in 1.5°C pathways due to the tight remaining carbon budget[5].

Several concerns are reported in the IPCC SR15 about the reliance on carbon removals at scale in 1.5°C pathways. Some of the most common concerns are listed below[3]:

- **Uncertainties:** No CDR technology has been deployed at scale yet, and all come with significant uncertainties about their potential, feasibility and/or sustainability. There are also uncertainties associated with the Earth system response to net negative emissions after a peak;
- **Delayed near-term mitigation:** Concerns have been raised that building expectations about large scale CDR deployment in the future can lead to an actual reduction of near-term mitigation efforts;
- **Social and environmental impacts:** The impacts of carbon dioxide removal (CDR) options on SDGs depend on the type of options and the scale of deployment. Pathways that rely on the deployment of large-scale land-related measures like afforestation and bioenergy supply, if poorly managed, can compete with food production and hence raise food security concerns.

[3] IPCC, 2018: Chapter 2 - Mitigation pathways compatible with 1.5°C in the context of sustainable development

2. Unpacking climate neutrality in the corporate sector

While the terms “carbon neutrality”, “climate neutrality” and “net-zero emissions” have distinct definitions in the scientific context (e.g. IPCC SR15), these terms have been used with more flexibility and often inconsistency in the corporate sector. More importantly, corporate neutrality targets are often set and implemented following very different approaches to mitigate climate impact. This section provides clarity on terminology and explores the different approaches commonly used by companies to mitigate their impact on the climate system.

2.1. Carbon neutral, climate neutral or net-zero?

The terms carbon neutrality, climate neutrality and net-zero emissions reflect the same intention, i.e. neutralising the impact of human activity on the climate system. While in the corporate sector these terms are often used to indicate different approaches pursued by companies to mitigate their impact on the climate, in the scientific context, these terms are used distinctly to reflect the scope of climate forcers being neutralised. Table 1 summarizes the scope of climate forcers for each of these terms based on the definitions from the IPCC:

Term	Scope of climate forcers	Definition from IPCC SR15
Carbon neutrality or net-zero CO_2 emissions	CO_2 emissions	Net zero carbon dioxide emissions are achieved when anthropogenic CO_2 emissions are balanced globally by anthropogenic CO_2 removals over a specified period.
Net-zero emissions	All GHG emissions[4]	Net zero emissions are achieved when anthropogenic emissions of greenhouse gases to the atmosphere are balanced by anthropogenic removals over a specified period. Where multiple greenhouse gases are involved, the quantification of net zero emissions depends on the climate metric chosen to compare emissions of different gases (such as global warming potential, global temperature change potential, and others, as well as the chosen time horizon).

[4] The GHG Protocol requires inclusion of all the GHGs required by the UNFCCC/Kyoto Protocol at the time a corporate or product inventory is being compiled. These GHGs are currently: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF_6), and nitrogen trifluoride (NF_3).

Climate neutrality	All GHG emissions, regional or local biogeophysical effects of human activities, and, arguably, other radiative forcers[5].	Concept of a state in which human activities result in no net effect on the climate system. Achieving such a state would require balancing of residual emissions with emission (carbon dioxide) removal as well as accounting for regional or local biogeophysical effects of human activities that, for example, affect surface albedo or local climate

Table 1. IPCC definitions of climate-neutrality-related terms

For most sectors and companies, net-zero emissions and climate neutrality will be practically equivalent, as the most material climate impacts, associated with the activity of the company, will be the release of GHG emissions into the atmosphere. Yet, for some sectors (e.g. aviation), it is relevant to consider other climate impacts from non-CO_2 radiative forcing.

2.2. Boundary of climate neutrality targets

Beyond the climate forcers covered by climate neutrality targets, the other aspect that differentiates corporate neutrality targets is the range of activities and sources covered by the target. These two aspects, scope of activities and scope of climate forces, constitute the boundary of a climate neutrality target. The combination of activities and climate forcers in climate neutrality targets is illustrated in Figure 4.

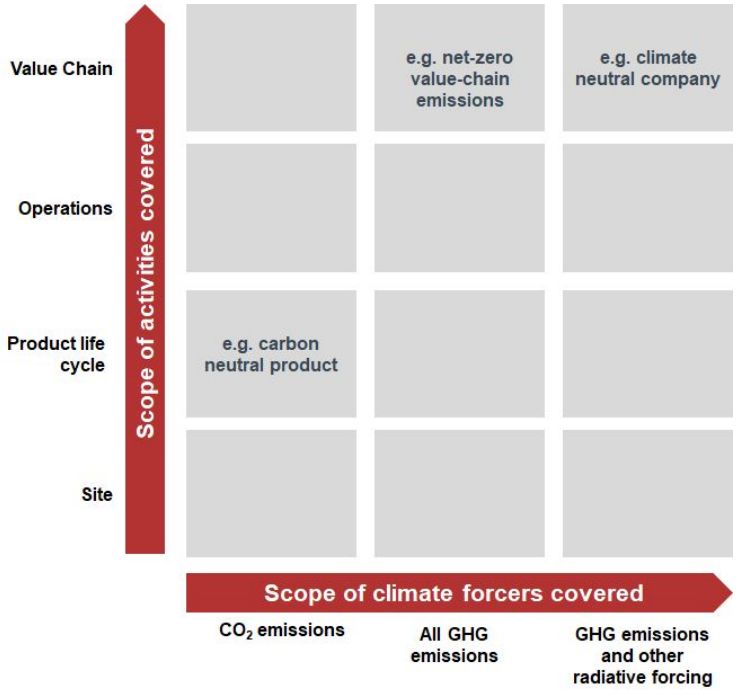


Figure 4. Boundary of corporate climate neutrality targets

[5] There is ambiguity as to whether climate warming non-CO2 effects from aviation would be included within the term biogeophysical effects of human activities. Some have coined a new term "zero climate impact" as distinct from climate neutrality to unambiguously indicate that non-CO2 effects from aviation should be neutralized as well

Table 2 below illustrates different target boundaries for corporate neutrality targets. Some of these targets are clear about the scope of activities and impacts covered, while others are formulated in a more ambiguous way. It is recommended that companies formulate neutrality targets clearly indicating the scope of activities and sources / impacts covered by the target.

Boundary	Definition	Example
Geographical boundary	In this case, companies set a neutrality target for the activities undertaken in specific geographies	Arcelormittal, the world's largest steel producer, has committed to achieve carbon neutrality in Europe by 2050
Operations	It is common for companies to set a neutrality target covering all of their operations (usually including Scope 1 and Scope 2 emissions)	Industrial company Bosh, has committed to achieve carbon neutrality by 2020 for their global operations, including over 400 manufacturing, research and administrative facilities across the globe.
Value-chain	More ambitious corporate neutrality targets cover all relevant activities and sources within the value chain of the company	Volkswagen has committed to be a CO_2 neutral company by 2050, including all production and vehicles.
Others	Companies can also set neutrality targets for a specific site, product, product portfolio or other boundaries.	Daimler AG aims to reach carbon neutrality by 2039 for its car division (Mercedes-Benz Cars), including a new carbon neutral passenger car fleet

Table 2. Examples of different target boundaries for corporate neutrality targets

2.3. Mitigation approach

Perhaps the most important aspect that differentiates corporate neutrality targets is the mix of measures that companies implement to meet such targets and to mitigate their impact on the climate. Table 3 describes the different approaches used by companies to seek or claim climate neutrality. The following chapter analyses each of these approaches and their effectiveness to mitigate climate-related risks and impacts.

Mitigation approach	Description
Decarbonisation	In this case, companies seek to mitigate their impact on the climate by eliminating the sources of emissions within the boundary of the target. This is often achieved by avoiding activities that generate emissions (e.g. avoiding combustion of fossil fuels) and/or by preventing the release of emissions that continue to be generated (e.g. through the capture and permanent sequestration of emissions before they are released into the atmosphere). While the term decarbonisation refers strictly to the abatement of carbon dioxide emissions, it is commonly used to encompass efforts to reduce other greenhouse gas emissions.
Balance emissions with atmospheric removals within the value-chain of the company	In this case, companies seek to mitigate their climate impact by balancing the impact of emissions occurring within the target boundary with an appropriate amount of carbon removed from the atmosphere over a specified period. The IPCC defines removals as the *withdrawal of GHGs from the atmosphere as a result of deliberate human activities. These include enhancing biological sinks of CO2 and using chemical engineering to achieve long-term removal and storage*. The amount of removals needed to compensate climate impact from greenhouse gas emissions depends on the volume and type of gases released into the atmosphere and the global warming potential of these gases.
Balance emissions within the value chain of the company with emissions avoided through the use of sold products	The GHG protocol defines avoided emissions as emission reductions that occur outside of a product's life cycle or value chain, but as a result of the use of that product. Avoided emissions is a relative metric estimated by comparing the climate impacts of a given product, activity or service against the climate impacts of a reference product, activity or service. It is a relatively common practice for companies set targets, or to make claims, that involve balancing the emissions generated by the company with an equivalent amount of emissions avoided through the use of the products sold by the company.

Offsetting	In the context of corporate climate neutrality, offsetting refers to the balancing of emissions within the target boundary with an equivalent amount of carbon credits originated from activities that avoid or remove emissions somewhere else. Carbon credits are often issued from two types of project activities: A. **Carbon removal projects:** Activities that remove and sequester atmospheric carbon as a result of a specific intervention (e.g. reforestation projects). In this case, a carbon credit if issued for every ton of carbon dioxide effectively removed and sequestered over a predefined period; B. **Avoided emission projects**: Activities that result in a lower emissions scenario compared to a hypothetical business-as-usual scenario as a result of a specific intervention. A carbon credit is issued for every ton of carbon dioxide equivalent effectively avoided, in comparison to the hypothetical business-as-usual scenario, over a certain period. Some project activities can remove and avoid carbon as a result of the same intervention (e.g. REDD+ programs or projects).
Hybrid approaches	Finally, it is worth noting that a large number of companies setting neutrality targets have a mixed approach involving a degree of decarbonisation often combined with other mitigation approaches.

Table 3. Mitigation approaches used by companies to achieve or to claim climate neutrality

3. Principles to guide climate neutrality in the corporate sector

Section 2 of this paper described different ways in which companies are approaching climate neutrality. This section proposes a set of guiding principles to ensure that climate neutrality targets effectively mitigate climate-related risks, including both, risks that the company imposes on society due to the climate impact of their activities, as well transition risks to which the company is exposed.

3.1. Mitigation of climate-related impacts

Climate-related impacts refer to the influence that a company exerts on the global climate system due to the release of greenhouse gas emissions, and other radiative forcing, associated with the activity of the company. Climate-related impacts should not be mistaken with *physical risks* (e.g. extreme weather events) to which the company may be exposed as a result of climate change.

For most sectors[6], the most material impact on the climate is associated with the release and accumulation of carbon dioxide and other greenhouse gas emissions into the atmosphere. For companies in these sectors, achieving climate neutrality[7] involves reaching a state in which the activities within the value-chain of the company result in no net accumulation of carbon dioxide and other GHG emissions in the atmosphere. From a physical point of view, this can be achieved by decarbonising sources of emissions within the value chain of the company, and/or by balancing unabated GHG emissions with an appropriate amount of carbon removals.

Achieving a state of climate neutrality involves a transition process. While each company, individually, is likely to follow a unique transition pathway, it is desirable that these pathways, collectively, add up to the transformation that our global economy needs to undergo to reach net-zero emissions at the global level in a way that allows us to limit global warming to 1.5°C.

The IPCC Special Report on 1.5°C depicts a wide range of mitigation pathways to limit warming to 1.5°C. As described in Section 1 of this paper, pathways that limit warming, with no or limited overshoot, require reaching net-zero CO_2 emissions by no later than 2050, accompanied by rapid declines in non-CO_2 emissions. This is accomplished through rapid and profound transitions in the global energy, industry, urban, and land systems that occur concurrently and that involve:

[6] A notable exception is the aviation sector, for which the climate impact of other radiative forcing is estimated to be considerably larger than the impact of direct CO_2 emissions.
[7] In this case, net-zero emissions and climate neutrality are considered equivalent

- Full or near-full decarbonisation for energy and industrial CO_2 emissions achieving a zero-emission energy supply system by mid-century;
- Eliminating CO_2 emissions associated with agriculture, forestry and land-use;
- Deep reductions in non-CO_2 emissions from all sectors; and
- Removing CO_2 from the atmosphere to neutralize residual emissions and to create net negative emissions that actively draw down the cumulative amount of CO_2 emissions to return below a 1.5°C warming level.

3.2. Mitigation of climate-related transition risks

The Task Force on Climate-related Financial Disclosures (TCFD) refers to climate-related transition risks as the financial or reputational risks that organisations face due to the policy, legal, technology, and market changes that occur as a result of societal efforts to mitigate and adapt to climate change. Examples of these risks include increased carbon pricing, more stringent policy frameworks, increases in litigation, changes in consumer behaviour, shift in consumer preferences, stigmatisation of sector, etc.

According to the TCFD, “Emissions are a prime driver of rising global temperatures and, as such, are a key focal point of policy, regulatory, market, and technology responses to limit climate change. As a result, organizations with significant emissions are likely to be impacted more significantly by transition risk than other organizations. In addition, current or future constraints on emissions, either directly by emission restrictions or indirectly through carbon budgets, may impact organizations financially.”

Acknowledging GHG emissions as a primary source of climate-related transition risks, reducing GHG emissions constitutes, consequently, a primary tool to mitigate climate-related transition risks. In a scenario in which the global economy is aiming to reach net-zero carbon emissions, as agreed by nearly 200 countries in the Paris Agreement, a commitment to transition towards climate neutrality could provide certainty to investors, and other stakeholders, that a company is aligning to the long-term climate goals and that the business model of a company will continue to be relevant in a net-zero carbon economy.

The Oxford Martin Net Zero Carbon Investment Initiative proposes a set of principles to facilitate engagement between investors and companies on long-term climate strategies. According to these principles, companies should: (1) Commit to a timeframe to reach net-zero emissions in line with the Paris goals; (2) Demonstrate that they will be able to continue to be profitable once they reach net-zero emissions; and (3) Set quantiatitative mid-term targets to be able to demonstrate progress against their long-term goals.

3.3. Principles to guide climate neutrality targets in the corporate sector

Acknowledging the need to mitigate the impact of a company on the climate, and the importance of mitigating climate-related transition risks to which companies may be exposed, the following guiding principles are proposed to inform climate neutrality targets in the corporate sector and to assess the effectiveness of different mitigation approaches to mitigate climate-related risks and impacts:

- **Guiding principle 1:** Reaching climate neutrality for a company involves achieving a state in which the business model of the company results in no net impact on the climate;
- **Guiding principle 2:** Companies should transition towards climate neutrality in line with mitigation pathways that limit global warming to 1.5°C with no or limited overshoot;
- **Guiding principle 3:** Transitioning towards climate neutrality should effectively mitigate the climate-related transition risks to which the company is exposed;
- **Guiding principle 4:** The approach followed by the company to reach climate neutrality should inform long-term strategies and investments and should provide certainty to investors, and other stakeholders, that the business model of the company will continue to be viable in a net-zero economy;

4. Assessing the effectiveness of different approaches to climate neutrality

Section 2 of this paper described different ways in which companies are approaching climate neutrality. Section 3 proposed a set of guiding principles to ensure that climate neutrality targets effectively mitigate climate-related risks, including both, risks that the company imposes on society due to the climate impact of their activities, as well transition risks to which the company is exposed. This section assesses the effectiveness of the different approaches to climate neutrality based on the proposed guiding principles. A set of recommendations is provided to inform the formulation, implementation and assessment of corporate climate neutrality targets.

4.1. Decarbonisation

Effectiveness to neutralise impacts from the company on the climate	In most sectors, the release of GHG emissions into the atmosphere constitutes the main climate impact. Therefore, reducing GHG emissions constitutes the most effective way to reduce climate impact.
Consistency with 1.5°C mitigation pathways	Deep decarbonisation constitutes the main mitigation option in scenarios that limit warming to 1.5°C with no or limited overshoot. Decarbonising in line with 1.5°C pathways requires halving CO_2 emissions by 2030, and reaching net-zero CO_2 emissions by no later than 2050. Companies that decarbonise at this pace, are not only reducing their impact on the climate, but also, contributing to limit warming to 1.5°C.
Effectiveness to mitigate climate-related transition risks	GHG emissions constitutes the main source of climate-related risks. Therefore, decarbonisation constitutes an effective tool to mitigate climate-related transition risks.
Effectiveness to transition towards a business model that is likely to be viable under a net-zero carbon economy	Long-term goals to achieve climate neutrality through deep decarbonisation will inform capital allocation, research and development and the long-term strategy of the company. Yet, companies would have to demonstrate their ability to continue to create value to shareholders and stakeholders under a net-zero carbon economy.

4.2. Balancing emissions with removals within the value chain

Effectiveness to neutralise impacts from the company on the climate	Removing carbon to compensate for emissions that the company puts into the atmosphere theoretically compensates the impact from the company on the climate, as it prevents GHG emissions to accumulate in the atmosphere. The effectiveness of this approach to climate neutrality depends, largely, on the ability to effectively store carbon permanently. Several options are currently being used or explored by companies. Some of the most common options include:: ***Common practice:*** ● Removal and storage of carbon in forests or soil; ● Removal and storage of carbon in harvested wood products; ***Emerging areas:*** ● Bioenergy combined with carbon capture and storage (BECCS); ● Direct air capture and storage (DACS). While natural carbon sinks offer significant potential to remove carbon from the atmosphere, some concerns have been raised about leakage, displacement and the permanence of such removals. Furthermore, some of the risks (e.g. fires, drought, pests, etc.) that could revert natural carbon sinks, could be exacerbated by climate change. Storing carbon into forest products is a temporary carbon storage option, with carbon returning into the atmosphere either as a result of abrupt circumstances or through natural decay. The range of decay rates is wide, with some products (e.g. paper) decaying in a short time (e.g. less than 5 years) and others (e.g. furniture, buildings) potentially decaying after several decades.
Consistency with 1.5°C mitigation pathways	The removal of carbon plays an important role in most pathways that limit warming to 1.5°C with no or limited overshoot. Yet, given the small budget available to

	limit warming to 1.5°C and the socio, economic and biophysical constraints to remove carbon from the atmosphere (e.g. competing land-use), removals occur in conjunction with a deep decarbonisation of the economy and a significant decrease in non-CO_2 emissions. In this context, removing carbon to compensate for residual emissions (e.g. unabated non-CO_2 emissions) would be consistent with limiting warming to 1.5°C. Yet, removing carbon instead of decarbonising, would not be consistent with 1.5°C pathways.
Effectiveness to mitigate climate-related transition risks	Some removal options could mitigate transition risks when combined with decarbonisation. For instance, the incorporation of wood products as structural material in buildings could help create net-zero buildings and meet evolving market expectations. On the other hand, the use of removals to maintain the status quo in companies would not mitigate transition risks. For instance, a car manufacturer could invest heavily in forest protection & restoration to neutralise the impact of their current product portfolio. Yet, consumer preferences, air quality regulations, climate policy and infrastructure could continue to evolve in favor of electric and zero-emission vehicles, making the mitigation approach of the company inadequate.
Effectiveness to transition towards a business model that is likely to be viable under a net-zero carbon economy	A decarbonised business model combined with an amount of removals to compensate for recalcitrant emissions is likely to be compatible with a net-zero carbon economy. A high-carbon business model, even if matched with a sufficient amount of removals to compensate for climate impact, is likely to face more challenges in a net-zero carbon economy. Also, planning to rely on carbon removals to attain long-term climate neutrality could increase the risks of operational, technological or capital lock-in in high-carbon assets that may be unviable in the long-term.

4.3. Balancing emissions with carbon credits from carbon-removal projects

Effectiveness to neutralise impacts from the company on the climate	The purchase of carbon credits represents a finance vehicle for projects that deliver climate benefits, either through the removal of carbon from the atmosphere (e.g. forestry projects), or by lowering emissions compared to a reference scenario. In the case of carbon removal activities, the effectiveness of these projects to deliver climate benefits, depends, to a large extent on their ability to permanently sequester carbon. The IPCC SR15 indicates that "Biogenic storage is not as permanent as emission reductions by geological storage. In addition, forest sinks saturate, a process which typically occurs in decades to centuries and is subject to disturbances that can be exacerbated by climate change". Another other aspect that is important to assess is the additionality of the project, or, in other words, the demonstration that the project would not have happened in the absence of the revenue associated with the transaction of carbon credits. Based on this, the effectiveness of compensating a company´s climate impact through the purchase of carbon credits from carbon removal activities, will be determined by the additionality of those activities and their ability to permanently store carbon.
Consistency with 1.5°C mitigation pathways	The removal of carbon plays an important role in most pathways that limit warming to 1.5°C with no or limited overshoot. Yet, given the small budget available to limit warming to 1.5°C and the socio, economic and biophysical constraints to remove carbon from the atmosphere (e.g. competing land-use), removals occur in conjunction with a deep decarbonisation of the economy and a significant decrease in non-CO_2 emissions. In this context, removing carbon to compensate for residual emissions (e.g. unabated non-CO_2 emissions) would be consistent with limiting warming to 1.5°C. Yet, removing carbon instead of decarbonising, would not be consistent with 1.5°C pathways.
Effectiveness to mitigate climate-related transition	A decarbonised business model combined with an amount of removals to compensate for recalcitrant

risks	emissions is likely to be compatible with a net-zero carbon economy. A high-carbon business model, even if matched with a sufficient amount of removals to compensate for climate impact, is likely to face more challenges in a net-zero carbon economy. Also, planning to rely on carbon removals to attain long-term climate neutrality could increase the risks of operational, technological or capital lock-in in high-carbon assets that may be unviable in the long-term.
Effectiveness to transition towards a business model that is likely to be viable under a net-zero carbon economy	A decarbonised business model combined with an amount of removals to compensate for recalcitrant emissions is likely to be compatible with a net-zero carbon economy. A high-carbon business model, even if matched with a sufficient amount of removals to compensate for climate impact, is likely to face more challenges in a net-zero carbon economy. Also, planning to rely on carbon removals to attain long-term climate neutrality could increase the risks of operational, technological or capital lock-in in high-carbon assets that may be unviable in the long-term.

4.4. Balancing emissions with carbon credits from emission-reduction projects

Effectiveness to neutralise impacts from the company on the climate	As noted by the Institute for Advanced Sustainability Studies (IASS), while all emission reduction and carbon removal activities that generate carbon credits contribute to global climate mitigation efforts, not all carbon credits are fit for climate neutrality purposes. According to IASS, "the only kinds of offsets that can be considered carbon neutral or climate neutral are those that sequester an amount of CO_2 equivalent to the amount of GHGs that was released." Other types of carbon credits, when used to offset emissions that occur elsewhere, still result in a net-release of emissions that will accumulate into the atmosphere contributing to global warming. Lack of additionality is also a reason for concern with a significant number of emission reduction projects. The Directorate-General for Climate Action (DG-Clima) of the European Union commissioned an independent study to assess the integrity of the Clean Development Mechanism. According to this study, up to 85% of the projects analysed, covering 73% of potential issuance between 2013 and 2020, were found to be non-additional. For these reasons, it is concluded that non-neutral carbon credits would not be an effective mechanism to neutralise the impact of a company on the climate.
Consistency with 1.5°C mitigation pathways	Limiting warming to 1.5°C requires achieving a state in which anthropogenic activity does not contribute to accumulation of carbon in the atmosphere. In a number of scenarios, it is even assumed, that anthropogenic activity should result in a net removal of carbon from the atmosphere. As explained in the previous paragraph, offsetting with non-neutral carbon credits still results in a net-release of GHG emissions and the accumulation of GHG emissions into the atmosphere. Therefore, this is not considered consistent with 1.5°C mitigation pathways.

Effectiveness to mitigate climate-related transition risks	Neutralising climate impact through offsetting does not lead to decarbonisation within the value chain, and therefore, does not mitigate the climate-related transition risks associated with the release of GHG emissions driven by the company.
Effectiveness to transition towards a business model that is likely to be viable under a net-zero carbon economy	Neutralising climate impact through offsetting does not lead to a decarbonised business model. A high-carbon business model is likely to face viability challenges in a net-zero carbon economy.

4.5. Balancing emissions with avoided emissions from sold-products

Effectiveness to neutralise impacts from the company on the climate	Avoided emissions is a relative metric that results from comparing lifecycle emissions of a product or service, with the lifecycle emissions of a reference product or service. Companies often compare the emissions that they are avoiding through the use of their sold products or services, with their own emissions. Climate neutrality is claimed when the company releases a volume of emissions that is equal or lower than the volume of emissions that the company is avoiding through their products or services. When companies avoid more emissions than their own emissions, companies claim that they have become climate positive. To assess if this is an effective approach to mitigate the impact of a company on the climate, three scenarios are explored: **Scenario 1 - Balancing emissions with avoided emissions resulting from comparing a higher-carbon with a lower-carbon alternative:** As an example, let's assume the hypothetical case of a power utility claiming climate neutrality through avoided emissions. Generating electricity through natural gas can avoid emissions compared to a higher-carbon alternative (e.g. coal generation). Even if it could be demonstrated that a new gas generation plant installed by the company is effectively displacing a more emissions-intensive coal-based plant, effectively avoiding a quantifiable amount of carbon emissions, the gas-based plant would still be releasing certain

	amount of carbon dioxide, contributing to the accumulation of carbon into the atmosphere, and therefore, to global warming. In this case, avoided emissions could not be used to claim climate neutrality. **Scenario 2 - Balancing emissions with avoided emissions resulting from comparing a higher-carbon with a carbon-neutral alternative:** In this case, let's assume that the power utility from the previous example is displacing a coal-based thermal power plant, with renewable electricity. The volume of avoided emissions would be higher, and in this case, the company would have decarbonised the emissions associated with the provision of electricity from this site. While this is an effective decarbonisation strategy, it doesn't mean that the company could claim neutrality balancing avoided emissions with emissions caused somewhere else. For instance, if the company has additional generation units in other locations, and these units release CO_2 into the atmosphere, these emissions would still cause a climate impact regardless of the amount of emissions saved from displacing coal. Therefore, in this case, avoided emissions can also not be used to claim climate neutrality. **Scenario 3 - Balancing emissions with avoided emissions resulting from comparing a higher-carbon with a "climate-positive" alternative:** In this third example, the hypothetical utility displaces coal with a generating unit using biomass as fuel and equipped with carbon storage and sequestration capabilities (BECCS). The lifecycle of the energy generated by the plant could lead to the effective removal of carbon from the atmosphere. If the amount of emissions effectively removed and stored is higher than the amount of emissions still released, it could be reasonable for the company to claim climate neutrality, as discussed earlier in this document. Yet, the neutrality claim would be based on balancing emissions with removals, and not with avoided emissions.

	Based on these three scenarios, it is concluded that the emissions prevented from the provision of products or services does not counteract the impact of the emissions that a company still releases into the atmosphere, and therefore, is not an effective method to achieve climate neutrality.
Consistency with 1.5°C mitigation pathways	Balancing unabated emissions with emissions prevented from the use of sold-products or services does not mitigate the impact of a company on the climate, and therefore, is not compatible with limiting warming to 1.5°C.
Effectiveness to mitigate climate-related transition risks	Claiming neutrality by balancing unabated emissions with avoided emissions does not mitigate the climate-related transition risks associated with unabated emissions.
Effectiveness to transition towards a business model that is likely to be viable under a net-zero carbon economy	Neutralising climate impact through avoided emissions does not lead to a decarbonised business model. A high-carbon business model is likely to face viability challenges in a net-zero carbon economy.

5. Summary and recommendations

The different approaches to climate neutrality have been assessed against the proposed guiding principles. The summary of this assessment is presented in Table 4:

	Effectiveness to neutralise impacts from the company on the climate	**Consistency with 1.5°C mitigation pathways**	**Effectiveness to mitigate climate-related transition risks**	**Effectiveness to transition towards a business model that is likely to be viable under a net-zero carbon economy**
Decarbonisation	High	Consistent, as long as decarbonisation happens in line with 1.5°C pathways	High	High
Balance of emissions with removals within the value-chain of the company	Depending on the permanence of the removals	Consistent only when removals are permanent and limited to balance residual emissions	In some cases	In some cases
Balance of emissions with carbon credits sourced from activities that remove carbon from the atmosphere	Depending on the permanence of the removals	Consistent only when removals are permanent and limited to balance residual emissions	Limited	Limited
Balance of emissions with carbon credits sourced from activities that avoid or reduce emissions	Limited	Not consistent	Limited	Limited
Balance of emissions with avoided emissions from the use of sold-products	Limited	Not consistent	Limited	Limited

Table 4. Assessment of mitigation approaches against corporate climate neutrality guiding principles

From this assessment, the following conclusions can be drawn:

- Climate neutrality targets represent an important tool for companies to signal their intention to evolve towards a business model that is compatible with a net-zero carbon economy and to inform short and longer term strategies and investments;
- Climate neutrality in the corporate sector should effectively mitigate the impacts of the company on the climate system, as well as the climate-related transition risks to which the company is exposed;
- When setting climate neutrality targets, companies should be transparent about the boundary of their targets, the timeframe of the target, and the measures that they will use to achieve climate neutrality;
- Decarbonisation constitutes the most effective tool available to companies to mitigate their impact on the climate, and to address climate-related transition risks;
- The effectiveness of carbon removals to mitigate climate-related risks and impacts depends on the ability to guarantee the permanence of stored carbon. Biogenic sequestration and storage is the most available sequestration option in the short-term. Yet, biogenic storage also represents higher non-permanence risks than geological storage;
- Storing carbon in harvested wood products represents a temporary carbon storage solution with variable decay rates ranging from a few years to a few decades, under normal conditions;
- In pathways that limit warming to 1.5°C with no or limited overshoot, negative emissions happen in addition to, not instead of, deep decarbonisation. Companies seeking to align to 1.5°C should resort to removals as an option to mitigate the impact of residual emissions. Not as an alternative to decarbonisation;
- While all emission-reduction projects contribute to climate mitigation, not all carbon credits are effective to neutralise climate impacts. Only carbon credits originated from activities that sequester atmospheric carbon prevent the accumulation of emissions in the atmosphere when used to offset emissions somewhere else;
- While displacing emissions from higher-carbon alternatives contributes to climate mitigation, balancing emissions with avoided emissions does not constitute an effective tool to neutralise climate impact, or to address transition risks.

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