

# CLIMATE CHANGE MITIGATION AND YOUR PORTFOLIO

Practical tools for investors



INVESTOR  
LEADERSHIP  
NETWORK









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## ABOUT US

The Investor Leadership Network is an open and collaborative platform for leading investors interested in addressing sustainability and long-term growth. As a direct outcome of Canada's 2018 G7 presidency, the ILN focuses on concrete actions and global partnerships.

Working together, we are committed to providing resources, expertise and networks to help address three global challenges: climate change, the lack of diversity and inclusion in the investment industry, and the infrastructure gap in developing economies.

Our aim is to accelerate collective action and offer robust, practical solutions.



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## FOREWORD

In 2019, the ILN Climate Change initiative published its first report, [TCFD Implementation: Practical Insights and Perspectives from Behind the Scenes for Institutional Investors](#), to speed the implementation of uniform and comparable climate-related disclosures.

This next priority initiative carries on this mission, focusing on decarbonization scenarios in line with the Paris Agreement. In this report, we aim to help colleagues and peer investors better understand the implications of decarbonization pathways that align to the Paris Agreement's target of limiting the increase in average global temperature to 1.5°C. While there are many emissions pathways and great uncertainty about which one the world will ultimately follow, we focus here on a decarbonization pathway in line with the Paris Agreement as a stress-testing scenario for investors.

As the implications of climate change unfold and investors improve their risk analysis, they need a credible, consistent and up-to-date fact base. We hope that the resources and tools we provide will help the investment industry recognize climate risks sooner and speed the transition to a more sustainable economy.



# THE CLIMATE IMPERATIVE

Climate change is underway, raising the risks of significant environmental, social and economic disruptions around the globe. According to overwhelming scientific consensus, greenhouse gases created by human activity, referred to as anthropogenic emissions, have caused much of the observed increase in Earth's temperatures over the past 50 years. Since the industrial revolution began in the 1880s,<sup>1</sup> the planet's temperature has risen approximately

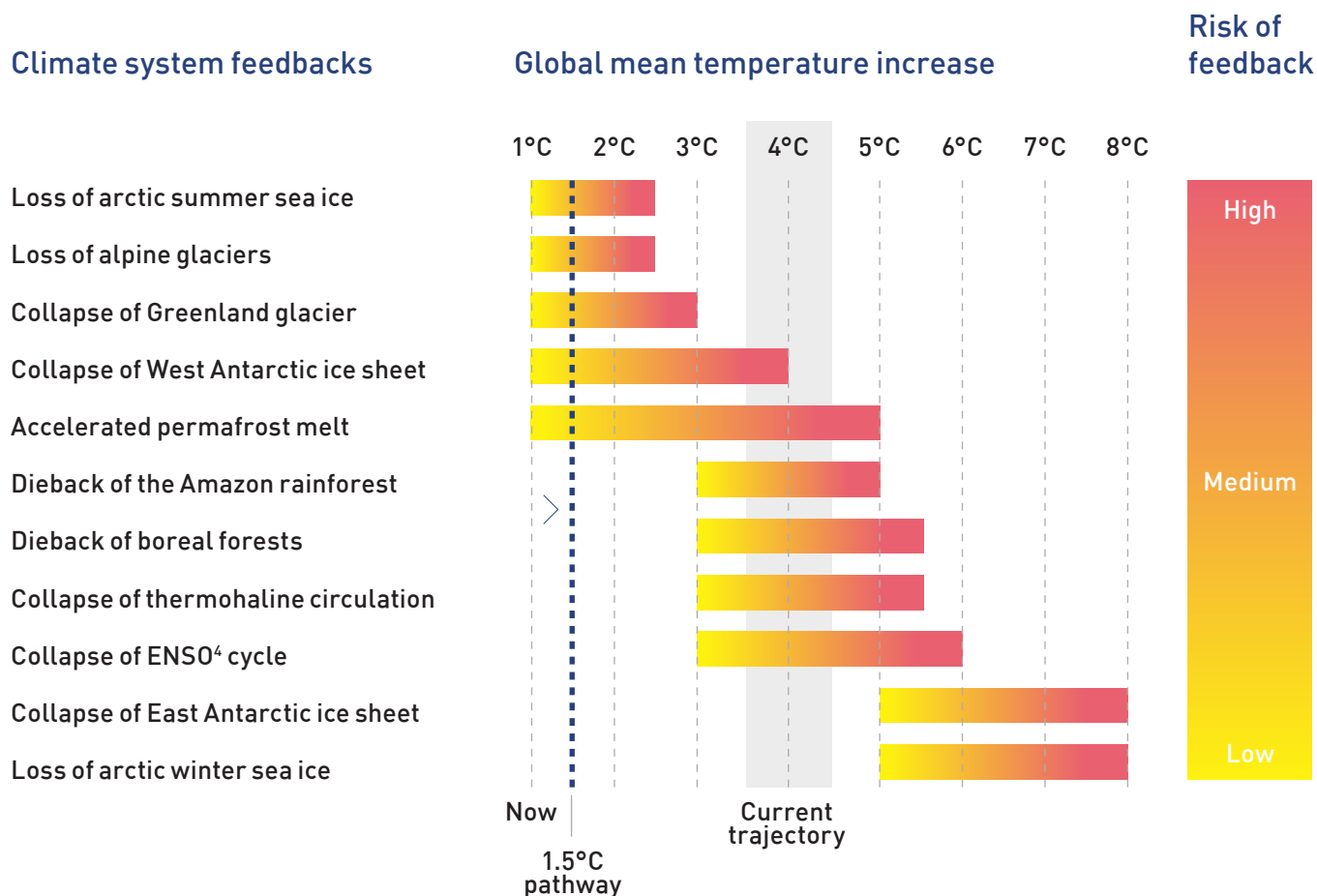
1.1°C on average, at least an order of magnitude more than it rose in the prior 65 million years.<sup>2</sup> Warming is higher in some regions – and as much as three times higher in the Arctic.<sup>3</sup>

Vital earth systems are being transformed now: glaciers are shrinking, permafrost is melting and forests are victims of forest fires, drought or deforestation. In some systems, "climate feedbacks" have

begun, accelerating climate change. Sea ice reflects most sunlight, for example, and sea water absorbs it, so the disappearance of sea ice speeds the warming of the ocean, melting even more ice and preventing new ice from forming. The risk of climate feedbacks rises along with temperatures, including the risk of runaway outcomes that could fundamentally disrupt and destabilize the global environment, as shown in Exhibit 1.

**Exhibit 1:** Climate feedbacks can accelerate temperature increases and the impacts of climate change

## RISK OF CLIMATE FEEDBACKS AS TEMPERATURES RISE



Sources: Steffan et al (2011), Frieler, K (2013), IPCC (2014), Robinson, Cavlov & Ganopolski (2012), Lenton, T. (2012) Levermann et al (2012), Rockstrom et al (2018), Shellhuber et al (2016); IPCC Assessment Report 5, Chapter 2; "Improvements in the GISTEMP uncertainty model" NASA GISTEMP and Lenssen et al.; McKinsey 1.5°C Scenario Analysis

<sup>1</sup> Based on average temperatures from 2015-2019

<sup>2</sup> Peter Siegmund et al., "The Global Climate in 2015-2019," World Meteorological Organization, 2019; Noah S. Diffenbaugh and Christopher B. Field, "Changes in ecologically critical terrestrial climate conditions," Science, August 2013, Volume 341, Number 6145; Seth D. Burgess, Samuel Bowring, and Shu-zhong Shen, "High-precision timeline for Earth's most severe extinction," Proceedings of the National Academy of Sciences, March 2014, Volume 111, Number 9

<sup>3</sup> Myles R. Allen et al., Special report: Global warming of 1.5°C, IPCC, 2018, ipcc.ch

<sup>4</sup> El Niño Southern Oscillation

No country or community is immune from the physical hazards that accompany warming. Extreme weather events such as hurricanes, drought, extreme precipitation and lethal heat waves continue to increase in both intensity and frequency.<sup>2</sup> The impact of climate hazards on human, physical and natural capital is already significant. Hurricane Harvey, for example, which caused about \$125 billion in damage in Louisiana and Texas in 2017, was about 15% more intense and three times more likely due to climate change, according to researchers.<sup>5</sup> More than 50 inches of rain fell in some areas in a few days; 23,000 homes were flooded to a depth of at least five feet, and more than 80 people lost their lives, most to drowning.

If warming continues unchecked, the number and size of regions affected by climate change will grow, along with socioeconomic and humanitarian impacts. By 2050 in a high emissions scenario, for example, hundreds of millions of people could be living in regions with a 14% average annual probability of a heat wave that even some healthy people, if exposed, would not survive. Extreme heat and humidity could reduce worker productivity and effective working hours in India, Pakistan and some other regions such that up to 3.5% of global GDP could be at risk.<sup>6</sup>

Recognizing the gravity of the challenges, governments around the world committed to the Paris Agreement in 2015 to limit warming to

**Progress at the country level has been insufficient and inconsistent, but overall commitments are accelerating: 120 nations across the Americas, Europe, Asia and Africa are committed to working towards net zero emissions by 2050.**

well below 2°C, and to pursue efforts to limit it even further to 1.5 °C. Three years later, the UN's Intergovernmental Panel on Climate Change published a Special Report on Global Warming of 1.5°C. The research shows that limiting warming to 1.5°C would reduce the risks of initiating the most dangerous and irreversible effects of climate change. The associated emissions pathway cuts carbon dioxide (CO<sub>2</sub>) emissions by about half by 2030 from 2010 levels, and reaches net zero by 2050, while reducing other greenhouse gas emissions.<sup>7</sup>

Since then, progress at the country level has been insufficient and inconsistent, but overall commitments are accelerating: 120 nations across the Americas, Europe, Asia and Africa are committed to working towards net zero emissions by 2050, along with more than 400 cities and 750 businesses.<sup>8</sup> The United Kingdom, for example, passed legislation in 2019 for a legally binding net zero by 2050 emissions target.

## THE RISK TO INVESTORS

Climate change presents systemic risks across society and the economy, giving rise to significant financial risk. Leaders in the public and private sectors, including the investment community, must recognize, quantify and manage these risks. Investors must consider both physical and transition climate-related risks:

- **Physical climate risk** manifests as acute or natural catastrophic weather events such as hurricanes, and as persistent, chronic impacts such as droughts. Acute physical risks include the rising frequency and severity of extreme weather events, such as floods, droughts, wildfires and hurricanes. Chronic physical climate effects materialize through the sustained shift of ecosystems from changes in temperature, precipitation and sea level rise.

- **Transition risks** are those induced by societal responses to climate change, such as new policies and regulations, shifts in markets and trends in consumer behaviors. Sudden repricing can affect entire asset classes, for example, and some assets can be stranded. Like physical risks, transition risks rise as governments delay setting policy and regulatory frameworks to align with a low-carbon pathway. Corporations and investors make decisions based largely on forecasts, which depend on current policy outlooks. Given the current high-carbon pathway policy outlook, investments in assets that will not perform well in a low-carbon pathway carry higher transition risk.

While physical climate risk is a material and ongoing consideration for investors, they urgently need to understand transition risk in light of governmental and corporate commitments and ongoing technological disruptions. This report focuses on the implications of a 1.5°C transition and provides tools to help readers evaluate companies' disclosures of scenario analyses for decarbonization pathways, particularly those aligned with a 1.5°C scenario.

**Decarbonization scenario analysis is a crucial tool for understanding transition risk, how emissions reductions will manifest in specific sectors over time, and the related implications for a company's strategy and performance.**

To help investors and other stakeholders manage climate risk, the Task Force on Climate-related Financial Disclosures (TCFD) has provided recommendations for companies and asset owners to conduct scenario analyses to test the resilience of their

<sup>5</sup> Geert Jan van Oldenborgh, et al., "Attribution of extreme rainfall from Hurricane Harvey, August 2017," Environmental Research Letters, December 13, 2017

<sup>6</sup> McKinsey Global Institute, Climate Risk and Response Report, Jan. 16, 2020

<sup>7</sup> "Net zero" refers to a balance of emissions released into and removed from the atmosphere. A net zero pathway requires reducing most emissions and then using natural or chemical carbon sinks to remove the remaining excess carbon from the atmosphere

<sup>8</sup> "Climate Ambition Alliance: Nations Renew their Push to Upscale Action by 2020 and Achieve Net Zero CO<sub>2</sub> Emissions by 2050," COP25 Chile UN Climate Change Conference, Dec 11, 2019, <https://cop25.mma.gob.cl/en/climate-ambition-alliance/>

strategies in the face of multiple climate scenarios. (For details, please see the task force sidebar.) While companies should consider a wide range of scenarios, the TCFD calls for at least one at 2°C or below, the focus of this report. Decarbonization scenario analysis is a crucial tool for understanding transition risk, how emissions reductions will manifest in specific sectors over time, and the related implications for a company's strategy and performance.

The ILN uses a 1.5°C warming scenario for this report to orient to the latest scientific research, the growing

momentum of "net zero by 2050" commitments, and the spirit of the Paris Agreement. The 1.5°C warming scenario, the most ambitious yet still plausible decarbonization pathway, would require stark deviations from business as usual. This makes it useful for stress-testing the resilience of portfolios and business models against transition risk.

While climate scenario analysis is key to understanding resiliency, the ILN recognizes that it is a relatively recent practice for many companies and that conducting and evaluating analyses present challenges for many

organizations. To address some of these challenges, the report provides a sector-level 1.5°C scenario aligned with the Paris Agreement and a structured approach to help investors evaluate corporate scenario analysis disclosures. The aim is to increase the maturity and standardization of the climate data landscape, drive more effective climate-related engagement between companies and investors, and ultimately improve climate resiliency.

## TASK FORCE ON CLIMATE-RELATED FINANCIAL DISCLOSURES

**The Financial Stability Board established the Task Force on Climate-related Financial Disclosures in December 2015 to develop voluntary, consistent recommendations for companies disclosing climate-related financial risks to investors, lenders and insurance underwriters.**

**After considerable stakeholder consultation, the TCFD presented its recommendations in 2017. The Task Force structured its recommendations around four thematic areas at the core of how organizations operate: governance, strategy, risk management, and metrics and targets. A key component of the recommendations is assessing the resilience of an organization's strategy under different climate-related scenarios, including a 2-degrees-or-lower scenario.**

## PARAMETERS OF A 1.5°C SCENARIO

A 1.5°C pathway is among a growing suite of scenarios available to investors. While there are many pathways to 1.5°C, all credible paths share common characteristics. (For details, please see the sidebar: The carbon budget and an orderly transition.) Elements of these pathways include:

- **Reducing all greenhouse gas emissions:** While CO<sub>2</sub> is the most significant greenhouse gas, methane's near-term impact is 85 times higher on a molecule-to-molecule basis. (For details, please see the sidebar: Methane emissions.) Nitrous oxides and

hydrofluorocarbons also need to be addressed.

- **Reaching net zero CO<sub>2</sub> emissions:** Because CO<sub>2</sub> is long-lived in the atmosphere, stabilizing the climate requires net zero or lower emissions to avoid accumulation that worsens climate change. A 1.5°C pathway requires emissions reductions of about half by 2030 from 2010 and reaching net zero by around 2050.
- **Emissions reductions in all sectors and geographies:** Given the pace of change required

and interdependencies across stakeholder actions, no one or two sectors or regions can carry the burden alone.

- **Direct reductions:** Carbon offsets are a helpful near-term bridge to carbon neutrality, and they can play a meaningful role in scaling reforestation and slowing deforestation. (Please see the sidebar: Offsets.) But they are not a substitute for the actual emissions reductions needed across industries.

## THE CARBON BUDGET AND AN ORDERLY TRANSITION

Scientific researchers use the concept of a carbon budget to describe the cumulative CO<sub>2</sub> emissions permitted in a certain timeframe to keep warming within a defined threshold. They estimate carbon budgets based on the likelihood of a temperature outcome at a given level of emissions. In line with the work of the Intergovernmental Panel on Climate Change, this report assumes a remaining global budget of 570 gigatonnes (Gt) of CO<sub>2</sub> to limit warming to 1.5°C.

Three archetypes of pathways would keep emissions within the budget, as shown in Exhibit 2. In an orderly transition, climate risks are immediately recognized and internalized, low-carbon regulation provides certainty for decision-makers, and the financial system efficiently allocates capital towards the transition. Conversely, an abrupt transition is characterized by uncertainty, delay and accumulating physical and transition risks, including the risks of sudden divestments, market volatility and catastrophic loss. Some scenarios model a third pathway archetype, “overshoot and recoup,” where CO<sub>2</sub> emissions exceed the carbon budget but negative emissions technologies in future years remove CO<sub>2</sub> from the atmosphere and return to the defined carbon budget. This pathway includes many uncertainties, since overshooting temperature limits could trigger climate feedbacks, and negative emissions technology may not advance quickly enough to decrease temperatures.

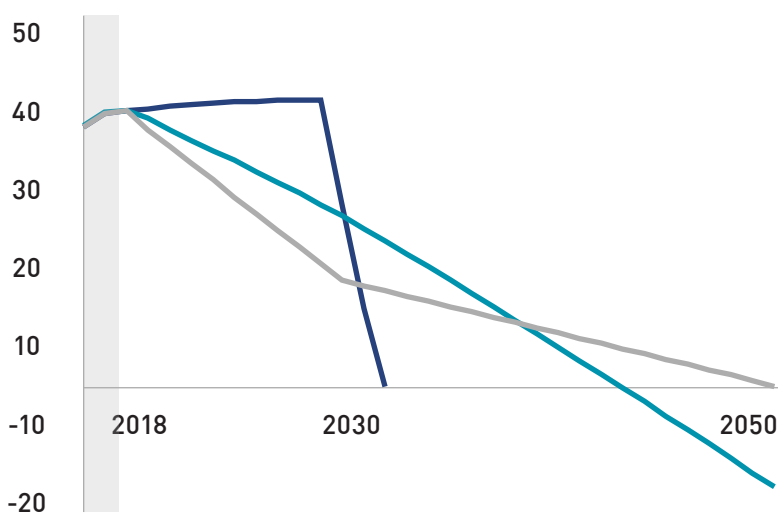
Because the latter two pathway archetypes are hazardous or unlikely, an orderly transition is the most desirable option. The window for an orderly transition is closing, however. Making that transition would require significant changes every year for the foreseeable future.

**Exhibit 2:** An orderly transition is the most viable pathway to limit temperature increases to 1.5°C.

### An “orderly transition” is the most viable pathway to a 1.5°C world

Illustrative emission pathways with a 1.5°C carbon budget,<sup>9</sup> Gigatonnes (Gt) of CO<sub>2</sub> emissions per year

— Abrupt transition — Overshoot then recoup — Orderly transition



### The 570-gigatonne CO<sub>2</sub> carbon budget

The area under the curve of each pathway remains within the same carbon budget:

- An orderly transition, the most viable pathway, would require steep emission reductions in the next 10 years, but would allow for a more stable transition.
- An abrupt transition, delaying CO<sub>2</sub> mitigation, would overshoot the 570 gigatonne budget, and a last-minute transition would create global instability.
- Overshooting and then recouping could trigger irreversible climate feedbacks; many negative-emission technologies remain largely unproven at the necessary scale.

<sup>9</sup> Staying within a cumulative budget of 570 gigatonnes of CO<sub>2</sub> emissions from 2018 onwards would yield a 66% chance of limiting global warming to 1.5°C (measured using a blend of near-surface air temperatures over both the ocean and land)

Source: McKinsey 1.5°C Scenario Analysis, IPCC SR1.5 (2018)



# 10 KEY LEVERS FOR ECONOMY-WIDE DECARBONIZATION

1 

Reduce demand with efficiency gains, process optimization, the circular economy and shifts in consumption patterns

2 

Electrify transport, buildings and industrial processes

3 

Rapidly deploy renewables at scale

4 

Expand the role of hydrogen in the energy mix

5 

Increase the use of bioenergy

6 

Scale carbon capture, utilization, and storage

7 

Curb deforestation

8 

Remove carbon dioxide from the atmosphere

9 

Reform agriculture and food systems

10 

Eliminate fugitive methane emissions

Source: McKinsey 1.5°C Scenario Analysis

While all industries need to decarbonize rapidly to stay on a 1.5°C pathway, how each industry reduces emissions may vary widely. To help investors better understand the options available to key emitting industries, this report details credible 1.5°C pathways and the concept of emissions reduction levers to enable decarbonization pathways. We discuss ten sector pathways and our assumptions for natural capital, including deforestation and reforestation, that would be needed alongside industry action for a 1.5°C pathway. Globally, these sources constitute over 80% of carbon dioxide, 80% of methane and 90% of nitrous oxide emissions.

A 1.5°C scenario would have significant impacts on demand and industry operations. Consumers would seek fewer products and services from high-emitting industries, from air travel to cement, and demand more from industries that rely on low-carbon fuel sources, such as renewable electric power. Many companies would need to transform their operations to decarbonize in line with a 1.5°C scenario, for example with energy efficiency improvements, process optimization, fuel switching and carbon management.

To help investors understand what the transition to a 1.5°C scenario would require, we present ten key levers available to industry and the

decarbonization trajectories of ten sectors of the economy. (For a deeper look into how the 1.5°C scenario and its outcomes would play out across each of these sectors, please see the 1.5°C Scenario Infographics Appendix.)

Four notes:

- **Alternative scenarios are possible but require trade-offs.** For any emissions reduction lever that falls short, another would need to accelerate. Such trade-offs may play out within an industry. For instance, an airline may be slower in adopting sustainable aviation fuel but make faster progress in improving efficiency. Trade-offs may also play out across industries. If the transportation sector decarbonizes more slowly than required, for example, deforestation might need to decline more quickly.
- **The analysis is based on an orderly transition to a 1.5°C pathway.** Each year of delay in reducing emissions would require increasingly abrupt reductions to reach the 1.5°C pathway, likely with severe economic dislocations and geopolitical consequences. The analysis does not consider an abrupt 1.5°C transition pathway, which would pose greater risk to the financial system and socio-economic stability.
- **1.5°C transition pathways will change.** Credible transition pathways will change, since the choices the world makes in the years ahead will use up the carbon budget. If emissions in the next few years do not fall in line with this pathway, steeper reductions would be required later. As noted, the window for a 1.5°C pathway will eventually close. Meanwhile, technological progress and industry scale-up will change the solution space. For instance, this scenario assumes that battery and electrolyzer industries scale rapidly to 2030. Should that scale-up be slower than expected, the solutions available to industries may look different in five to ten years.
- **This pathway is not a forecast.** The 1.5°C scenario, by definition a stark departure from society's current path, serves as a useful tool to stress-test portfolios and strategies.

## METHANE EMISSIONS

**Methane is the second-most abundant greenhouse gas, contributing 17% of human-caused warming alongside CO<sub>2</sub>, which contributes 66%. Carbon dioxide emissions are much larger and last much longer in the atmosphere, but methane emissions are far more potent, with a warming potential roughly 84 times larger over 20 years. Continued increases in methane emissions would therefore offset progress in reducing CO<sub>2</sub> emissions, while steep reductions would help limit climate risk. This is particularly relevant over the next ten years, when the pace of change required for a 1.5°C pathway is greatest.**

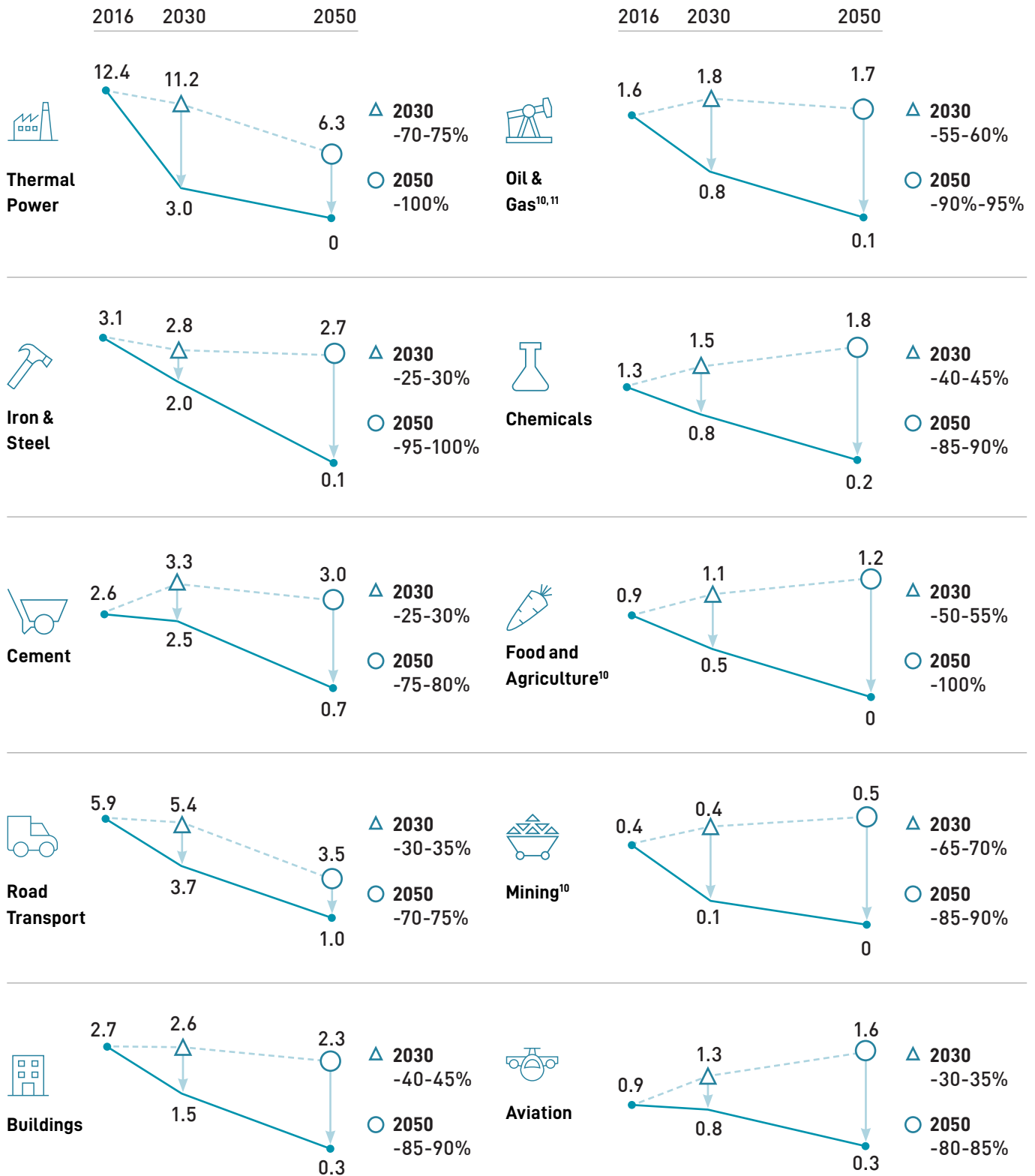
**Most anthropogenic methane emissions come from four sectors: beef and agriculture (40%), oil & gas (25%), coal mining (15%) and waste (20%). Many technologies can help mitigate methane emissions in these sectors, but steep emissions reductions would require a permanent shift away from activities that produce methane, such as beef production.**



# SECTOR EMISSIONS PATHWAYS FOR A 1.5°C SCENARIO

Gt CO<sub>2</sub>

----- Global Energy Perspective Reference Case 2019 — 1.5°C Scenario



<sup>10</sup> In addition to CO<sub>2</sub> emissions, oil & gas, food & agriculture, and mining sectors are responsible for a significant amount of other greenhouse gases, including methane and nitrous oxide. For more information, see the 1.5°C Sector Infographics in Appendix.

<sup>11</sup> Includes the emissions related to the production of oil & gas products; does not include the emissions associated with end use combustion

Source: Global Energy Perspective – Reference Case 2019; McKinsey 1.5°C Scenario Analysis

## IMPACT OF DEFORESTATION ACROSS SUPPLY CHAINS

Deforestation accounts for close to 15% of global emissions today, claiming land area nearly the size of Greece every year, even accounting for reforestation. In addition to emissions reductions in each sector, achieving a 1.5°C scenario would require drastically reducing emissions from land use change. If all sectors pursue the rapid decarbonization outlined in this report, deforestation would still need to fall 75% by 2030, and be virtually eliminated by 2050. If any sector lags in reducing emissions from fossil-fuel sources, this trajectory would have to be even steeper.

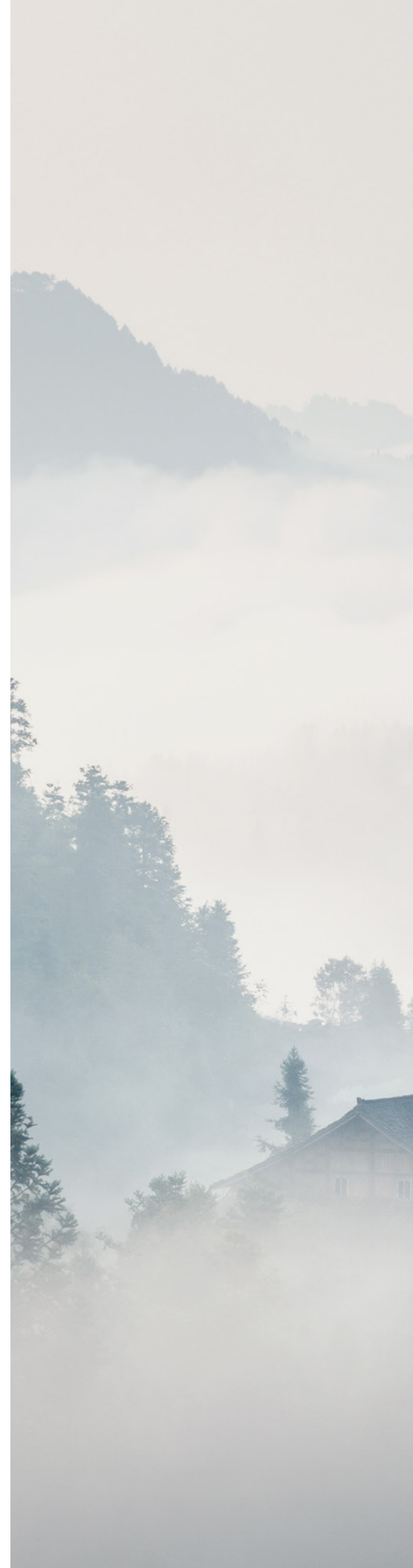
Research suggests that commodity-driven deforestation for products such as palm oil, beef, cocoa and minerals represent more than a quarter of recent tree cover loss. A 1.5°C pathway would therefore require companies to commit to tracing and eliminating deforestation throughout their supply chains.

## GROWING ROLE OF CARBON OFFSETS

Voluntary offsets are increasingly important to corporate sustainability – near-term bridges to carbon neutrality while companies pursue full decarbonization in the long term. Offsets also help preserve the social license to operate and can improve brand reputation as concerns about climate change rise. In the voluntary offset market, where companies and consumers purchase carbon credits, transactions have grown rapidly over the past decade, doubling in value from 2017 to 2018 alone.

Categories of offsets include land use and forestry, resource recovery such as methane capture, renewable energy, and household devices, such as cleaner appliances. Land use and forestry is the leader today, with over 50% of new offset credit issuances in 2019, driven by the growing recognition of the potential of nature-based climate solutions. Negative emissions solutions, such as reforestation, are seen as the most credible means of offsetting, as they literally capture and store CO<sub>2</sub> from the atmosphere.

In the 1.5°C scenario used in this report, reforestation is a critical tool in reducing emissions, together with avoided deforestation. This scenario would require reforesting an area roughly the size of Turkey by 2030, a significant undertaking that can be supported by corporate offsetting.





# A PRACTICAL GUIDE TO ASSESSING 1.5°C SCENARIO ANALYSES

**Scenarios aligned with the Paris Agreement require changes at unprecedented speed across business, policy and consumer demand to achieve economy-wide deep decarbonization.**

Investors can use scenario analysis to assess how an organization may manage risks and opportunities in a range of future environments, and they can use decarbonization scenario analysis to understand the resiliency of a company's strategy and its likely performance in a low-carbon transition.

Scenarios aligned with the Paris Agreement require changes at unprecedented speed across business, policy and consumer demand to achieve economy-wide deep decarbonization. This toolkit references the 1.5°C scenario provided above as the deep decarbonization scenario, but some investors may choose to use a 2°C scenario, where the same questions would apply but with different parameters.

We see three core elements in informative, mature Paris-aligned scenario analysis by corporations and issuers:

1. Scenario transparency and credibility
2. Translation to sector impact
3. Financial and strategic implications

To help investors review these disclosures and engage with issuers across each of these elements, we suggest questions investors might ask:

## Scenario transparency and credibility

**Has the company clearly explained how it formed the scenario?** Some companies use existing external reference scenarios; others build their own. To help investors understand underlying premises and assumptions, the disclosure should identify a credible source for the scenario or the underlying data used to create it. (Few detailed external 1.5°C scenarios are available, so this report includes a reference 1.5°C scenario and parameters.)

**Does the scenario align to key 1.5°C parameters?** While there are many pathways to limit temperature increases to 1.5°C, all credible paths share important characteristics, as noted. Disclosures should describe how the scenario reflects these constraints.

## Translation to sector impact

**Is the scenario consistent with the emissions pathway of the company's sector?** Does the analysis acknowledge and reflect the emissions reductions over the coming decades in its sector in a 1.5°C scenario? If emissions reductions are not aligned to the range expected in a 1.5°C scenario, how does the disclosure describe the trade-offs required in other sectors? Are these conclusions credible?

**Does the analysis accurately reflect various potential market impacts to the company in a 1.5°C scenario, such as changes in demand for some products and services?** In some sectors, a 1.5°C scenario would reflect major demand shifts away from core businesses, while demand would rise in others. Disclosures should be transparent about these market dynamics.

## AUTO MANUFACTURING EXAMPLE

**In a 1.5°C scenario, passenger cars with internal combustion engines would fall to under half of new sales by 2030 and close to zero by 2050, while electric powertrains rise to meet much of that demand. Growth in overall passenger kilometers travelled would slow with the adoption of new shared modes of transport. How would this affect a car manufacturer's unit sales projections and investment decisions?**

**Does the analysis clarify the operational changes required in a 1.5°C scenario?** Effective scenario analysis requires understanding the implications of emissions trajectories on how a sector and its constituents do business. Most companies would likely have to switch to lower-carbon fuels and power sources, for example, and deploy new smart technologies to boost efficiency and carbon management. Many will need to work closely with suppliers and customers to find further efficiencies and make the changes required in their sector. To assess a firm's 1.5°C scenario analysis, an investor should understand how closely these sector implications align to an acceptable range in a 1.5°C scenario.

## Financial and strategic implications

**Does the analysis link the scenario to financial impacts for the company?** Ideally, the scenario analysis should consider the financial implications of climate and sector impacts. The TCFD recommends disclosing the scenario's effect on corporate revenue, expenditures, assets, liabilities and cost of capital. A fully developed analysis should describe quantitative, timebound metrics that cover all material impacts to these areas.

**How clearly has the company explained the implications for strategy under a 1.5°C pathway?** This question demonstrates the core purpose of scenario analysis: understanding how the company's strategy will fare under the 1.5°C scenario, which parts of the business may be at risk, and where the company might find opportunities. In many sectors, as noted, deep decarbonization will shift product mixes, portfolios and supply chain composition, and increase risk of stranded assets. It may also create significant opportunities for low-carbon investments and companies that can adopt new business models.

**Does the disclosure explain how the company may adapt its strategy if the world follows a 1.5°C pathway?** What changes should the company be prepared to make if the world shifts towards a 1.5°C scenario? What signposts related to policy, consumer trends and technology development will help the company track which pathway or scenario the world is likely to follow?

### AIRLINE EXAMPLE

**Airlines will need to ask questions like these:**

- Which short-haul routes could switch to hydrogen or battery-powered aircraft, and how quickly can we make those changes?
- How will fleet upgrades and retirements improve efficiency?
- How can the integration of sustainable aviation fuels be accelerated?
- What efficiency improvements can we make in airport operations?
- What collaborative measures should we take across airlines and air traffic management?
- How will we work with airports, fuel suppliers, technology innovators, aircraft manufacturers and customers to achieve decarbonization?

### OIL AND GAS EXAMPLE

**Energy companies will need to ask questions like these:**

- How could changes in demand and emissions regulations affect oil and gas prices in a 1.5°C scenario? How could that impact revenue?
- How could carbon prices change in regions where we operate, and how would those prices impact operating costs, feasibility and revenues?
- What capital investments should we make in low-carbon technology?
- How would shifts in demand, regulations and energy prices impact the cost of capital, either through share prices or the cost of financing?
- How would the three factors affect free cash flow and the useful life of assets, and therefore capital deployment planning for exploration, production and other projects?

### MINING EXAMPLE

**Mining companies will need to ask questions like these:**

- Which product end-markets will grow? Which will shrink? How will those changes impact our portfolio?
- Which assets might have shorter lives because of stranded asset risk or other factors?
- How could shifting regulation or consumer pressure affect our license to operate?
- How could higher carbon prices affect our cost structure or end markets?
- How could our access to capital and funding change?





# INVESTOR GUIDE

## 1.5°C SCENARIO ANALYSIS RUBRIC

	Questions	Mature	Partially developed
Scenario transparency and credibility	1. Has the company clearly explained how it formed the scenario?	<p>The scenario is clear and transparent with:</p> <ul style="list-style-type: none"> <li>• Scenario source (e.g, internally or externally created, credible input data source)</li> <li>• Scenario narrative and objective</li> <li>• Scenario data and assumptions, such as: <ul style="list-style-type: none"> <li>— Projected temperature level</li> <li>— GHG emissions level</li> <li>— Energy consumption levels</li> <li>— Sector activity levels</li> <li>— Regulatory requirements</li> </ul> </li> </ul>	<p>The scenario includes a partial description of its source and objective</p> <p>The data and assumptions required to assess the scenario are not all disclosed or aligned to a 1.5°C pathway</p>
	2. Does the scenario align to key 1.5°C parameters?	<p>The scenario aligns to 1.5°C parameters</p> <ul style="list-style-type: none"> <li>• A 50-55% decline by 2030 and net zero CO<sub>2</sub> emissions by 2050</li> <li>• Carbon budget of 570 Gt from 2018-50</li> <li>• Methane and nitrous oxide steeply mitigated</li> </ul>	<p>The scenario aligns to some 1.5°C parameters</p>
Translation to sector impact	3. Is the scenario consistent with the emissions pathway of the company's sector?	<p>The analysis connects the economy-wide scenario to the emissions pathway in the company's sector in 2030 and 2050</p> <p>The sector emissions trajectory is in line with the ranges identified in this report (See: 1.5°C Sector Infographics) or, if using an alternative scenario, compensating emission reductions are clear and realistic</p>	<p>The analysis connects the economy-wide scenario to its sector, but it is not a reasonable sector allocation and doesn't provide clear tradeoffs for compensation</p>
	4. Does the analysis accurately reflect how the company's market would change in a 1.5°C scenario?	<p>The disclosure is transparent on potential changes to demand for the company's products or services in a 1.5°C scenario</p> <p>The projected changes are in line with "market dynamics" outlined (See: 1.5°C Sector Infographics )</p>	<p>The disclosure discusses the changes in demand under a 1.5°C scenario but is not in line with projections</p>
	5. Does the analysis clarify the operational changes required for companies in their sector in a 1.5°C scenario?	<p>The disclosure identifies the key operational implications for the sector in line with those shared (See: 1.5°C Sector Infographics ), such as:</p> <ul style="list-style-type: none"> <li>• Changes to fuel and power sources</li> <li>• Energy efficiency and process optimization</li> <li>• Deployment of carbon capture technology</li> <li>• Recycling and waste reduction</li> </ul>	<p>The disclosure outlines some of the operational implications but does not account for some major changes</p>





	Questions	Mature	Partially developed
Financial and strategic implications	6. Does the analysis link the scenario to financial impacts for the company?	<p>The disclosure assesses key financial implications, such as value at risk, with quantitative and timebound metrics or sensitivity:</p> <ul style="list-style-type: none"> <li>• Revenue</li> <li>• Expenditures</li> <li>• Assets &amp; liabilities</li> <li>• Cost of capital</li> </ul> <p>The metrics cover all material impacts to the business</p>	<p>The disclosure provides a high-level qualitative synthesis of key financial implications. Disclosed information is not specific, quantified or timebound</p>
	7. Are strategic implications clear for a 1.5°C scenario?	<p>The disclosure includes a comprehensive review of risks and opportunities that will impact strategy under a 1.5°C scenario:</p> <ul style="list-style-type: none"> <li>• Business model: Risks to some business models and opportunities for new business models and geographic applications</li> <li>• Portfolio: Stranded asset risks, including infrastructure, property and IP, and opportunities to allocate capital to new projects</li> <li>• Regulatory: Risks to existing policy and regulatory frameworks that enable the operating model, versus increased market certainty from new regulations</li> <li>• Supply chain: Dislocations from changes in regional environments and access to input materials, versus opportunities for efficiency and resiliency</li> <li>• Brand and reputation: Social license to operate and reputational risk of inaction, versus opportunity to build brand value in line with climate action</li> </ul>	<p>The disclosure considers some strategic risks and opportunities, but the implications are incomplete or misaligned to a 1.5°C pathway</p>
	8. Does the company explain how it may adapt strategy if the world follows a 1.5°C pathway?	<p>The company identifies signposts it will use to track which pathway the world and its sector are following, including:</p> <ul style="list-style-type: none"> <li>• Emissions trajectories</li> <li>• Policy and regulatory constructs</li> <li>• Consumer trends</li> <li>• Technology development</li> </ul> <p>The disclosure describes governance and processes in place to evaluate changes in trajectory and incorporate them into strategy</p>	<p>The analysis connects the economy-wide scenario to its sector, but it is not a reasonable sector allocation and doesn't provide clear tradeoffs for compensation</p>



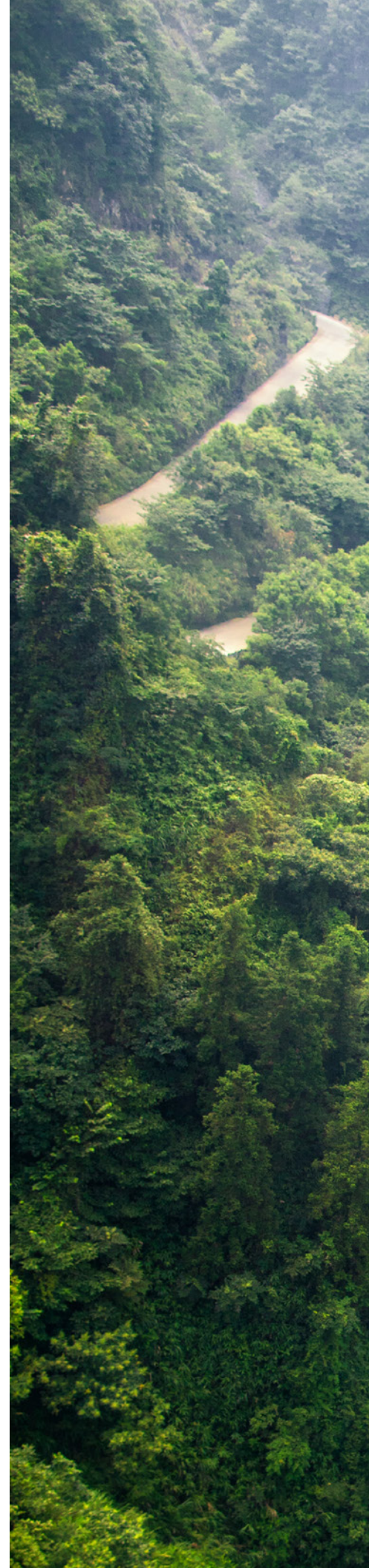
# THE PATH FOR INVESTORS

While the investment community has made tremendous progress in recognizing climate risk, it is still in the early stages of the journey. To lead the industry, investors need to continue to:

- **Advocate for more transparency, standardization and comparability in reporting:** Investors can help establish clear standards and metrics for climate-related disclosures to make information more usable and comparable. They can serve as role models by continuing to improve their own disclosures and by providing clear, unified perspectives on the metrics they require. Ushering in a new era in climate disclosures will require collaboration across a global ecosystem of stakeholders that includes investors, companies, regulators, assurance and research entities.
- **Enhance institutional understanding of climate risk:** Framing climate risk from a common perspective will improve our understanding and communication at every organizational level and help decision-makers develop better plans and strategies. Investors who use qualitative and quantitative methods of scenario analysis will be able to stress-test portfolios for physical and transition climate risks across sectors, geographies and assets. Investors need the capabilities to quantify (and ultimately price) climate risk in as much detail as other fundamental financial risk drivers, and the tools they use should be systematically embedded into core portfolio and enterprise risk processes. The business community will make advances in this area as it learns more about the physical impacts of climate change and as transition scenarios crystalize.
- **Incorporate climate mitigation and adaptation into capital allocation:** Adapting to locked-in climate risk and transitioning to a low-carbon economy will require major capital expenditures. Investors have a critical role in exploring and pursuing promising opportunities to invest in low-carbon technologies, and consider innovative strategies that may help companies, industries and nations adapt to and mitigate climate risk.
- **Support regulation that enables an orderly transition to the low-carbon economy:** An orderly transition will reduce transition and physical risks for investments. Uncertainty will grow until regulations provide transparent and concrete guardrails for a low-carbon economic trajectory, such as national and local GHG reduction targets, CO<sub>2</sub> pricing and sector-level efficiency standards. Regulatory frameworks in line with a low-carbon transition will therefore make sharp corrections less likely, lowering financial risk.
- **Engage with portfolio companies on climate change mitigation:** Investors can educate and influence portfolio companies on climate strategies and practices, including climate governance, scenario analysis, transition plans and emissions reduction targets. Investors can help forge decarbonization alliances across the value chain, identify high-ROI investments in adaptation and mitigation, and help companies prepare to face climate risk.

The world must take bold, well-planned action now. Without steep and rapid reductions in carbon emissions, climate risks will rise over the next decade, leading to catastrophic and irreversible changes. That said, decarbonization efforts that are too abrupt would inflict significant socioeconomic harm. Moving too slowly or too quickly would cause people and economies to suffer, and the poorest people and countries would be most vulnerable.

This is a moment for investors to step up and help lead industry and society towards a better understanding of climate risk and the actions required to manage it.









# APPENDIX

## 1.5°C SCENARIO SECTOR INFOGRAPHICS

### METHODOLOGY

The scenario described in this report is based on McKinsey & Company's [research](#) into the pathway to limiting global warming to 1.5°C. The scenario is built on a bottom-up, sector-by-sector assessment of greenhouse gas emissions and abatement potential. The analysis began with the status quo of each emissions source and the constraints of emission reduction forecasts by the IPCC (See main report, Sidebar: The carbon budget and an orderly transition). The researchers then applied ten levers across the economy in light of technology readiness, implementation constraints and regional variations. Most of

the technologies considered in this analysis are commercially available; only a handful still require material R&D.

This scenario is contrasted with business as usual, represented by McKinsey & Company's [Global Energy Perspective 2019 Reference Case](#). Based on granular regional and sectoral modeling, this perspective illustrates an outlook on energy and related emissions that follows the world's current trajectory towards at least 3-4°C of warming by the end of the century.





## DEFINITIONS

**Emissions pathway:** The trajectory of emissions of CO<sub>2</sub> and other gases such as methane and nitrous oxide, where relevant, in a 1.5°C scenario, compared to the Global Energy Perspective Reference Case.

**Decarbonization levers:** How the ten decarbonization levers are used in each sector to achieve emissions reduction. Some levers are sector dynamics that change the markets where companies operate; others are operational levers that companies would deploy.

**Key 1.5°C scenario sector indicators:** These metrics illustrate the scale of change in each industry under a 1.5°C scenario.



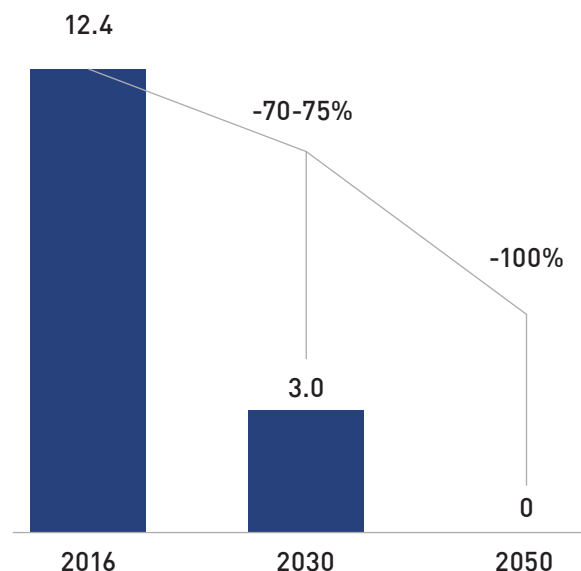


## EMISSIONS PATHWAY

### Thermal power<sup>1</sup> emissions, Gt CO<sub>2</sub> per year

— Global Energy Perspective Reference Case 2019

■ 1.5°C Scenario



## DECARBONIZATION LEVERS

### Sector dynamics

**Demand increase:** By providing zero-carbon electricity, the power sector could play an outsized role in helping other sectors reduce emissions. Electrification in other sectors would significantly increase demand for decarbonized power generation.

### Operational levers

**Deploy renewables:** Replace thermal generation with renewable power sources.

**Hydrogen:** Use green hydrogen for buffering and seasonal balancing of the power system.

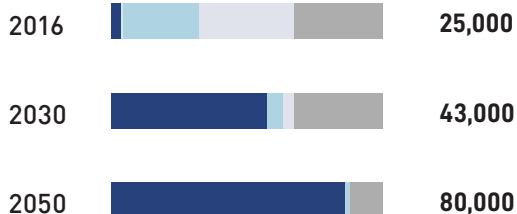
**Carbon capture, utilization, and storage:** Capture emissions from remaining natural gas generation, providing grid flexibility.

## 1.5°C SCENARIO SECTOR INDICATORS

■ Solar+Wind power generation ■ Coal ■ Natural gas ■ Other<sup>2</sup>

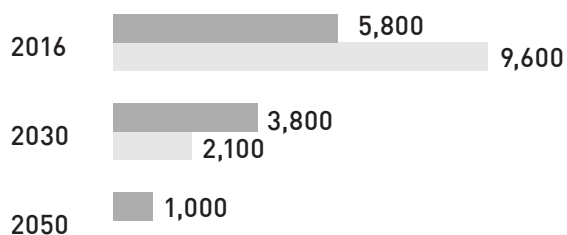
### Share of power generation

Total,  
Terawatt hours



■ Gas ■ Coal

### Total thermal generation, Terawatt hours



By 2050, renewables meet about 80% of power needs, replacing all coal, while some natural gas generation is retained for flexibility and retrofitted with carbon-capture technology.

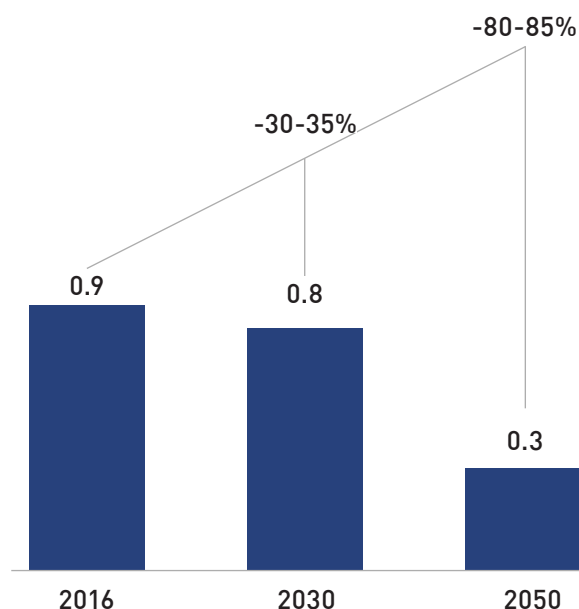
<sup>1</sup> Includes emissions from coal, gas, and oil. <sup>2</sup> Includes hydro, bioenergy with carbon capture and sequestration, biomass, oil, geothermal, marine, and nuclear  
Source: McKinsey 1.5°C Scenario Analysis



## EMISSIONS PATHWAY

### Aviation emissions, Gt CO<sub>2</sub> per year

— Global Energy Perspective Reference Case 2019  
■ 1.5°C Scenario



## DECARBONIZATION LEVERS

### Sector dynamics

**Demand reduction:** Demand growth slows due to shifts from short-haul flights to high-speed rail, use of communication technologies, and changes in consumer preferences and behavior following COVID-19.

### Operational levers

**Efficiency:** Reduce energy consumption by replacing older aircraft, using winglets and more lightweight components, optimizing air traffic control, etc.

**Electrification:** Use electricity and hybrid systems for short-haul flights.

**Hydrogen:** Switch to synthetic fuels made from hydrogen and captured carbon.

**Bioenergy:** Switch to sustainable fuels made from a variety of sources, including crops, used cooking oil, and solid waste.

## 1.5°C SCENARIO SECTOR INDICATORS

■ Sustainable aviation fuels<sup>1</sup> ■ Electricity ■ Fossil kerosene

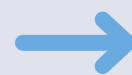
### Share of fuel mix in aviation



By 2050, aviation relies on fossil fuels for only about 25% of the energy it uses, replacing it mostly with biofuels and hydrogen-based synfuels

### Annual growth in revenue passenger kilometers to 2050

2.9%  
Reference Case



2.4%  
1.5°C Scenario

<sup>1</sup> Includes hydrogen-based synthetic fuels and biofuels  
Source: McKinsey 1.5°C Scenario Analysis





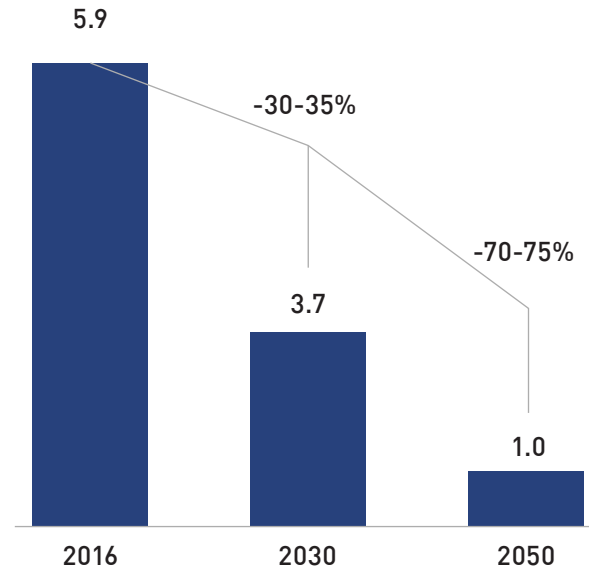
# ROAD TRANSPORT

## EMISSIONS PATHWAY

### Road transport emissions, Gt CO<sub>2</sub> per year

— Global Energy Perspective Reference Case 2019

■ 1.5°C Scenario



## DECARBONIZATION LEVERS

### Sector dynamics

**Demand reduction:** Global kilometers traveled by passenger cars would decline with stricter regulations, emissions standards, and shifts to public transport and alternative mobility such as shared bicycles and pooled vehicles.

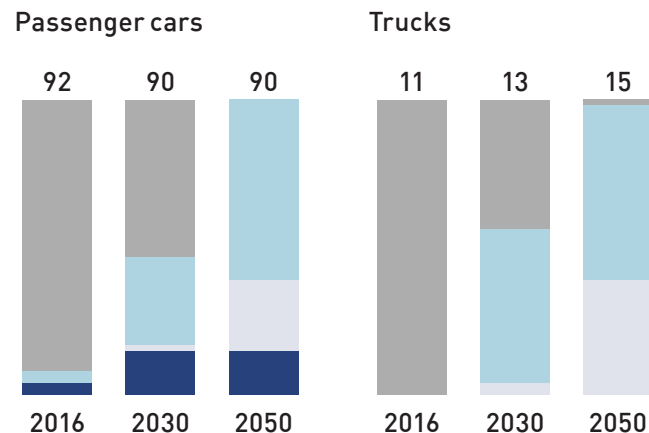
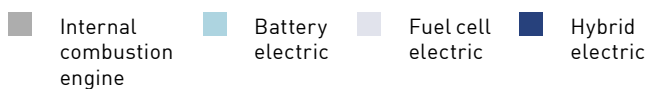
### Operational levers

**Efficiency:** Improve design of engines, tires, etc. to reduce demand for fuel per kilometer driven.

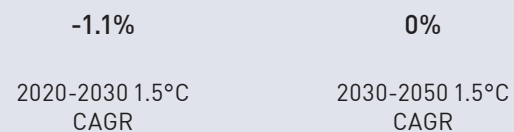
**Electrification:** Switch from internal combustion to electric and hydrogen-powered fuel cell vehicles.

## 1.5°C SCENARIO SECTOR INDICATORS

### New vehicle sales per powertrain, millions of vehicles



### Annual decline in passenger vehicle kilometers



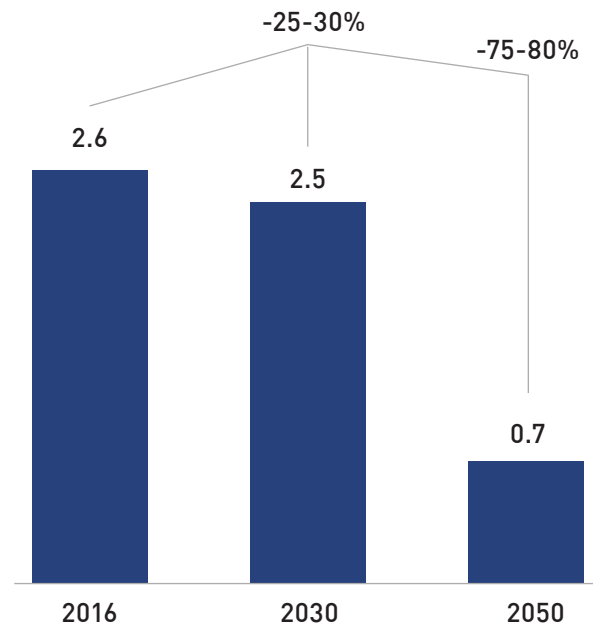
**10%**      Estimated decline in passenger car kilometers by 2030 compared to 2016 levels



## EMISSIONS PATHWAY

Cement emissions, Gt CO<sub>2</sub> per year

— Global Energy Perspective Reference Case 2019  
■ 1.5°C Scenario



## DECARBONIZATION LEVERS

### Sector dynamics

**Demand reduction:** Cement demand would decline as it is replaced with alternative building materials such as cross-laminated timber, and as builders adopt different methods, such as prefab homes.

### Operational levers

**Efficiency:** Improve kilns and use advanced analytics to optimize plant utilization and fuel use. Produce carbon-free electricity with recovered heat waste.

**Bioenergy:** Use more biomass and waste products to heat kilns.

**Carbon capture, utilization, and storage:** Retrofit existing kilns and equip new ones with CCUS, and develop carbon curing technology.

**Feedstock:** Substitute clinker feed with cementitious materials (e.g., natural and calcined pozzolans) and industrial byproducts (e.g., fly ash and blast furnace slag)

## 1.5°C SCENARIO SECTOR INDICATORS

■ 2030 ■ 2050

### Alternatives and efficiency, share vs. reference case

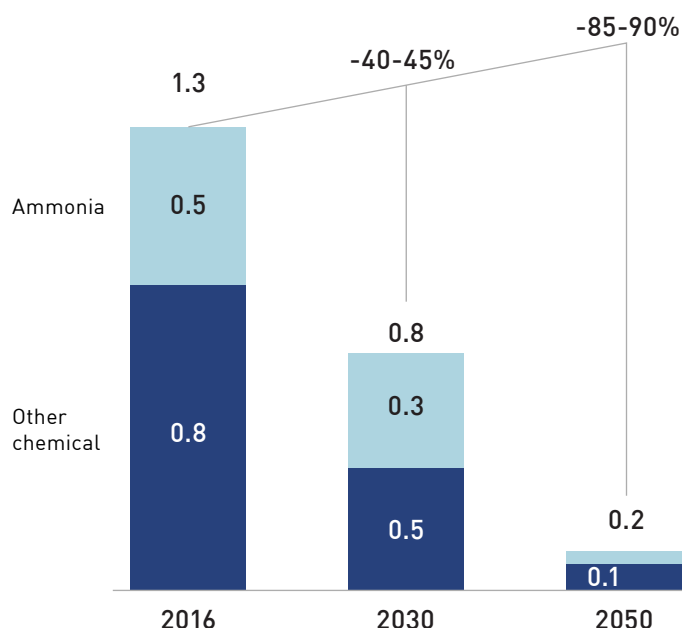




## EMISSIONS PATHWAY

### Chemical emissions, Gt CO<sub>2</sub> per year

— Global Energy Perspective Reference Case 2019



## DECARBONIZATION LEVERS, AMMONIA

### Sector dynamics

**Demand reduction:** Demand for ammonia would fall as farmers reduce over-application of conventional fertilizers, improve fertilization rates and timing, use nitrogen-fixing rotations and more organic fertilizers.

### Operational levers

**Efficiency:** Optimize energy efficiency of chemical production processes.

**Hydrogen:** Scale electrolysis-derived "green" hydrogen production for use as feedstock.

**Bioenergy:** Replace natural gas

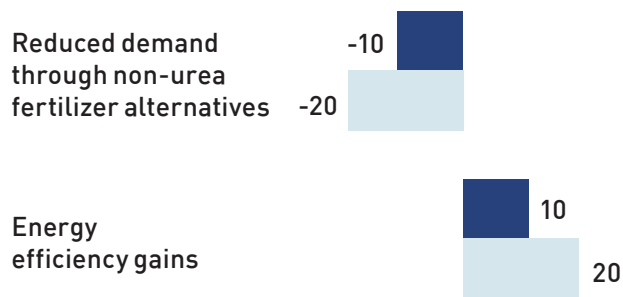
feedstocks with biogas in existing ammonia production sites.

**Carbon capture, utilization, and storage:** Install CCUS in remaining conventional ammonia plants for process and combustion emissions, shifting to "blue" hydrogen production.

## 1.5°C SCENARIO SECTOR INDICATORS, AMMONIA

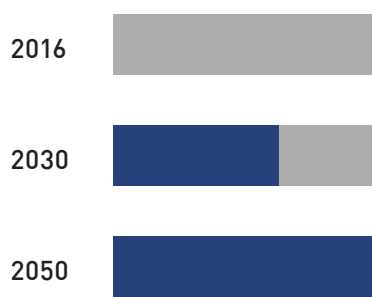
■ 2030 ■ 2050

### Alternatives and efficiency, % vs. reference case



■ Electrolysis and fossil fuel + CCS ■ Fossil fuel

### Hydrogen feedstock production



Source: McKinsey 1.5°C Scenario Analysis

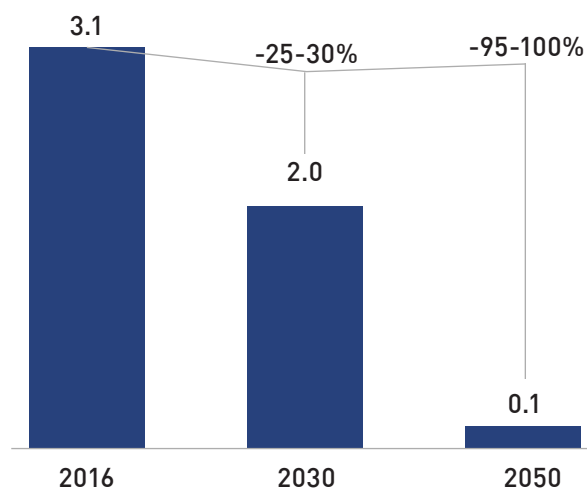




## EMISSIONS PATHWAY

### Iron & steel emissions, Gt CO<sub>2</sub> per year

— Global Energy Perspective Reference Case 2019  
■ 1.5°C Scenario



## DECARBONIZATION LEVERS

### Sector dynamics

**Demand reduction:** Switch to alternative materials and lightweight end-market products, such as cars that use less steel or stronger alloys.

### Operational levers

**Efficiency:** Reduce production losses and increase lifetime of steel products. Increase recycling and shift from ore-based to scrap-based steel. Deploy technologies to recover heat and reuse top gases for heat or power.

**Hydrogen:** Use green hydrogen as reduction agent.

**Bioenergy:** Use biomass as an alternative reduction agent, replace natural gas with biogas.

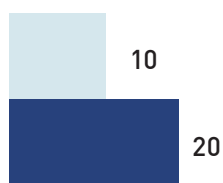
**Carbon capture, utilization, and storage:** Retrofit existing furnaces and equip new ones with CCUS.

## 1.5°C SCENARIO SECTOR INDICATORS

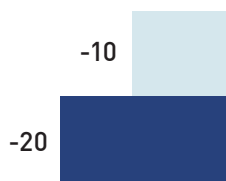
■ 2030 ■ 2050

### Alternatives and efficiency, % vs. reference case

#### Increased steel recycling<sup>1</sup>



#### Reduced demand through increased material lifetime and alternatives materials

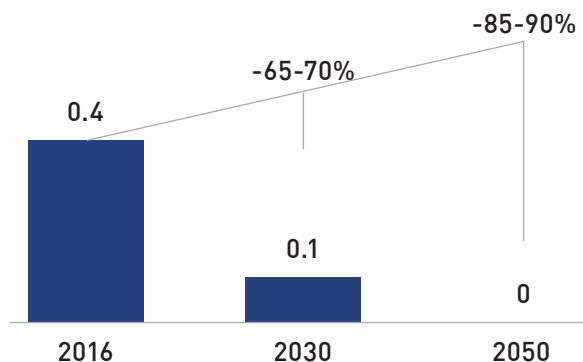


<sup>1</sup> Increase above current recycling rate of approx. one third, based on switching from ore-based to scrap-based steel  
Source: McKinsey 1.5°C Scenario Analysis

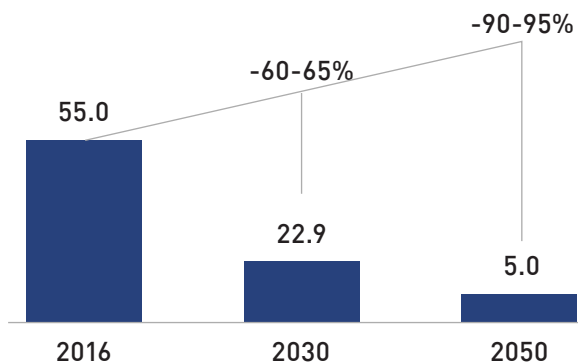
## EMISSIONS PATHWAY

— Global Energy Perspective Reference Case 2019 ■ 1.5°C Scenario

Mining CO<sub>2</sub> emissions, Gt CO<sub>2</sub> per year



Methane emissions, Mt CH<sub>4</sub> per year



## DECARBONIZATION LEVERS

### Sector dynamics

**Demand shifts:** Coal demand declines in a 1.5°C pathway, while other mined commodities, such as nickel and lithium, could see increased demand to support the energy transition.

### Operational levers

**Efficiency:** Reduce fuel and electricity consumption by optimizing processes and operations with advanced analytics, truck route optimization, etc.

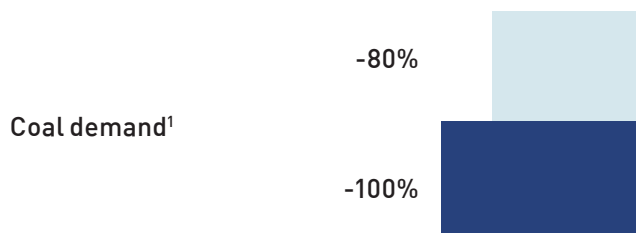
**Electrification:** Electrify diesel- and gas-fueled equipment.

**Fugitive emissions:** Capture or prevent fugitive methane emissions from coal seams in new, existing, and abandoned mines.

## 1.5°C SCENARIO SECTOR INDICATORS

■ 2030 ■ 2050

Demand reduction for thermal coal, % change vs. 2016



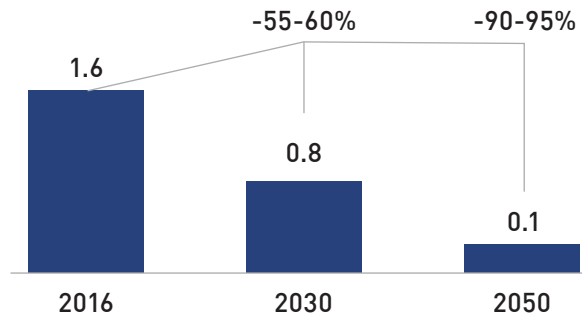
<sup>1</sup> Demand for coal used for power generation  
Source: McKinsey 1.5°C Scenario Analysis



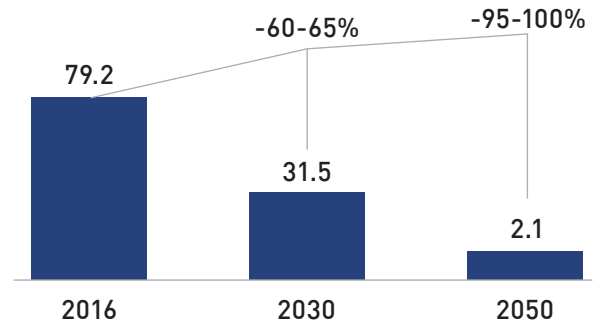
## EMISSIONS PATHWAY

— Global Energy Perspective Reference Case 2019 ■ 1.5°C Scenario

O&G CO<sub>2</sub> emissions, Gt CO<sub>2</sub> per year



O&G CH<sub>4</sub> emissions, Mt CH<sub>4</sub> per year



## DECARBONIZATION LEVERS

### Sector dynamics

**Demand reduction:** The electrification of industry and transport would shift energy demand away from O&G and towards renewable energy sources.

A 1.5°C scenario would result in relatively flat demand for plastics globally due to recycling and alternative products.

### Operational levers

**Efficiency:** Reduce emissions via energy efficiency equipment and higher efficiency processes.

**Electrification:** Electrify onshore and near-shore operations. Develop high-temperature electric crackers.<sup>†</sup>

**Fugitive emissions:** Deploy solutions to reduce flaring, venting and fugitive methane, such as vapor recovery units (VRU), leak detection and repair (LDAR), and investments in transport and export infrastructure.

**Carbon capture, utilization, and storage:** Apply carbon capture to the steam methane reforming process to produce hydrogen for refining.

## 1.5°C SCENARIO SECTOR INDICATORS

■ 2030 ■ 2050

Oil & gas operations energy demand, %



■ Natural Gas ■ Oil ■ Electricity

Oil & gas operations energy demand, %



<sup>†</sup> - Technology still in research & development phase  
Source: McKinsey 1.5°C Scenario Analysis



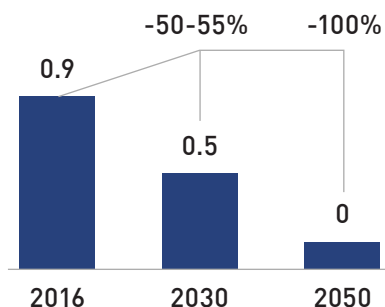


# FOOD & AGRICULTURE

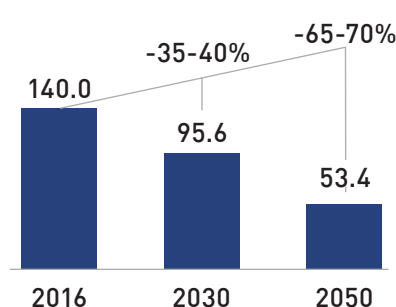
## EMISSIONS PATHWAY

— Current trajectory ■ 1.5°C Scenario

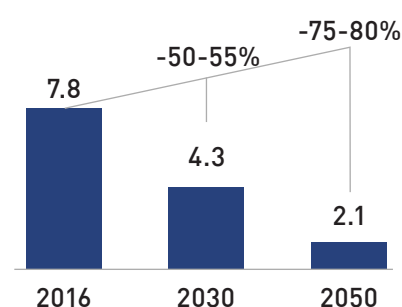
CO<sub>2</sub> emissions,  
Gt CO<sub>2</sub> per year



CH<sub>4</sub> emissions,  
Mt CH<sub>4</sub> per year



N<sub>2</sub>O emissions,  
Mt N<sub>2</sub>O per year



## DECARBONIZATION LEVERS

### Sector dynamics

**Demand reduction:** Diets shift to lower-emission protein sources and food waste is reduced.

### Operational levers

**Rice cultivation:** Apply low-emissions practices, such as dry direct seeding, rice paddy water management, anaerobic rice.<sup>T</sup>

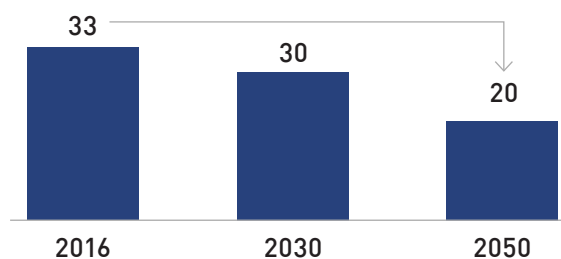
**Crop production:** Apply low-emissions practices, such as fertilization timing, variable rate fertilization, and equipment maintenance.

**Animal protein production:** GHG-focused breeding and genetic selection, improved health monitoring, feed mix optimization, methane inhibitors.<sup>T</sup>

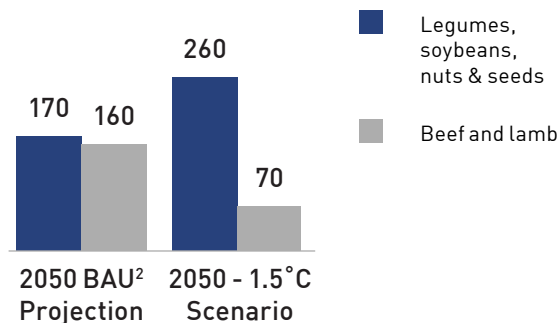
**Plant sequestration:** Gene editing to improve carbon sequestration of plants.<sup>T</sup>

## 1.5°C SCENARIO SECTOR INDICATORS

### Reduction in food waste, % of food wasted



### 2050 global protein consumption Million tons per year



Beef and lamb consumption would need to halve, replaced by plant-based proteins.

<sup>1</sup> Based on GWP AR5 values for CH<sub>4</sub> and N<sub>2</sub>O; T. Technology still in research & development phase

<sup>2</sup> Business as usual

Source: McKinsey 1.5°C Scenario Analysis

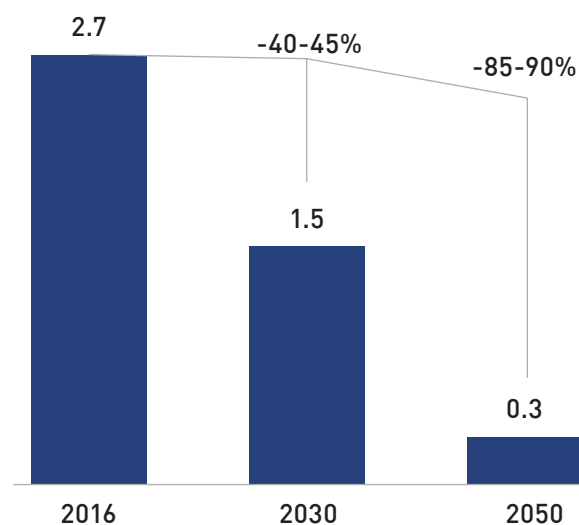


# BUILDINGS

## EMISSIONS PATHWAY

### Buildings emissions, Gt CO<sub>2</sub> per year

- Global Energy Perspective Reference Case 2019
- 1.5°C Scenario



## DECARBONIZATION LEVERS

### Operational levers

**Efficiency:** Raise standards for insulation, appliances and home energy management.

**Electrification:** Use electric heat pumps and cookstoves to reduce the use of fossil fuels in buildings.

**Hydrogen:** Use hydrogen in remaining non-electrified applications, such as by blending it into existing gas networks or switching to pure hydrogen.

**Bioenergy:** Replace coal, oil and natural gas with advanced biofuels, such as green gas.

## 1.5°C SCENARIO SECTOR INDICATORS

- Coal
- Oil
- Natural Gas
- Bioenergy
- Hydrogen
- Electricity
- District heating
- Other Renewables

### Final energy consumption in buildings, % total of fuel consumption



By 2050, 90% of space heating, water heating and cooking energy has transitioned to non-fossil fuel sources.





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The ILN would like to acknowledge the valuable contributions of our partners in the development of this document:

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**INVESTOR  
LEADERSHIP  
NETWORK**

---

As companies conduct and disclose climate-related scenario analyses, investors must be equipped to understand and assess the disclosures. This report provides tools to help investors evaluate scenario analyses in line with the Paris Agreement and a 1.5°C pathway.

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