wbcsd

# TCFD Chemical Sector Preparer Forum

## Climate-related financial disclosure by chemical sector companies: Implementing the TCFD recommendations

July 2019

**In collaboration with:**

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# Executive summary

# 1 Executive summary

**Chemicals play an essential role in almost every aspect of our daily lives. The chemical sector develops and supplies chemical products that serve a range of markets and industries, including nutrition, healthcare, electronics, buildings and transport. More than 95% of all manufactured products rely on chemistry and the chemical sector supplies ingredients and solutions for many of the products on which society depends. Demand for chemical products is expected to increase to meet the needs of a growing global population and rising standards of living.**

The chemical sector is carbon intensive but is also an enabler of the low-carbon transition. The sector has significant opportunities to develop its activities and products and to minimize its carbon emissions in response to the ambitions of the low-carbon transition. Complex value chains and interconnections with many other industries mean that the chemical sector can leverage and enable significant opportunities that support the transition. However, these also present considerable challenges in assessing how climate change might affect the strategic resilience of chemical sector companies.

The TCFD Chemical Sector Preparer Forum ("the Forum") is a collaboration between AkzoNobel, BASF, DSM, Solvay, Sumitomo Chemical Company, Limited and the World Business Council for Sustainable Development (WBCSD). The Forum's aim is to advance the implementation of the recommendations of the Task Force on Climate-related Financial Disclosure (TCFD) by reviewing members' current climate-related financial disclosures, identifying examples of disclosure practice that are consistent with the TCFD's recommendations (which cover four main areas: governance, strategy, risk management and metrics and targets), and considering how disclosures might evolve over the TCFD's "implementation path" which anticipates the development of climate change-related disclosure practices over a three to five year period following the publication of the recommendations in June 2017.

Two years on from the release of the TCFD's recommendations, corporate reporting on climate change is still evolving. The 2019 TCFD Status Report shows that, although companies have made some progress, the pace of implementation is slow and there is scope for further improvement in climate-related financial disclosure practices. In particular, disclosures about the potential financial impact of climate-related issues and the resilience of company strategies under different climate scenarios require more clarity.

The aim of this report is to provide a snapshot, including examples, of how Forum member companies are currently providing effective climate-related financial disclosures. It includes perspectives from users of climate-related financial disclosures, including investors and other financial market participants who use the information prepared by companies in order to assess and price risk and make decisions about how to allocate financial capital. The report also explores some of the challenges Forum member companies face in responding to the TCFD's recommendations and meeting the expectations of users of climate-related information.

## THE MAIN FINDINGS AND THEMES FROM THE REPORT

Governance – Forum members integrate climate change into their standard governance structures and manage climate risks across different business functions. Provided it is made clear that companies integrate climate change into standard governance processes, there is little value in duplicating disclosures about how those processes apply to climate change unless and to the extent that the standard processes are adapted to take account of the particular characteristics of climate change governance. However, practical examples can help to illustrate governance processes. Disclosures are useful where they enable readers to assess whether the board and management team have sufficient skills, capacity, access to information and incentives to exercise appropriate oversight of climate risks and opportunities.

**Strategy** – Forum members currently regard transition risks as more material to their businesses in the short and medium term than physical risks. Transition risks affecting the chemical sector include changes in carbon regulation, reputational risks and reduced demand for products due to changing customer behavior and emerging technologies. Forum members regard physical climate-related risks as longer-term or emerging risks and recognize that more work is needed to evaluate physical risks.

Forum members' disclosures about the potential impacts of climate change focus on impacts that affect business operations, product portfolios, (including the development of sustainable products and solutions) and value chains. As the TCFD implementation path progresses, Forum members expect reporting to develop so that it:

- Links product portfolios to specific sustainability outcomes, including climate change mitigation and adaptation ambitions;
- Explains financial impacts of climate change including capital expenditure plans, R&D spending on innovation, sales and expected revenue/income associated with sustainable products; and
- Describes the potential implications of physical risks to business.

In line with findings in the TCFD's 2019 Status Report, the Forum regards the recommendation that companies should describe the resilience of their strategy, taking into consideration different climate-related scenarios, as the most challenging aspect of the TCFD's recommendations.

The scoping of scenario analysis is particularly challenging for chemical companies due to the number and diversity of products and the interrelatedness of the chemical sector with many other industries. The Forum has developed an illustrative approach to scenario analysis which suggests the use of both a 1.5 - 2°C scenario and a higher emissions scenario based on publicly available scenarios.

**Risk management** – Forum members provide details of their enterprise risk management (ERM) processes in mainstream reports and those processes apply equally to climate-related risks. Forum members balance their disclosures to demonstrate that they are managing climate risks appropriately without repeating details of how the ERM process applies, except where it is specifically adapted for managing climate risk.

While explicit descriptions of climate risk management processes may not add value in these circumstances, users value information about the outputs of risk management processes as they apply to climate change. This can include changes to the business model, use of a carbon price in capital appraisals, and actual or anticipated portfolio changes.

**Metrics and targets** – Currently, Forum members primarily disclose operational metrics such as greenhouse gas (GHG) emissions and energy efficiency. In order to stimulate the development of climate-related metrics beyond operational measures, Forum members have prepared a set of illustrative metrics for potential disclosure by chemical companies. As TCFD implementation progresses, attention is likely to focus on eliciting financial metrics such as revenues from low-carbon products, low-carbon solution R&D and capital expenditure.

The TCFD recommends that for industries with high energy consumption, it is useful to provide metrics related to emissions intensity. However, given the heterogeneity of chemical companies, there is not a single intensity-based metric that is specific to the sector and that can provide complete comparability. The choice, usefulness and interpretation of metrics depends on whether a company is producing commodity or specialty chemicals, the processes used and end markets. It is therefore important to provide a narrative to explain the use of particular metrics.

Forum members are committed to enhancing their disclosures over time in order to provide clear and useful disclosures to aid investors in their decision-making. In particular, Forum members expect to develop their reporting in the following areas: scenario analysis to assess long-term physical and transition risks and opportunities under future climate states and financial information connected to sustainable solutions and products.

# 2 Introduction

# 2 Introduction

## THE GLOBAL ECONOMY DEPENDS ON CHEMICALS

Chemicals play an essential role in almost every aspect of our daily lives. The chemical sector develops and supplies chemical products that serve a range of markets and industries, including nutrition, healthcare, electronics, buildings and transport. More than 95% of all manufactured products rely on chemistry and the chemical sector supplies ingredients and solutions for many of the products on which society depends.[1] Demand for chemical products is expected to increase to meet the needs of a growing global population and rising standards of living and demand for the most energy-intensive chemicals is expected to increase 2.8-fold by 2050.[2]

## THE CHEMICAL SECTOR IS A CRITICAL ENABLER OF THE LOW-CARBON ECONOMY

The chemical sector operates across the entire value chain and is intrinsically linked to almost all other industries. As such, the chemical sector is uniquely positioned to catalyze the low-carbon transition across other industries. The use of chemical products and solutions downstream can help to address a wide range of climate-related challenges; the industry estimates that its solutions could reduce emissions by 2.5 gigatons of carbon dioxide equivalent ($GtCO_2e$) per year up to 2030.[3]

Many low-carbon technologies rely on innovations in chemistry to become more efficient, affordable and scalable. In particular, the chemical sector provides materials for solar photovoltaic (PV) systems and wind turbines. Other products, such as insulation, sealing barriers and composite materials, can improve the efficiency of new and existing buildings and the efficiency of road transport, including electric vehicles. The sector also has an important role to play in enabling the transition to a circular economy. The introduction of bio-based and renewable feedstocks, mechanical and chemical recycling and energy recovery, can all reduce fossil fuel consumption.

## THE CHEMICAL SECTOR IS A LARGE ENERGY USER AND GREENHOUSE GAS (GHG) EMITTER

The chemical sector will need to transition to net zero emissions during this century as well as play a role in catalyzing the transition in other industries. It is a significant user of energy and emitter of GHG emissions. It has the highest energy demand and the third highest $CO_2$ emissions of all industrial sectors, accounting for 18% of global industrial $CO_2$ emissions and approximately 7% of global anthropogenic global GHG emissions.[4] Achieving reductions in emissions in line with a 2°C global warming trajectory, taking into account the expected 2.8-fold increase in output, requires a 75% reduction in emissions per unit of chemical product by 2050.[5]

The sector has already made significant efficiency improvements. Moving forward, catalyst and related process improvements have the potential to contribute energy savings leading to a GHG emission reduction of 1 $GtCO_2e$ per year by 2050 compared with the business as usual.[6] However, the pace of efficiency improvements is incremental and the sector will require game-changing technologies in feedstock and production processes in the medium to long term to meet ambitious climate targets.[7] These include the development of alternative means of fuel production, feedstock production efficiency improvements, the use of biomass as a feedstock and the adoption of alternative chemical production processes.

## THE SECTOR FACES RISKS ASSOCIATED WITH CLIMATE CHANGE AND OTHER SUSTAINABILITY ISSUES

The chemical sector is poised to balance the increasing demand for chemicals with the effects of climate change mitigation and adaptation activity. For example, new regulations and cap-and-trade systems are likely to increase the cost of production; climate-related physical risks could disrupt operations and supply chains; and shifting customer demands are driving portfolio changes. At the same time, other sustainability trends affect the chemical sector, such as issues linked to water scarcity, product toxicity and waste. Chemical companies are also under increasing consumer pressure to accelerate the transition to the circular economy by enabling maximum durability in end-use products and by reusing and recycling existing molecules.[8]

The sector faces a complex mix of challenges. However, its actions are vital in the global response to climate change, both through the sector's own operations and the changes it catalyzes in other sectors. Companies that invest in reducing their carbon emissions and in capitalizing on opportunities presented by the transition will strengthen their position. The disclosure of climate-related financial information will assist users in assessing companies' readiness to respond to climate change and, consequently, in identifying the businesses that will remain resilient in the future.

## BACKGROUND ON THE FORUM, ITS MEMBERS AND PURPOSE

Representatives from AkzoNobel, BASF, DSM, Solvay and Sumitomo Chemical Company, Limited established the Task Force on Climate-Related Financial Disclosures (TCFD) Chemical Sector Preparer Forum in December 2018. The World Business Council for Sustainable Development (WBCSD) coordinates the Forum's work. Membership of the Forum is restricted to a small, manageable number of chemical sector companies because of the limited project timeline. Forum members include companies whose senior management has made public statements of support for the TCFD's work and welcomed the initiative to further enhance transparency on climate-related risks and opportunities.

### FORUM MEMBERS

Mark Didden – AkzoNobel
Trang Dam – AkzoNobel
Andreas Horn – BASF
Maaike Lambrichts – DSM
Simon Gobert – DSM
Marc Silvertand – DSM
Michel Washer – Solvay
Marc Vermeire – Sumitomo Chemical Company, Limited
Yoshihisa Takasaki – Sumitomo Chemical Company, Limited

The Forum received valuable input from the TCFD Secretariat and representatives of a limited group of self-selected users of climate-related financial disclosures, including equity and credit analysts. The purpose of the informal consultation with a limited group of users of information was to seek views on how companies can respond to the four areas of the TCFD's recommendations in such a way as to maximize the usefulness of information for financial market participants. User perspectives have been synthesized for the purposes of this report and are presented anecdotally in the "user perspectives" sections. Readers should recognize the limited nature of the engagement with users.

The Forum's objectives are to review the current state of climate-related financial disclosure and to identify examples of effective practice consistent with the TCFD's recommendations. In addition, the Forum provides a commentary on each of the recommendations and makes proposals about how disclosures may evolve over time. In the commentary, the Forum considers the seven principles of effective disclosure that form part of the TCFD recommendations (Figure 1) to inform its observations about the types of climate-related financial disclosure that are useful and effective.

## PURPOSES OF AND AUDIENCES FOR THIS REPORT

This report:

- Reflects the current state of climate-related financial disclosure by highlighting how Forum member companies are implementing the TCFD recommendations and giving practical examples of effective climate change disclosure;
- Deals with one of the main challenges associated with climate-related financial disclosure by setting out an illustrative approach to scenario analysis for companies in the chemical sector;
- Considers how reporting might continue to develop in future in line with the TCFD's illustrative implementation path.

The audiences for this report include:

- Chemical sector companies seeking to enhance their climate-related financial disclosures;
- The TCFD in order to provide input into any further deliberations on how the recommendations should evolve over time;
- Investors and others using climate-related financial disclosures who seek to understand the current state of disclosure practice and the scope for its development over time;
- Organizations the TCFD has identified as making valuable contributions supporting adoption of the recommendations, including stock exchanges, investment consultants, credit rating agencies and organizations that develop climate-related scenarios so that they can consider what further work is required to support and enhance climate-related financial disclosure;
- Companies from other industries looking to implement the TCFD's recommendations.

## STRUCTURE, SCOPE AND CONTENT OF THIS REPORT

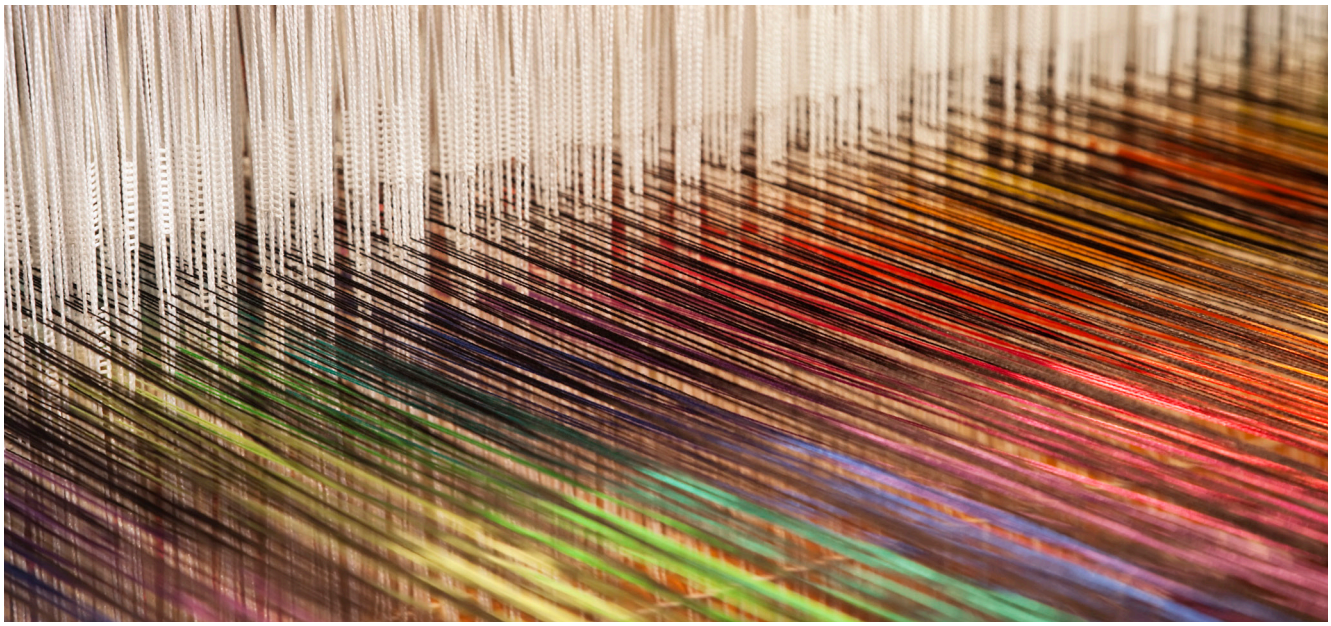
### Chapter 3: Governance, strategy, risk management and metrics and targets

Chapter 3 provides examples of current public disclosures by Forum members, highlighting challenges and opportunities for the further development of corporate climate reporting aligned with the TCFD recommendations.

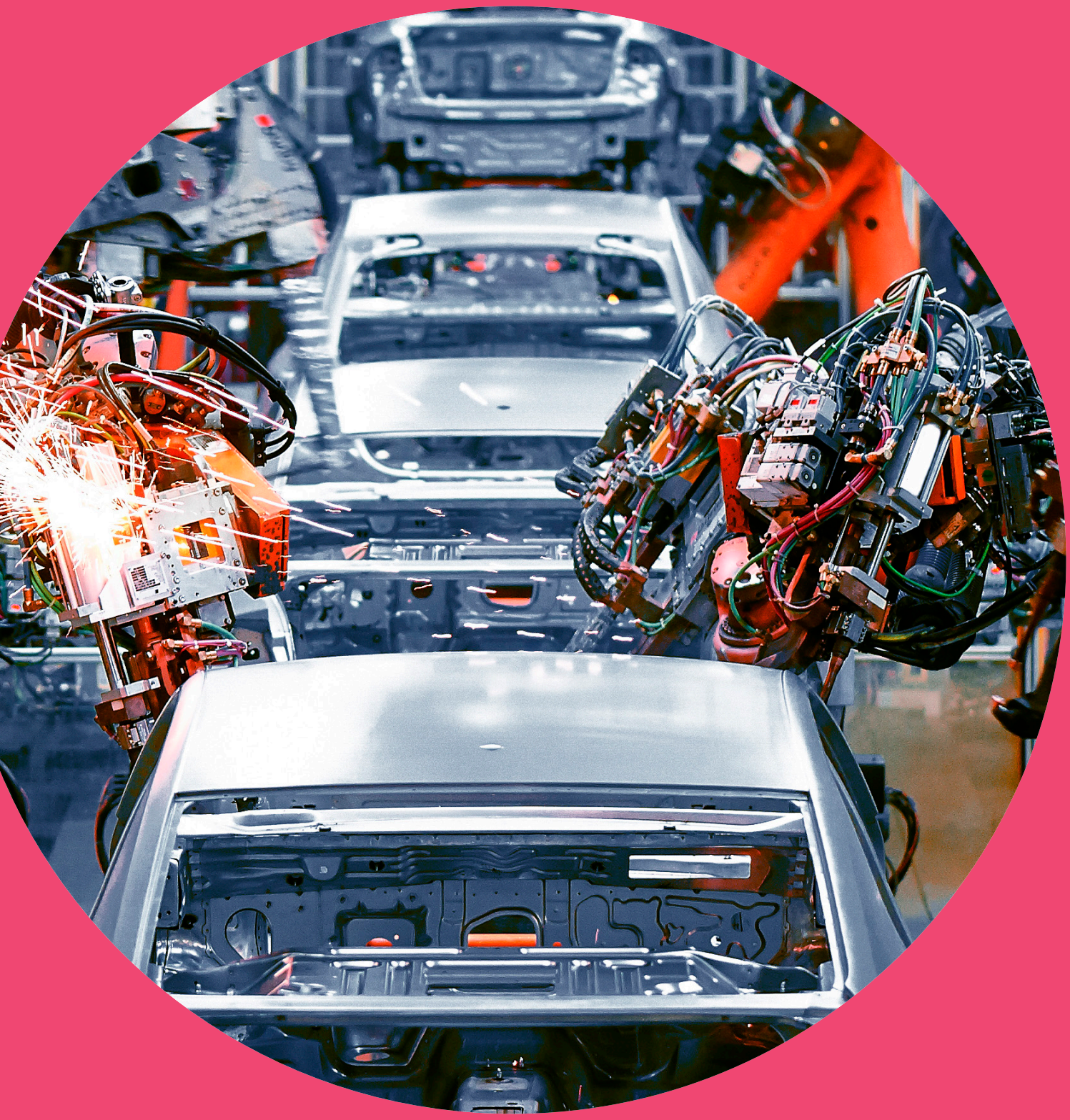
### Chapter 4: Scenario analysis

Chapter 4 offers an illustrative framework for approaching climate scenario analysis that builds on the TCFD's Technical Supplement: The Use of Scenario Analysis in Disclosure of Climate-Related Risks and Opportunities.[9]

**Figure 1:**
**Principles of effective disclosure**
TCFD Final Report: Recommendations of the Task Force on Climate-related Financial Disclosures

# 3 Effective disclosure across the TCFD's four recommendations



# ③ Effective disclosure across the TCFD's four recommendations

## GOVERNANCE

### TCFD RECOMMENDATION

Disclose the organization's governance of climate-related risks and opportunities.

The TCFD recommends that companies:

A. Describe the board's oversight of climate-related risks and opportunities;

B. Describe management's role in assessing and managing climate-related risks and opportunities.

Information about the role an organization's board plays in overseeing climate-related issues and management's role in assessing and managing those issues "supports evaluation of whether climate-related issues receive appropriate Board and management attention."[10]

### FORUM COMMENTARY

All Forum member companies have integrated climate change into their governance processes using a range of governance structures and cross-functional management approaches, often as a subset of sustainability or the risk management function. In the Forum's disclosures, a widely highlighted feature of climate-relevant governance is the use of a sustainability committee, council or board that reports directly to or advises the main board of directors. Whie focused on sustainability matters, sustainability committees/councils comprise professionals from many disciplines including legal, planning and risk functions.

Sustainability committees/councils work with and take advice from a variety of departments and professionals, including insurance, risk, strategy and health, safety and the environment (HSE), in recognition of the wide ranging and multidisciplinary nature of sustainability matters.

In common with other companies that have integrated climate change into their existing governance processes, the Forum is working to develop disclosures that respond to the TCFD's recommendations on climate governance without giving disproportionate attention to climate change. Provided it is clear that existing governance processes take account of climate change, it may not add value to make separate or repetitive statements on the way in which the board treats climate change matters within the annual report. Where climate change is identified as a material risk, readers can be confident that existing governance processes extend to include it.

However, the Forum also acknowledges that climate change risks have unique characteristics compared with other matters on board agendas. In particular, climate risks are long-term, uncertain and have far-reaching consequences. Therefore, Forum members support the TCFD's recommendation that disclosures should provide

sufficient information for readers to assess whether appropriate expertise and oversight are in place to monitor and manage climate change risks and opportunities.

Useful disclosures may include information that:

- Explains when and how climate change has been a major factor in strategic board decisions, for example, the use of a carbon price in capital appraisals, strategic changes to the product portfolio, and acquisitions or divestments motivated wholly or partly by climate considerations;
- Identifies where remuneration aligns with metrics used to assess material climate-related risks, opportunities and targets;
- Provides clear evidence of climate-specific responsibilities among board members and management;
- Describes organizational structures and reporting lines for the governance of climate change;
- Explains the competencies of board members to make robust and well-informed decisions on climate change.

## USER PERSPECTIVES

Users gave a range of perspectives on what constitutes useful governance information. Some users believe that the most useful disclosures include evidence of the outputs or implications of climate governance, for example, where strategic board decisions take account of climate-risks and opportunities. Other users said that where climate change considerations are integrated into standard governance structures, a separate document referenced in the annual report may be used to provide detailed descriptions of sustainability and climate governance.

### Examples: Governance

**Figure 2: BASF's organizational structure for managing sustainability, including climate-related issues**
BASF website

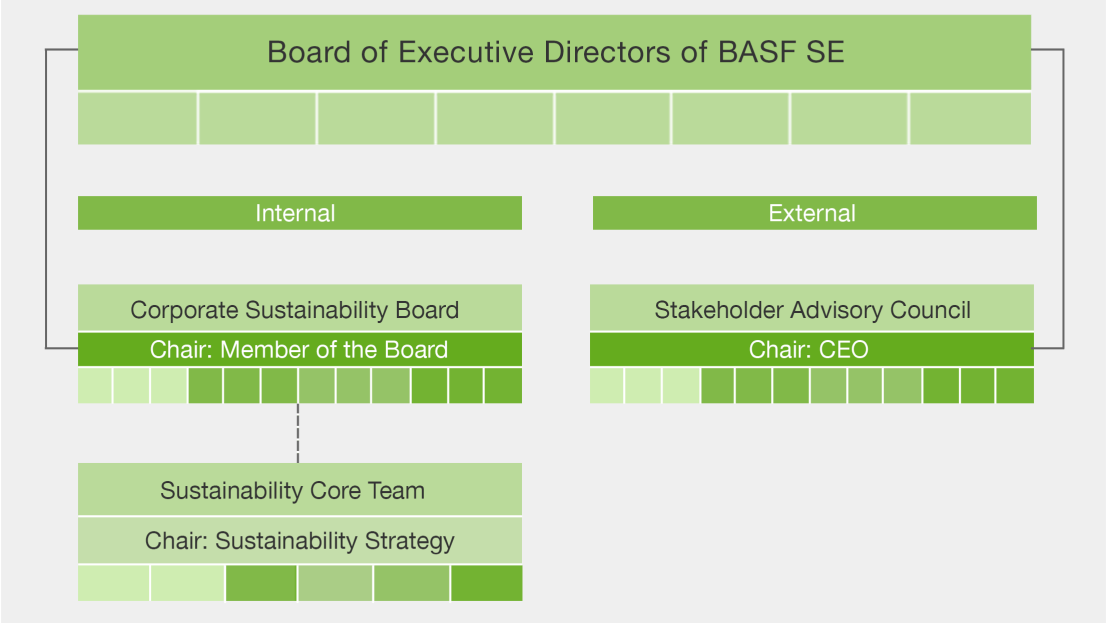
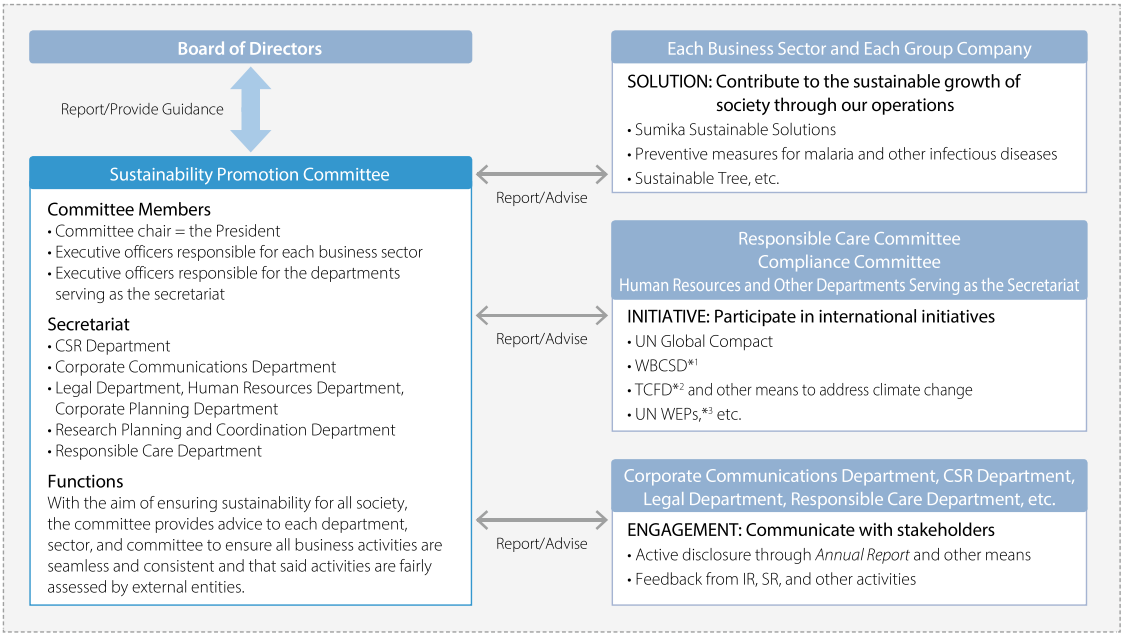


**Figure 3: Sumitomo Chemical's sustainability management structure**
Sumitomo Chemical Sustainability Data Book 2018




*1 WBCSD: World Business Council for Sustainable Development
*2 TCFD: Task Force on Climate-related Financial Disclosures
*3 UN WEPs: Women's Empowerment Principles

**Figure 4: AkzoNobel's disclosure explaining the role of the Sustainability Council**
AkzoNobel Annual Report 2018

**SUSTAINABILITY COUNCIL**

The Executive Committee has established a Sustainability Council to advise on sustainability developments. The council monitors the integration of sustainability into management processes and oversees the company's sustainability targets and sustainability performance. The council, which meets quarterly, is chaired by the CEO and includes the Chief Corporate Development Officer, Chief Operating Officer, Chief Supply Chain Officer, Chief Human Resources Officer, representative business and functional directors and the Corporate Director of Sustainability. Significant sustainability aspects material to the company are reviewed annually, with input from internal and external stake holders. The Sustainability Council focuses on topics with the biggest impact on accelerating the AkzoNobel strategy to create shared value, building on our core principles of sustainability, safety and integrity, including respect for human rights.

Progress regarding sustainability objectives, development, target-setting and implementation is reviewed quarterly by the Executive Committee, semi-annually by the Supervisory Board and is verified annually by PricewaterhouseCoopers Accountants N.V.. The Audit Committee takes an active role in assessing the quality and reliability of sustainability performance reporting.

**Figure 5: BASF's disclosure explaining the role of its Corporate Sustainability Board**
BASF Annual Report 2018

The Corporate Sustainability Board is BASF's central steering committee for sustainable development. It is composed of the heads of our business, corporate and functional units, and regions. A member of the Board of Executive Directors serves as chair. We have also established an external, independent Stakeholder Advisory Council. Here, international experts from academia and society contribute their perspectives to discussions with BASF's Board of Executive Directors, helping us expand our strengths and identify potential for improvement.

**Figure 6: DSM's disclosure showing sustainability as an integral part of governance**
Royal DSM Integrated Annual Report 2018

Sustainability, including climate risks & opportunities, is a direct responsibility of the Managing Board. Sustainability is an integral part of how we do business. It is a key responsibility, our company's core value, and a business growth driver. Our CFO is responsible for the implementation of the TCFD recommendations and has appointed a taskforce for this.

**Sustainability Governance Framework.** Defines in more detail how Sustainability, including climate-related topics, is governed within our company. Our external Sustainability Advisory Board acts as sparring partner to the Managing Board and senior executives.

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**Supervisory Board - Committees.** The Sustainability Committee prepares the Supervisory Board's discussions on sustainability topics, including our low-carbon future, improving our climate impact, and reducing our climate risk exposure.

**Figure 7:** Solvay's explanation of sustainability governance and management roles
Solvay Annual Integrated Report 2018


**Figure 8:** DSM's description about how the Sustainability Committee works with the Supervisory Board
Royal DSM Integrated Annual Report 2018

The Sustainability Committee prepares the Supervisory Board's discussions on sustainability topics. The Sustainability Committee met three times in 2018. This Committee comprises Eileen Kennedy (Chair), Pradeep Pant and Frits van Paasschen. The Chair of the Supervisory Board has a standing invitation, and participated in all meetings. The recommendations and minutes of these meetings were shared and discussed with the entire Supervisory Board during its meetings with the Managing Board. The Supervisory Board also has access to all the meeting materials posted for the Sustainability Committee meetings. The feedback from the Committee to the full Board included advice and recommendations regarding topics to be approved by the Supervisory Board, in particular the sustainability reporting in this Report. Taking into consideration the 'Assurance report of the independent auditor' on the sustainability information by KPMG, the full Supervisory Board approved the reporting in these sections on 27 February 2019. The Sustainability Information complies with the Standards of the Global Reporting Initiative and our internal reporting criteria, which are included in this Report, and is also aligned with the international Integrated Reporting Council <IR> Framework where possible.

During the year, a recurring topic was the company's performance against its People and Planet aspirations, with a focus on Brighter Living Solutions, responsible care, and inclusion and diversity. Through these discussions, the Sustainability Committee followed up on the progress made with the implementation of the sustainability and safety aspirations set as part of Strategy 2018. Deep dives were made into several topics. One was on preparing for a low-carbon future as well as setting science-based targets. The Committee discussed actions that were being undertaken to further future-proof the company by improving our climate impact and climate risk exposure, by enabling a low-carbon economy, and by advocating appropriate action externally and internally. Other topics addressed more extensively were Safety (including the revitalization of DSM's Life Saving Rules), the outcome of the Employee Engagement Survey, and finally, the process through which the company identifies risk and materiality topics and how these processes are intertwined.

Furthermore, the Committee was updated on DSM's performance in the various Environmental, Social and Governance indices such as CDP, Sustainalytics, Fortune's 'Change the World' list and the Dow Jones Sustainability World Index.

## STRATEGY

### TCFD RECOMMENDATIONS FOR STRATEGY A AND B

Disclose the actual and potential impacts of climate-related risks and opportunities on the organization's businesses, strategy and financial planning where such information is material.

The TCFD recommends that companies:

A. Describe the climate-related risks and opportunities the organization has identified over the short, medium and long term;

B. Describe the impact of climate-related risk and opportunities on the organization's businesses, strategy and financial planning.

"Improved disclosure of climate-related risks and opportunities will provide investors, lenders and insurance underwriters and other stakeholders with the metrics and information needed to undertake robust and consistent analysis of the potential financial impacts of climate change."[11]

Note: Chapter 4 covers the TCFD's Strategy C recommendation on strategic resilience in detail.

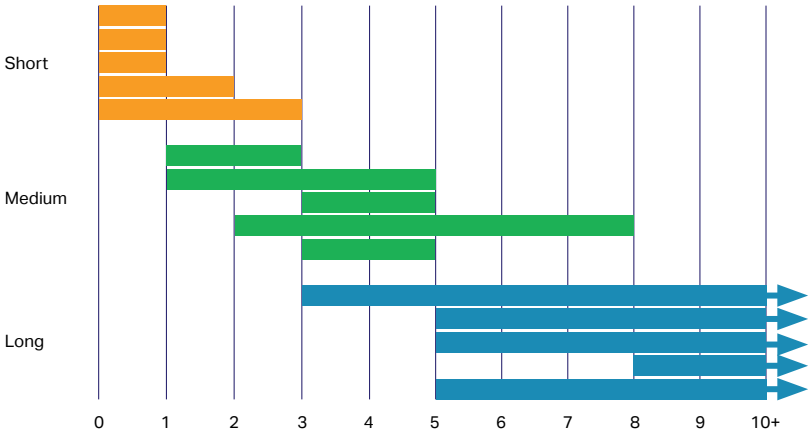
### FORUM COMMENTARY STRATEGY A:

Figure 9 illustrates the range of interpretations Forum members apply to defining short-, medium- and long-term time horizons. The time horizon over which companies expect risks and opportunities to manifest inevitably influences analysis and disclosure.

Disclosures about short-term risks and opportunities are more likely to include precise and quantitative information, whereas disclosures about longer term risks and opportunities are, by definition, more qualitative and characterized by uncertainty.

Forum members expect to develop clearer expressions of time frames as the implementation of the TCFD's recommendations matures.

**Figure 9: Approximate short-, medium- and long-term time horizons reflected in Forum members' disclosures**



## DISCLOSURE OF CLIMATE-RELATED RISKS

The TCFD divides climate-related risks into two categories: risks related to the transition to a low-carbon economy, including policy and legal, technology, market and reputation risks; and physical risks from climate change, including both acute and chronic risks (Figure 10).

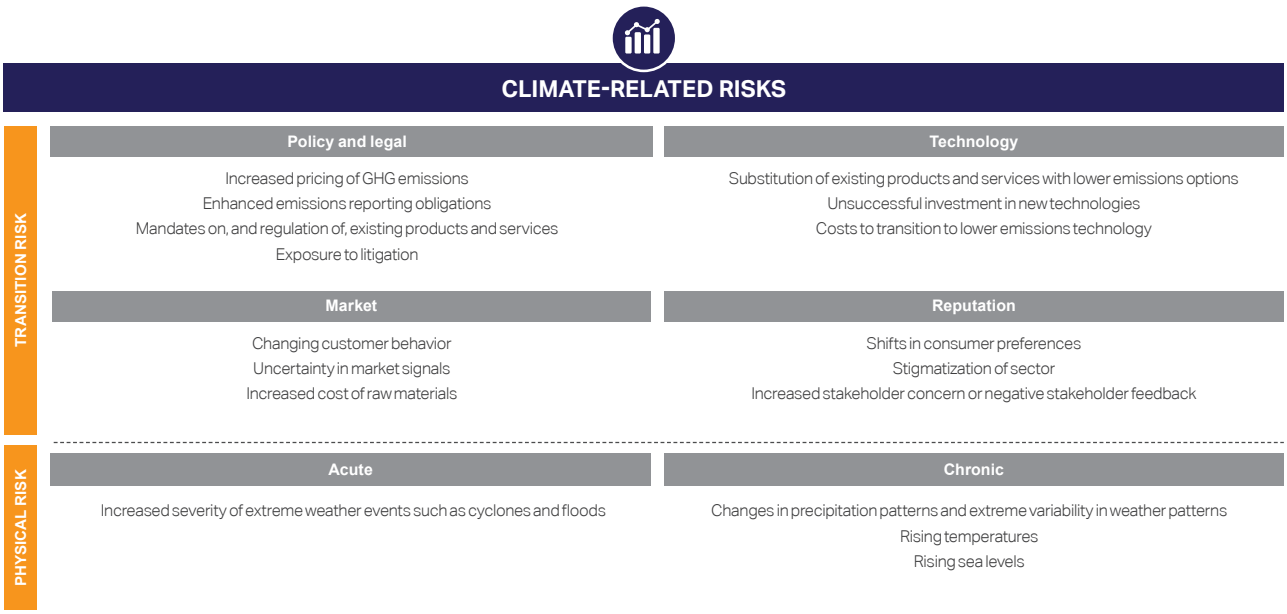
Most Forum members recognize climate change as a principal risk factor and disclose climate-related risks in annual reports and other public disclosures.

In accordance with the TCFD's recommendations, they distinguish between transition risks and physical risks.

Forum members consider transition risks to be most material to their businesses in the short and medium term including regulatory risks, reputational risks and reduced demand due to changing customer behavior and emerging technologies.

Forum members' disclosures include physical climate-related risks as long-term or emerging risks. As more modeling and information about physical risks from climate change (such as water scarcity, sea level rise and heat stress on operations) emerges, Forum members are committed to integrating new information into their analyses of the potential impact of physical climate-related risks and opportunities.

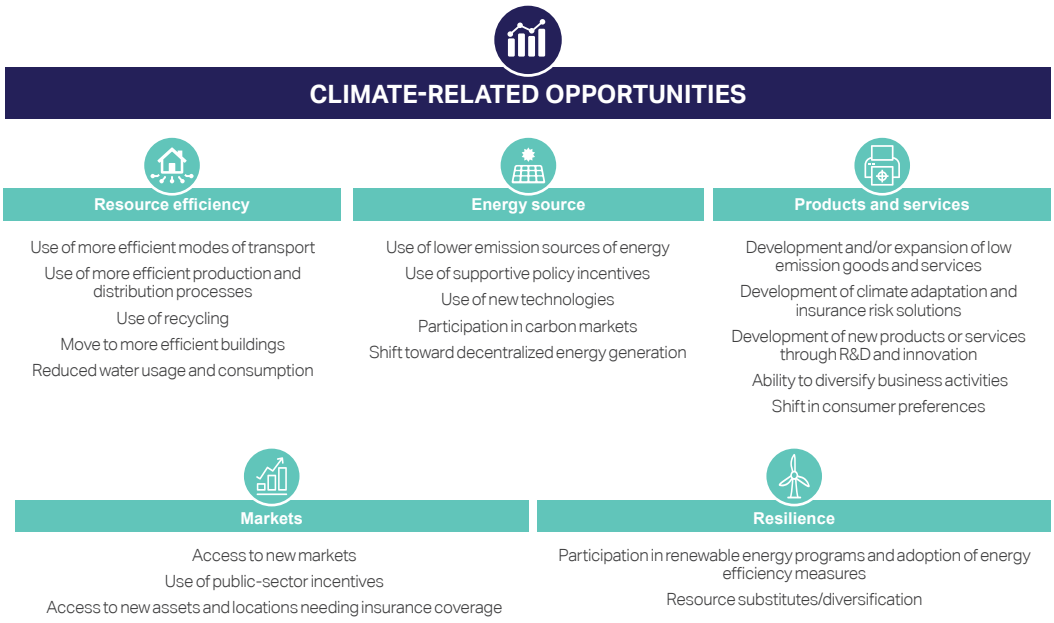
**Figure 10: Climate-related risks**
WBCSD CEO Guide to Climate-related Financial Disclosure




## DISCLOSURE OF CLIMATE-RELATED OPPORTUNITIES

The TCFD identifies several climate-related opportunities, including resource efficiency, energy source, products and services, markets and resilience (Figure 11).

**Figure 11: Climate-related opportunities**
WBCSD CEO Guide to Climate-related Financial Disclosure




There are many opportunities for the chemical sector to continue to develop products and solutions that support the transition to a low-carbon economy and the management of physical climate risks. The sector can be a catalyst in helping to improve energy efficiency, reduce GHG emissions across multiple value chains, providing crucial building blocks for the low-carbon economy.[12] Many chemical products are intermediate materials and can contribute to reducing GHG emissions through their use in final products, such as automobiles and home electronics.

Figures 12 and 13 summarize the risks and opportunities that affect the chemical sector based on a review of Forum members' public disclosure.

**Figure 12: Climate-related risks facing the chemicals sector based on Forum members' public disclosures**

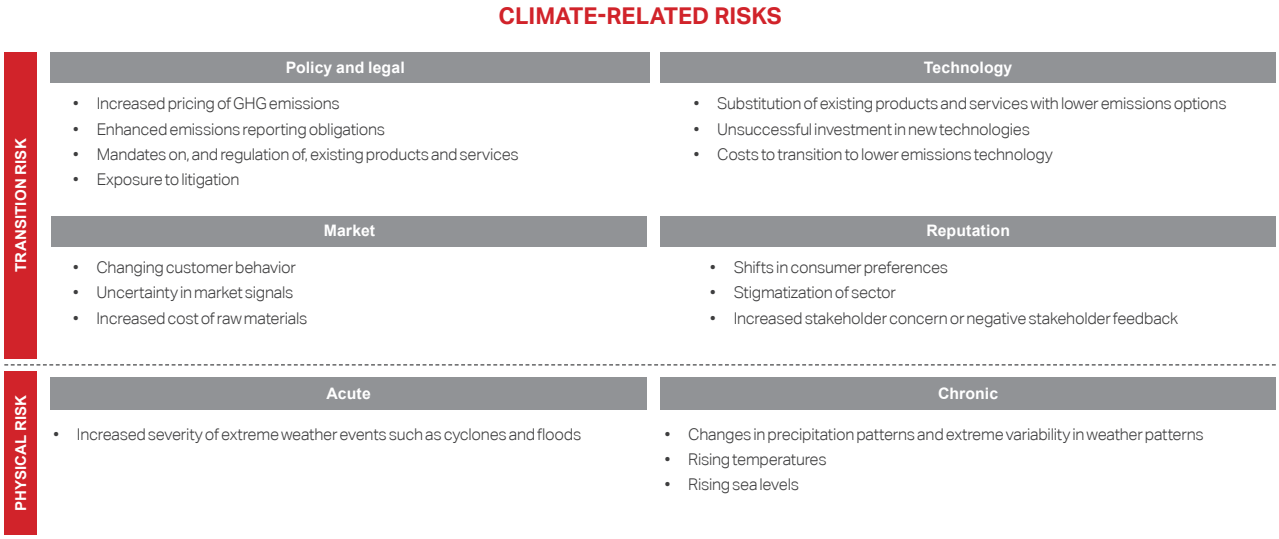
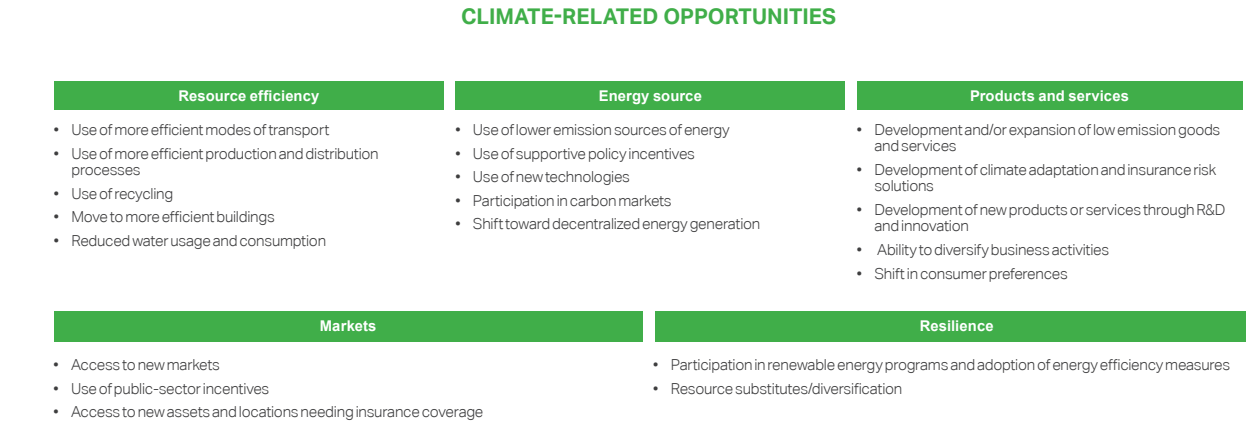



**Figure 13: Climate-related opportunities for the chemical sector based on a review of Forum members' disclosures**



## Examples: Strategy A

**Figure 14: AkzoNobel's description of the time-horizons over which strategic risk is considered**
AkzoNobel Annual Report 2018

> Our initial focus is on risks that may impact achievement of our strategy in the next three-to-five years (medium-term risks). We also recognize relevant risks beyond this five-year horizon (long-term risks).

**Figure 15: AkzoNobel's description of the potential business impacts of climate change**
AkzoNobel Annual Report 2018

> Impact on business of climate change and the shift towards a circular economy under various scenarios:
>
> - A carbon price leading to higher cost of raw materials
> - Increase in frequency and severity of extreme weather events, leading to supply chain disruption
> - Restrictions on emissions leading to increased demand for low carbon solutions or higher production costs
> - A global shift to a circular economy with major implications for businesses to be an enabler and deliver circular solutions in collaboration with others

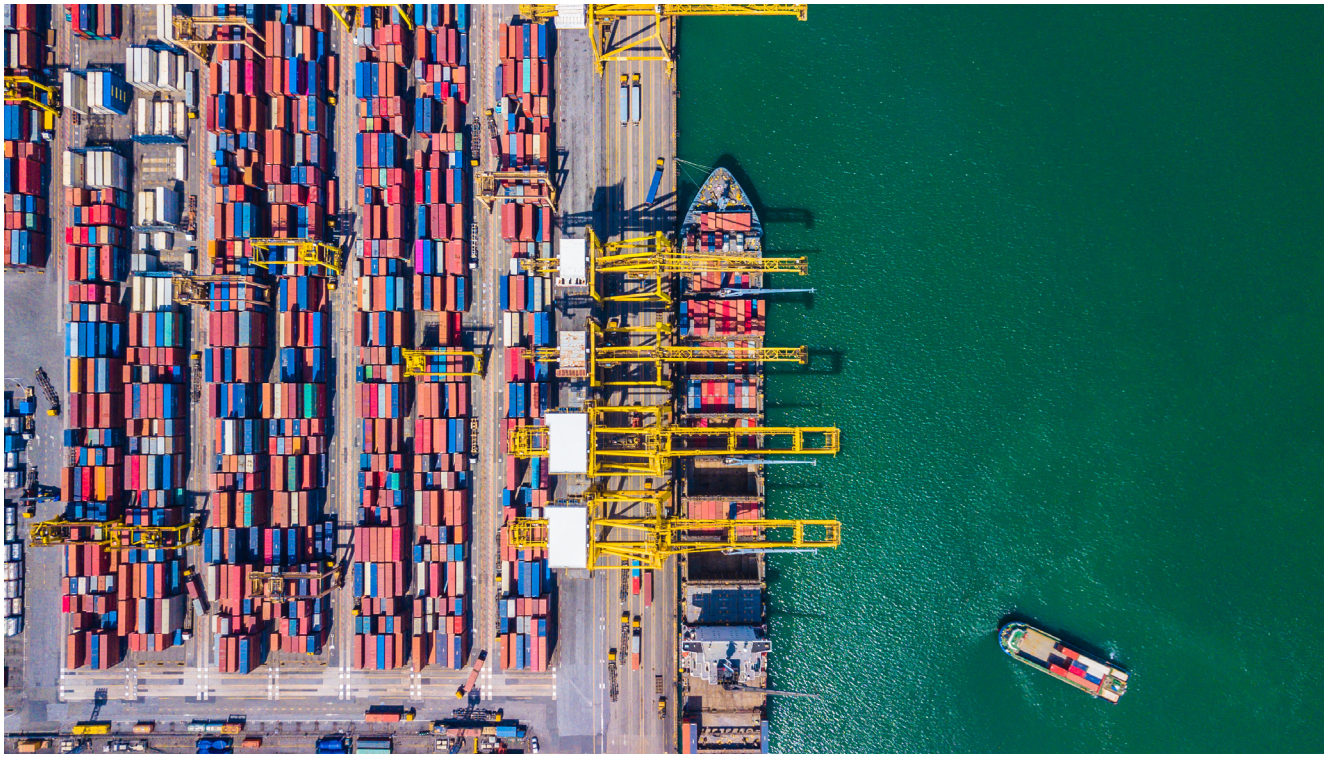


**Figure 16: Solvay's description of its climate-related transition risks together with the responses to those risks**
Solvay Annual Integrated Report 2018

**Risk description**

The Group strategy to address climate-related transition risks (as defined by TCFD) could be ineffective and damage Solvay's reputation, business losses, undervaluation, and difficulty attracting long-term investors. The Group has decided to include water-related risks in climate-related transition risks, rather than in physical risks.

**Climate transition risks stem from various causes:**

- Policies and legal context: regulations and actions to limit $CO_2$ emissions, for example increasing the price of greenhouse gas (GHG) emissions;
- Technology: unsuccessful investment in new, lower-emission technologies;
- Markets: failure to adapt to changing customer behavior;
- Reputation: negative stakeholder attitudes if their climate change concerns are not addressed effectively.

**Prevention and mitigation actions**

- Solvay's strategy focuses on businesses with higher added value and less environmental exposure;
- Every year, the Sustainable Portfolio Management (SPM) tool assesses the environmental exposure of our sales and our innovation projects portfolio. SPM includes climate-related criteria aligned on 2°C scenarios;
- Solvay has a GHG emissions reduction plan.

**2018 main actions**

Solvay updated in September 2018 its greenhouse gas emissions approach. Solvay commits to reducing greenhouse gas emissions by 1 million tons by 2025, by improving its energy efficiency and energy mix and by investing in clean technologies. Climate risks and opportunities will be reviewed in 2019.

**Figure 17: DSM's disclosure of its emerging risks, including climate-related risks**
Royal DSM Integrated Annual Report 2018

**Emerging risks**

The following three emerging risks have been identified by the Executive Committee. They are being carefully monitored so that we can take action or use them as new opportunities in a timely manner.

1. Our Nutrition and Materials markets may be disrupted by longer-term changes such as:
   - New food preferences / food systems
   - Potential impact of climate and health trends on animal protein
   - Innovations such as 3D printing
   - Replacing fossil fuels by energy from renewable sources
   - New mobility and transport options

   This could create a risk if the speed of change in the world is higher than our speed of adaptation to it.
2. We may not be able to adjust our environmental footprint fast enough.
3. We may not be able to respond to climate change fast enough in connection with:
   - Sourcing risks
   - Physical risks (e.g. in operations)
   - Disruption to our end-markets (transitional risks)

At the same time, these emerging risks will also offer new opportunities for our Brighter Living Solutions.

## FORUM COMMENTARY STRATEGY B:

The impacts of climate-related risks are, in some cases, described by Forum members alongside their descriptions of the risks. For example in Figure 15, AkzoNobel describes some of the impacts of climate change on the business, including a possible carbon price leading to higher costs of raw materials, extreme weather events leading to supply chain disruption and restrictions on emissions leading to increased demand for low-carbon solutions and/or higher production costs. Similarly, in Figure 17, DSM refers to business impacts from climate change on sourcing and disruption to end markets.

However, at this stage in the development of climate-related disclosure, Forum members most commonly report on the impact that climate-related opportunities have had on the formulation of sustainable products and solutions. All Forum member companies report the characteristics and methodologies applied to assess the sustainability of product portfolios (see examples in Table 1. However, the way in which a company defines and characterizes the sustainability of its product portfolio varies depending on the make-up of the business, the context and markets in which it operates, the risks it faces and its objectives.

In practice the criteria used for characterizing products as being "sustainable" span a wide range of general sustainability issues. These include product recyclability, water usage in production and social issues such as health, working conditions and safety, as well as climate-related factors such as energy efficiency, carbon intensity of production and avoided emissions by customers. There is no common definition of "sustainable products." However, disclosures might be made more effective if companies were to organize sustainable products and solutions according to the outcomes they aim to contribute to (e.g., water usage, circularity or climate change). For example, BASF specifically identifies Accelerator solutions that contribute to climate goals as climate protection products.

These solutions enable customers to avoid GHG emissions over their entire life cycle compared to reference products. DSM links its Brighter Living Solution products to relevant Sustainable Development Goal (SDG) outcomes, for example climate action or affordable and clean energy. Table 1 provides further examples of Forum members' sustainable product solutions. Forum members agree that clearly disclosing characteristics, methodologies and definitions used to define green products enables readers of information to understand the basis on which products have been classified as sustainable.

Disclosures about the business impacts of products that respond to climate change are useful when supported by narrative explaining the rationale for the product, the climate outcomes to which it contributes, the timescales over which benefits are likely to manifest, the size of the market for the product and expected changes in demand. It is useful to estimate the contribution of the products to particular climate mitigation or adaptation outcomes, for example the amount of GHG emissions avoided. Companies should disclose whether changes in the quality and availability of raw materials, inputs or feedstocks on which the products depend could jeopardize the optimization of opportunities.

Over time, companies could develop disclosures so that they attribute capital expenditure, revenue, and research and development expenditures to chemical products and processes designed to contribute to climate change mitigation and adaptation.

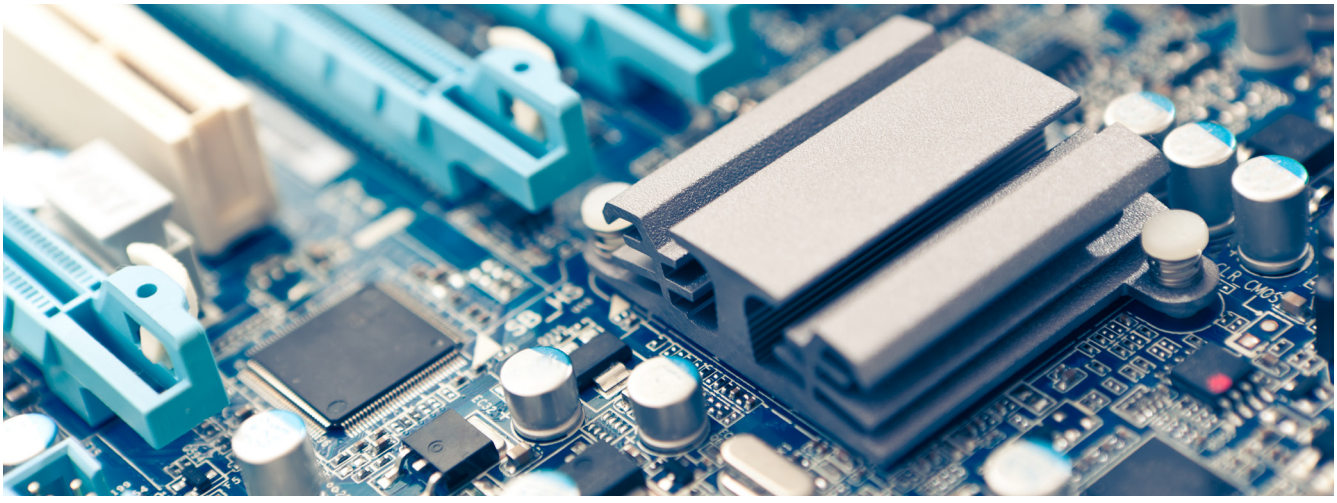


**Table 1: Sustainable solutions developed by Forum members**

| COMPANY | METHODOLOGY | CLIMATE-RELEVANT CRITERIA CONSIDERED | PRODUCT EXAMPLES |
|---|---|---|---|
| AkzoNobel's Eco-premium solutions[13] | Benchmarks the performance of products across six sustainability aspects against the most common competing alternative products on the market (mainstream solutions) from a life cycle (value chain) perspective | • Energy efficiency<br>• Emissions and waste | Intersleek coatings are an industry-first application used on ships to reduce fuel consumption and emissions. The application incorporates bio-renewable raw materials and users can receive carbon credits. To date, Intersleek products have helped ship owners and operators save over 10 million tons of fuel and reduce $CO_2$ emissions by 32 million tons.[14,15] |
| BASF's Accelerator solutions[16] | Sustainable solution steering:<br>• Assesses the sustainability contribution of products in its specific application and region along all three dimensions of sustainability in a cradle-to grave value chain approach<br>• Portfolio grouped into four categories, ranging from solutions with a substantial sustainability contribution in the value chain (Accelerators), to solutions with market standard performance, up to solutions with a significant sustainability concern | • Reduces carbon footprint in production<br>• Enables GHG savings downstream<br>• Reduces energy consumption in production<br>• Enables energy savings downstream | Luprosil® and Lupro-Grain® are propionic acid-based preservatives that enable farmers to store feed grains for up to 12 months after harvesting without drying them, which can reduce GHG emissions by an average of 85% per metric ton of feed. |
| DSM's Brighter Living Solutions[17] | Evaluates products/innovations that are better for the planet (environmental benefits) and/or people (social benefits), compared to the market and across the entire life cycle | • Reduces or avoids GHG emissions<br>• Energy efficiency<br>• Application of renewable energy | DSM's engineering plastics, such as Stanyl® Diablo, replace metals and other materials to achieve weight savings, reducing fuel consumption and the associated GHG emissions in the automotive industry. Using Stanyl® Diablo for one component, reduces $CO_2$ emissions by 1g per 10km. When used to reduce friction in the engine, Stanyl® reduces $CO_2$ consumption by 1g per km. |
| Solvay's Sustainable Solutions[18] | Evaluates product/application combinations that bring higher social and environmental contributions to customer performance and at the same time demonstrate a lower environmental impact in production | • GHG emissions<br>• Biogenic $CO_2$ emissions<br>• Energy efficiency<br>• Water use | Highly dispersible silica (HDS) reinforces tires, reducing rolling resistance while improving traction on wet surfaces. This translates to reductions in fuel consumption and $CO_2$ emissions of 7%.[19] |
| Sumitomo Chemical's Sumika Sustainable Solutions[20] | Identifies products and technologies that help to address climate change, reduce environmental burdens and accelerate their swift development and widespread use | • Contribution to reducing GHG emissions<br>• Products, parts and materials used for development of new energy sources<br>• Use of biomass-derived materials<br>• Contribution to adapting to climate change impacts | Pervio™, a lithium-ion secondary battery separator, provides increased battery capacity. The material contributes to the expansion of the use of next-generation vehicles, such as electric vehicles.[21] |

As well as the strategic impacts climate change has on the development of product portfolios, Forum members disclose impacts on other parts of the value chain, including:

- Supply chain, with descriptions of the processes used to evaluate suppliers across several criteria, including sustainability risk. Several Forum members disclose sustainability and CSR requirements for critical suppliers, including climate-related indicators such as carbon footprint, water use, energy use and circularity (Figure 31)
- Operations, with comprehensive descriptions of process innovations supporting operational efficiency and measures taken to optimize energy efficiency and reduce GHG emissions and procure renewable energy across operations (Figures 28, 29 and 30)

## USER PERSPECTIVES

Users are keen to understand how ready companies are for the future, how flexible their business models are and how they might respond to changing conditions resulting from climate change and the low-carbon transition. Disclosures about product portfolio diversification and specialization are particularly relevant. Disclosures related to sustainable products are useful where they:

- Explain the characteristics or criteria used to define sustainable products and the outcomes they aim to achieve (for example, increased circularity, reduced water-use, reduced GHG emissions)
- Clearly articulate the downstream uses and impacts of products
- Explain how demand and markets may change through the low-carbon transition
- Provide the proportion of R&D and capital expenditure allocated to the development of products designed to achieve sustainable outcomes
- Provide the proportion of sales and revenues from sustainable products

### Examples: Strategy B

**Figure 18: BASF's disclosure about the outcomes of its climate protection products**
BASF Annual Report 2018

An analysis of 22 climate protection product groups revealed that customers' use of products sold in 2018 helps to avoid 640 million metric tons of $CO_2$ equivalents. Every product makes an individual contribution in the value chain of customer solutions. Value chains are assessed in terms of BASF's economic share of the respective customer solution. On average, 5% of the emissions avoided were attributable to BASF in 2018. The calculation of avoided greenhouse gas emissions took into account the chemical industry standards of the International Council of Chemical Associations (ICCA) and the World Business Council for Sustainable Development (WBCSD).

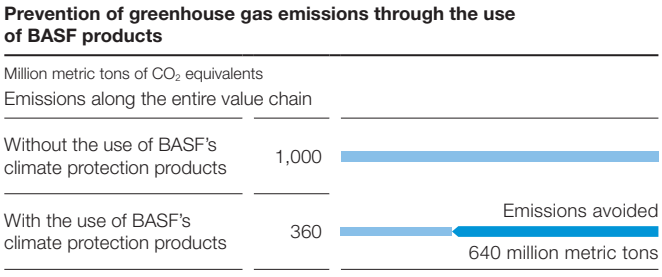


**Figure 19: DSM's disclosure about participation in WBCSD's Chemical Sector SDG Roadmap, which led to the identification of key impact opportunities for the sector to contribute to the SDGs**
Royal DSM Integrated Annual Report 2018

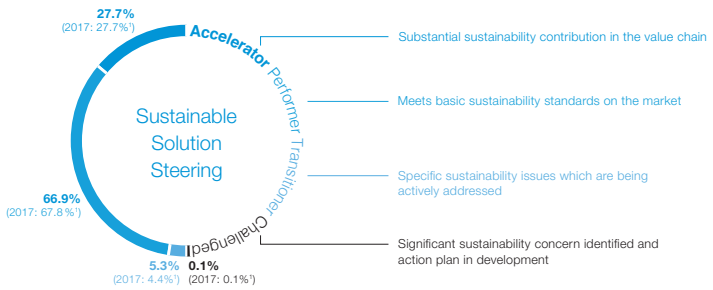
**The Chemical Sector SDG Roadmap**

We joined the World Business Council for Sustainable Development's Chemical Sector SDG Roadmap working group in 2018. In July, this group published a Roadmap that defines the key impact opportunities where the sector can make the most meaningful contribution to the material SDGs and SDG targets of the sector. Importantly, it recognizes the potential for both positive and negative impact on the SDGs.

We support the Roadmap's invitation to the chemical industry to collaborate around eff orts to achieve SDG action.

**Figure 20: BASF's disclosure about steering the product portfolio towards sustainable products**
BASF Annual Report 2018

**Portfolio management: increase Accelerator sales and phase out Challenged products**




Evaluating and transparently classifying our products enables us to systematically improve these in cooperation with our customers and at the same time, steer our product portfolio. Our aim is to increase sales from Accelerator products to €22 billion in 2025. We have identified substantial sustainability concerns for our Challenged products and are developing action plans. These action plans include research projects, reformulations or even replacing one product with an alternative product. At the end of 2018, action plans had been created for 100% of Challenged products. To systematically align our portfolio with contributions to sustainability, as of 2018 we will phase out all Challenged products within five years of initial classification as such at the latest. We strive to offer products that make a greater contribution to sustainability in their area of application to live up to our own commitments and meet our customers' demands.

1 Figures for 2017 have been restated due to the agreement between BASF and LetterOne to merge their oil and gas businesses.

**Figure 21: Sumitomo Chemical's disclosure about Sumika Sustainable Solutions designation and certification requirements**
Sumitomo Chemical Report 2017

## Sumika Sustainable Solutions (SSS)

Since fiscal 2016, the Sumitomo Chemical Group has identified those of its products and technologies that contribute to such issues as global warming countermeasures and reducing environmental burdens as Sumika Sustainable Solutions. By promoting the development and the widespread use of these products and technologies, the Sumitomo Chemical Group is offering solutions that will help build a sustainable society, with the aim of contributing to the achievement of the SDGs.

### Certification Requirements for SSS Designation

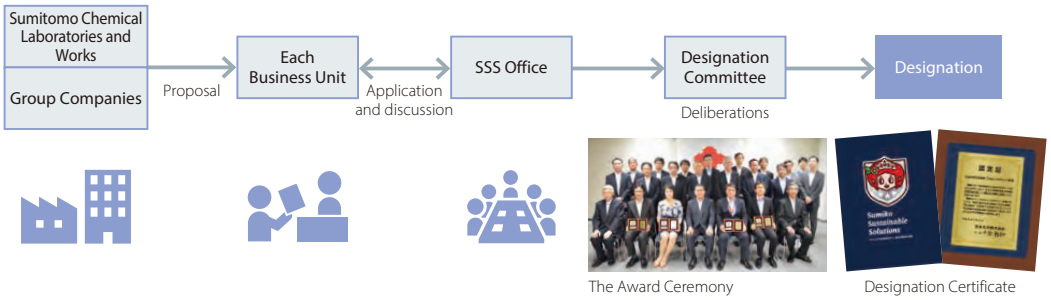
① Contribute to reducing greenhouse gas emissions
② Contribute to adapting to the climate change impacts
③ Contribute to reducing wastes, hazardous substances, and other environmental burdens
④ Contribute to the efficient use of water resources
and five other requirements

### Measuring Contribution to Reducing Environmental Burdens

Sales of currently designated products were 293.4 billion yen in fiscal 2016, contributing to a reduction in greenhouse gas emissions of approximately 53 million tons ($CO_2$ equivalent, predicted total by fiscal 2020) over the lifecycle of the products.

### SSS Designation Process

The Designation Committee officially designates products and technologies as SSS after they have been proposed for certification by laboratories, works, or Group companies. Moreover, when discussing requirements for designation, the Committee seeks advice from third-party institutions.

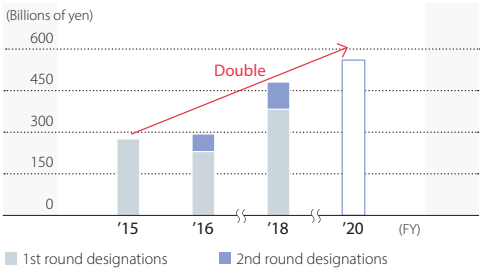




The Award Ceremony

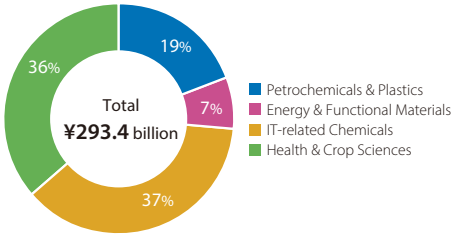

Designation Certificate

### Sales of Designated Products and Technologies




A total of 34 products and technologies have been designated so far, and Sumitomo Chemical aims to quickly double their sales.

### Sales of Designated Products and Technologies by Sector (FY2016)




Designated products and technologies are listed on the pages for each Sector (p.39, 43, 47, 51).

**Figure 22:** Solvay's Sustainable Portfolio Management methodology
Solvay website

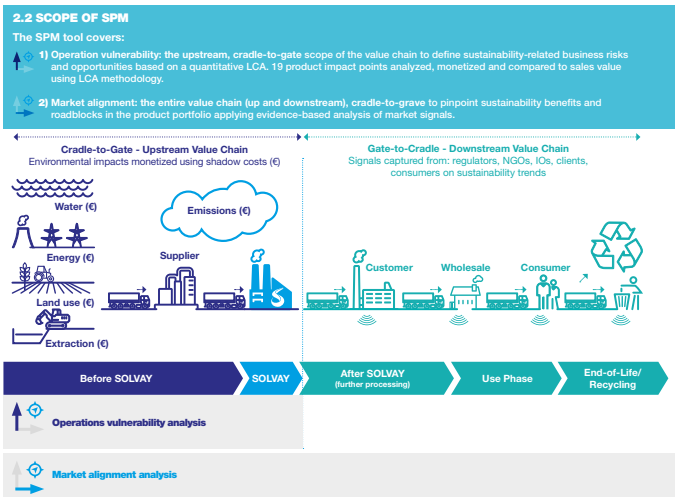



**Figure 23:** DSM's disclosure of its Brighter Living Solutions methodology
Royal DSM Integrated Annual Report 2018

Brighter Living Solutions (BLS) are products and services that, when considered over the product life cycle, offer an environmental benefit (ECO+) and/or a social benefit (People+) compared to mainstream reference solutions.

ECO+ qualifications are made based on comparative Eco Life Cycle Assessment (LCA). DSM is using the standard approach to evaluate environmental footprint as published by the WBCSD Chemical sector in 2014. Qualifications are also made based on documented expert opinion by business managers or relevant internal experts based on identified mainstream reference solutions and identified environmental differentiators.

The People+ qualifications are made based on DSM People LCA method or expert opinions, similar as for ECO+. The People LCA method helps to identify social impacts of products on the dimensions health, comfort and well-being, working conditions, and community development. This methodology is developed by DSM based on internal standards and external stakeholder dialogues.

**Figure 24: AkzoNobel's description of its sustainable portfolios**
AkzoNobel Annual Report 2018

Our portfolio approach promotes the use of safer and more sustainable products in all stages of the value chain. We translate societal developments into product offers. We take action to manage harmful substances in advance of legislation, future-proofing our products against changes in regulations. We constantly review our existing offer in close alignment with our strategic focus. This ensures the delivery of products and solutions that are fit-for-purpose in the markets we want to lead.

Since 2012, we have measured the eco-premium part of our product portfolio – those solutions with clear sustainability benefits that outperform the market.

In 2018, sales for this segment totaled 22% of our revenue. Eco-premium solutions present a moving target because we measure our performance against the market reference, which is continuously evolving. By constantly innovating, our aim is to maintain eco-premium solutions at a sustainable 20% of revenue through 2020, which will help to drive margin improvement and revenue growth.

Another significant portion of our portfolio fits into the eco-performer category. These are solutions offering clear sustainability benefits, but are overall on a par with other offers. Initial assessments indicate that eco-performers are 20% of sales, making total sales of sustainable solutions 42%.

Products classed in the performer category meet the needs of our customers and are comparable to mainstream alternatives.

The transitioner and priority categories contain substances highlighted as being of concern by some stakeholders, such as governments, NGOs, customers and public groups. We manage hazardous substances through our priority substance program, which promotes the use of more sustainable and safer products.

**Figure 25: DSM's description of their "Project Clean Cow" - a product innovation to reduce methane emissions**
Royal DSM Integrated Annual Report 2018

Around the world, dairy and beef cattle are an important source of milk and protein. They are also an essential source of income for farmers and local communities. However, along with its clear nutritional and socio-economic benefits, cattle farming also generates a substantial environmental footprint. In fact, an estimated 14.5% of all human-caused greenhouse gas (GHG) emissions come from livestock, with nearly 65% of this figure originating from dairy and beef cattle.

A large proportion of livestock emissions come from enteric (burped) methane, as a result of the natural digestive processes of cows. Whereas the GHG carbon dioxide remains in the atmosphere for centuries, methane warms the planet far more quickly. Over a period of 20 years, the global warming potential of methane is an astounding 84 times higher than that of $CO_2$.

Some years ago, we decided to take the lead in exploring practical solutions for reducing ruminant enteric methane emissions. After extensive research, our scientists came up with the answer. Through our Project Clean Cow, we have developed a proprietary feed supplement (3-NOP) that inhibits the enzyme which is responsible for producing methane in the rumen of the cow. Peer-reviewed studies by independent scientific institutions have shown that 3-NOP has the ability to consistently reduce enteric methane by approximately 30% for dairy and beef cattle, if delivered at the recommended dose.

**Purpose**

By helping to reduce the methane impact of cattle farming, we are also helping to solve the global sustainability challenge of how to supply consumers with sufficient animal protein in a way that minimizes harmful emissions.

**Performance Driven**

Our solution is designed to help the dairy and beef value chain (farmers, cooperatives, brands and retailers) to lower their carbon footprint while also meeting growing consumer demand for sustainable products. In addition to preparing for the market introduction of the feed supplement, we are working with key players and influencers across the value chain to shape a more sustainable, low emission future. The potential market for innovative solutions like 3-NOP is estimated at € 1–2 billion.

**Figure 26: Sumitomo Chemical's disclosure of its product-level energy consumption reductions**
Sumitomo Chemical Annual Report 2018

### Contributing to Climate Change Countermeasures and the Spread of Eco-friendly Vehicles through the Separator Business

The shift to eco-friendly vehicles is accelerating due to the strengthening of environmental regulations around the world. Under these circumstances, separators are indispensable to the spread of these vehicles. Sumitomo Chemical contributes to climate change countermeasures through our separator business.

**Sumika Sustainable Solutions**
Separators, essential components in producing high density, high capacity and safe lithium-ion secondary batteries, have been designated as one of the Sumika Sustainable Solutions. Eco-friendly vehicles featuring lithium-ion secondary batteries can reduce energy consumption in comparison to gasoline-powered cars.

Pervio® separators for lithium-ion secondary batteries

**Figure 27: AkzoNobel's disclosure about its resource productivity program**
AkzoNobel Annual Report 2018

We launched the Resource Productivity program as a key accelerator to deliver on our sustainability objectives and contribute to the company's Winning together: 15 by 20 strategy.

The program aims to maximize raw material and process efficiency, eliminate waste and drive energy, carbon footprint and VOC reduction across the whole integrated supply chain (ISC).

As well as reducing the environmental footprint of our activities, resource productivity contributes to business performance by driving continuous improvement and reducing operating costs.

We use our company-wide continuous improvement program ALPS (AkzoNobel Leading Performance System) to drive the environmental agenda. We continuously measure and report our performance on a range of environmental and financial indicators.

The three key indicators are: waste, energy use and VOC emissions, for which targets are set. We deliver on our targets thanks to a wide range of improvement projects introduced as part of the Resource Productivity program. These projects (currently more than 500) are monitored monthly to assess progress with regard to environmental impact and financial benefits. Savings achieved total more than €20 million.

We've increased our focus on material efficiency and are maximizing the conversion of raw materials into final product by optimizing raw material use and solving the root cause of material losses, reducing the amount of waste and waste water generated, as well as reducing the carbon footprint. It also contributes to reduced manufacturing costs.

**Figure 28: DSM's sustainability approach to its own operations**
Royal DSM Integrated Annual Report 2018

*Improve* is all about the impact of our own operations. In 2018, we continued our sustainable approach to our own operations. We apply an internal carbon price of €50 per ton of $CO_2$ to help guide our investments and operational decisions and are making good progress in reducing our own greenhouse gas (GHG) emissions. Our GHG efficiency improved from 26% in 2017 to 33% in 2018 versus our 2008 baseline, strongly outperforming our aspirations. Also, in absolute terms our emissions fell by more than 8% in 2018. Last year 41% of our purchased electricity came from renewable resources, compared with 21% the year before, which puts us on track to achieve 75% in 2030. In addition to this our energy efficiency improved by 1.4% year-on-year, compared with a 1% average annual target.

**Figure 29: Sumitomo Chemical's disclosure of GHG and water-use reductions within its operations**
Sumitomo Chemical Annual Report 2018

Sumitomo Chemical and its major Group companies have set common goals for environmental activities, endeavoring to reduce the environmental burden of the Group as a whole. In particular, as a response to climate change, the Sumitomo Chemical Group has announced that it will set goals in accordance with the Science Based Targets (SBT) initiative, which aims to help companies set goals to voluntarily reduce greenhouse gas emissions that conform to the 2°C goal set by the Paris Agreement, and the Group has already begun working to meet those goals. Specifically, we have begun reviewing systems to promote energy-saving investments, in order to reduce greenhouse gas emissions at each plant. Moreover, starting in fiscal 2017, the Sumitomo Chemical Group began disclosing data that complies with the GHG Protocol, an international standard for greenhouse gas emission disclosure. Going forward, we will further enhance coordination between units such as plants, research facilities, and production technology departments, in an effort to accelerate technological innovations that promote reductions in greenhouse gas emissions. In addition, as it is a precious resource, we are working to reduce the amount of water we use, through effective utilization depending on the application.

**Figure 30: Solvay's emissions reduction within its own operations**
Solvay Annual Integrated Report 2018

- Solvay has continued to step up its involvement in renewable energy production on sourcing in 2018. The Solvay Jasper County Solar Farm has been commissioned in the United States of America. Wind power has been contracted in India. Works are ongoing to expand use of biomass energy on top up the assets in Brotas (Brazil), Dombasle (France), Rheinberg (Germany), with new additions in India and China. Finally, Solvay has decided to invest in a new biomass boiler in Germany, which will lower emissions by 0.2 million tons of $CO_2$ per year and play a significant role in meeting the Group's commitment to reduce $CO_2$ emissions by 1 million tons no later than in 2025, regardless of its growth;
- The SOLWATT© energy and carbon efficiency program has delivered 0.54 million tons of emission reductions since 2014, with 1,000 actions deployed across 70 sites worldwide. New savings achieved in 2018 are estimated at 63.7 million tons of $CO_2$;
- In the trona mine at Green River (Wyoming, United States), partial recovery of the methane emitted during the extraction and combustion of trona has avoided emissions equivalent to 0.1 million tons of $CO_2$ eq. per year since 2011. Since 2012 some of the heat from combustion of the recovered methane has been used in the manufacturing process, bringing additional energy and $CO_2$ savings.

**Figure 31: AkzoNobel's sustainability supplier framework**
AkzoNobel Annual Report 2018

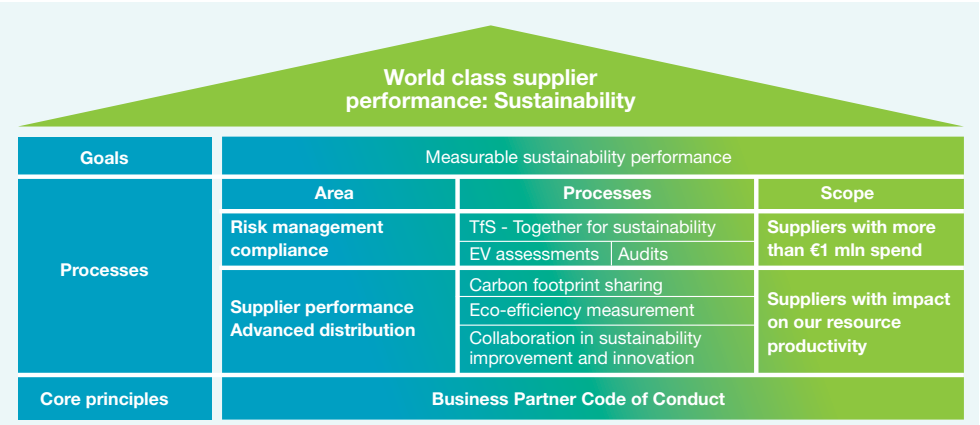



**Figure 32: Solvay's disclosure about the alignment of its businesses and strategic resource allocation decisions with sustainability megatrends**
Solvay Annual Integrated Report 2018

At Solvay, we have developed a unique tool to guide our portfolio towards more sustainable solutions. Our Sustainable Portfolio Management (SPM) tool measures the alignment of our businesses with sustainability megatrends. It is a reference framework that is a helpful complementary tool to guide strategic resource allocation and portfolio choices. The tool rigorously assesses each of Solvay's products in all its applications and our R&I, CAPEX and M&A projects, evaluating their environmental impact and their benefit or challenge to society. As a result, it also enables strategic de-risking, reducing negative impact on performance and freeing up resources for new sustainable opportunities.

**Figure 33: BASF's disclosure of its climate strategy together with commitments and targets**
BASF Annual Report 2018

- **We are committed to energy efficiency and global climate protection along the value chain**
- **New climate protection goal: $CO_2$-neutral growth until 2030**

Climate protection is very important to us. As a leading chemical company, we want to achieve $CO_2$-neutral production growth from 2019 to 2030. We have articulated this commitment in our new climate protection goal, which will apply from 2019. In order to reach this target, we aim to maintain total greenhouse gas emissions from our production sites and our energy purchases at the 2018 level. Sharp increases due to the startup of large-scale plants will be progressively offset. We will compensate for additional emissions with optimization measures at existing plants and a focus on purchasing low carbon energy. When deciding on investments and acquisitions, we systematically consider the effects on greenhouse gas emissions.

## RISK MANAGEMENT

### TCFD RECOMMENDATION FOR RISK MANAGEMENT

The TCFD recommends that companies:

A. Describe the organization's processes for identifying and assessing climate-related risks;

B. Describe the organization's processes for managing climate-related risks;

C. Describe how the organization integrates processes for identifying, assessing and managing climate-related risks into its overall risk management.

### FORUM COMMENTARY

Forum members use enterprise risk management (ERM) frameworks, such as the Committee of Sponsoring Organizations of the Treadway Commission (COSO) ERM framework and climate change issues are integrated into Forum members' standard ERM process (Figures 35 and 38). Where Forum members identify climate change as a principal risk, it is therefore monitored and managed according to the company's standard ERM processes.

Where companies use such ERM frameworks and it is clear that they are used to monitor and manage climate change risk, detailed descriptions of how the risk process applies specifically to climate change are unlikely to add value to disclosures, unless standard risk management processes are adapted in relation to climate risk.

Where climate is not identified as a principal risk or where standard ERM processes do not apply, disclosures should explain the process used to identify, monitor and prioritize climate risks in accordance with the TCFD's recommendations.

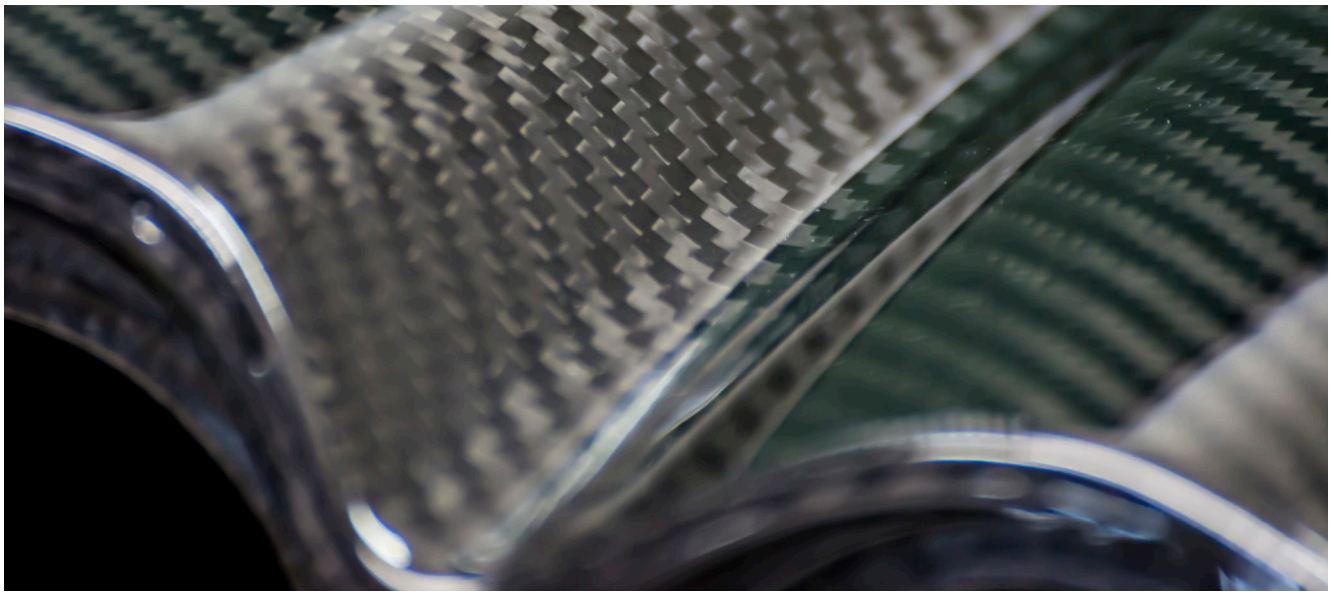
Even where the process used to identify and monitor climate risks is clear, the following information is likely to be useful:

- A list of emerging risks companies monitor but do not currently consider material;
- Examples of processes, methodologies or management approaches to climate-specific risks and opportunities, such as the use of a carbon price in capital appraisal or portfolio development.

### USER PERSPECTIVES

Users had different views about the degree of detail required in disclosures where climate change is identified as a principal risk.

For some users, disclosures are sufficient where climate – if identified as a principal risk – is integrated into standard ERM processes which are described in the annual report. For other users, even where the risk management process is clear, they appreciate evidence of the outputs or implications of the process as it is applied to climate change. For example, evidence of the strategic decisions made in response to climate-related risks provide confidence that existing processes are effective for managing climate risks. This is particularly useful where it is not possible to quantify or weigh different risks.



## Examples: Risk management

**Figure 34: Solvay's assessment and prioritization of risks**
Solvay Annual Integrated Report 2018

| Criticality | Risk | Trend | Link with sustainable development high materiality aspects | Link to Stakeholders |
|---|---|---|---|---|
| High | Security | ↘ | • Data security and customer privacy<br>• Critical incident risk management | • Employees<br>• Local Communities<br>• Customers |
| | Ethics and Compliance | → | • Management of the legal, ethics & regulatory framework | • Suppliers<br>• Employees<br>• Planet<br>• Investors |
| | Industrial safety | → | • Critical incident risk management<br>• Employee health and safety | • Employees<br>• Local Communities |
| | Transport accident | → | • Critical incident risk management<br>• Waste and hazardous material management | • Suppliers<br>• Employees<br>• Local communities |
| | Climate transition risk * | ↘ | • Greenhouse gas emissions<br>• Energy management<br>• Sustainable business solutions<br>• Water and wastewater management | • Customers<br>• Local Communities<br>• Employees<br>• Planet<br>• Investors |
| | Cyber-risk | ↘ | • Data security and customer privacy | • Customers<br>• Employees |
| | Chemical product usage | → | • Waste and hazardous materials management<br>• Sustainable business solutions | • Employees<br>• Customers |
| Moderate | | | | |

* emerging risk - newly developing or changing risk that may have, in the long term, a significant impact which will need to be assessed in the future.

**Figure 35: AkzoNobel's risk management framework**
AkzoNobel Annual Report 2018

Doing business involves taking risks. By seeking to take balanced risks, we strive to be a successful and respected company and managing those risks is an essential element of our corporate governance and strategy development.

We continuously strive to foster a high awareness of business risks and internal control to provide transparency in our operations.

The Board of Management and the Executive Committee are responsible for managing the risks associated with our activities and, in turn, for the establishment and adequate functioning of appropriate risk management and control systems (see Statement of the Board of Management in the Leadership section).

### RISK MANAGEMENT FRAMEWORK

Our risk management framework is in line with the Enterprise Risk Management – Integrated Framework of COSO and the Dutch Corporate Governance Code, and provides reasonable assurance that our business objectives can be achieved and our obligations to customers, shareholders, employees and society can be met.

For more information on our risk management framework, visit: www.akzonobel.com/en/risk-management-framework

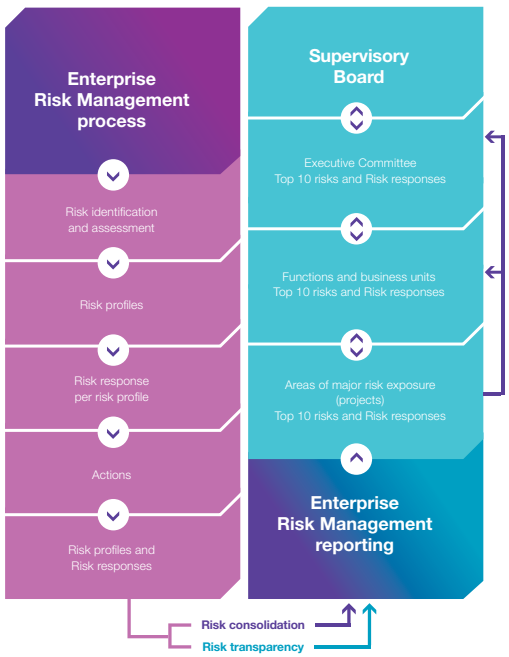


**Figure 36: BASF's disclosure of the process for identifying and assessing sustainability risks and opportunities**
BASF Annual Report 2018

As part of our sustainability management, we also assess the opportunities and risks associated with the topics we have identified as material. These also include the increasing internalization of external effects, through which positive and negative earnings contributions from companies' activities that were previously borne by the community are attributed to these companies.

For example, the material topic "energy and climate" is analyzed to enable us to identify, assess and manage climate-related risks and opportunities. For BASF as an energy-intensive company, these arise particularly from regulatory changes, such as in carbon prices through emissions trading systems, taxes or energy legislation.

**Figure 37: Solvay's disclosure of the process used to rank and analyze sustainability-related risks and opportunities**
Solvay Annual Integrated Report 2018

- Analysis of sustainability-related risks and opportunities is done through the Sustainable Portfolio Management methodology, for each product in each application or market, including the climate change transition risk;
- "Greenhouse gas emissions" (GHG) has been identified as a priority aspect in the Group's materiality analysis. "Climate transition risks" has been identified as part of the Group's main risks. Links between main risks and high materiality issues are part of the materiality analysis process. "Climate-related physical risks" has been ranked up to now as "moderate materiality aspects";
- The Sustainable Portfolio Management tool is a mandatory requirement in key Group processes and in particular in the assessment of capital expenditures projects, Research and Innovation projects, and acquisition and divestiture projects.

**Figure 38: DSM's disclosure around the integration of climate risk management**
Royal DSM Integrated Annual Report 2018

IAR DISCLOSURES

**Risk Management**. Climate risks are integrated in our normal risk management processes and also monitored as such in the Managing Board. Additional focus has been placed on climate related risks during our bottom-up 'Letter of Representation' process to sensitize the organization to long term climate risks. Climate risk is again identified in our Corporate Risk Assessment as an emerging risk with both transitional and physical aspects.

OTHER CONSIDERATIONS

**Risk Management**. Quantification and monetization of long-term climate-related risks needs to be addressed.

## METRICS AND TARGETS

### TCFD RECOMMENDATION FOR METRICS AND TARGETS

Disclose metrics and targets used to assess and manage relevant climate-related risks and opportunities where such information is material

The TCFD recommends that companies:

A. Disclose the metrics the organization uses to assess climate-related risks and opportunities in line with its strategy and risk management process;

B. Disclose scope 1, scope 2 and, if appropriate, scope 3 greenhouse gas (GHG) emissions and any related risk;

C. Describe the targets the organization uses to manage climate-related risks and opportunities and performance against targets.

### FORUM COMMENTARY

Forum members currently report on operational metrics such as GHG emissions and energy efficiency (Figures 39 and 41). Current disclosures include details of Scope 3 GHG emissions (Figures 44, 46 and 47) and comparative GHG emissions over time (Figure 43). As TCFD disclosure matures, the Forum expects climate-related financial and performance-related metrics and targets to develop and feature more prominently in disclosures. These could include details on internal carbon prices and investments in and revenue from products and services supporting the low-carbon transition (Figures 40, 49, 50 and 51).

In order to stimulate the development of climate-related metrics beyond operational measures, the Forum has prepared Table 2, which outlines a set of illustrative metrics for potential disclosure by chemical companies. These illustrative metrics reflect the Forum's discussions and the views of some investors.

A number of these metrics do not have universally agreed definitions. Companies choosing to disclose these metrics should therefore explain how they define metrics and associated terminology. This table builds upon the TCFD's Materials and Buildings Group – Illustrative Examples (see Appendix 1: Illustrative examples).

**Table 2: Illustrative climate-related metrics for chemical companies**

| CATEGORY | POTENTIAL METRICS TO ASSESS AND/OR MANAGE RISKS AND OPPORTUNITIES |
|---|---|
| Physical risks, e.g.:<br>• Storms and cyclones<br>• Extreme rainfall and flood<br>• Low levels of water/water scarcity/ stress<br>• Drought<br>• Extreme heat<br>• Variability in precipitation<br>• Variability in temperature<br>• Sea level rise | • Sales or proportion of sales from sites in high-risk areas (water stress, flooding, heat stress, etc.)<br>• Number of operating days lost due to weather-related impacts (e.g., flooding, hurricanes)<br>• Financial impact (lost production, impact on sales, earnings, damage to facilities, claims from customers) due to weather-related impacts<br>• Percentage of freshwater withdrawn in regions with high or extremely high baseline water stress<br>• Water withdrawal intensity<br>• Stress test – value-at-risk from extreme weather events disrupting operations, production, important suppliers, customers or markets |
| Physical opportunities, e.g.:<br>• Increasing demand for climate-adaptation products | • Sales from climate adaptation products |
| Transition risks, e.g.:<br>• Increased regulatory activity<br>• Reduced demand for high-carbon products<br>• Feedstock availability/switching | • Scope 1, 2 & 3 emissions*<br>• EBITDA/revenues/proportion of revenues from high-carbon products<br>• Total energy consumed, broken down by source (e.g., purchased electricity and renewable sources)*<br>• Total fuel consumed – percentage from coal, natural gas, oil and renewable sources*<br>• Implementation level of management systems for energy and water (e.g., ISO 50001) |
| Transition opportunities, e.g.:<br>• Increased demand for low-carbon products<br>• Increased operational efficiency | • Investment (CAPEX) in low-carbon solutions<br>• EBITDA/revenue from low-carbon/sustainable products<br>• R&D spending on climate-related innovations<br>• Number of patents for low-carbon products/technologies/solutions<br>• GHG emissions avoided |

*Companies could consider regional or country-level breakdown of these metrics

The TCFD recommends providing metrics related to emissions intensity (for example, emissions per unit of economic output) for industries with high energy consumption and Forum members disclose intensity metrics (Figures 42 and 45). However, given the heterogeneity of chemical companies, there is not a single intensity-based metric that is specific to the sector and that can provide complete comparability. The choice and interpretation of metrics will depend on a number of factors. For example, basic chemistry in upstream operations is more GHG-intensive and will result in higher Scope 1 emissions.

More specialized chemistry usually has lower GHG intensity and scope 1 emissions, but Scope 3 emissions increase because of the basic chemistry production processes upstream in the value chain.

Additionally, the variability in product mix and production volume, market fluctuations and other factors across the chemical sector means that the choice and usefulness of intensity-based measures for carbon or energy use will depend on the circumstances of the company.

Forum members contend that both intensity and absolute metrics are useful in disclosures, depending on the individual context. An accompanying narrative may help to explain the context and is especially useful in providing the rationale for the use of a particular formula or calculation in select cases of company-specific metrics.

Forum members also disclose metrics and targets that reflect their climate-related goals and performance against those goals over time (Figures 49, 52 and 53).

## USER PERSPECTIVES

Users value the following in relation to climate metrics and targets:

- More regular disclosure of Scope 3 GHG emissions.
- The development of more standardized and sector-specific climate-related metrics to facilitate comparability across different companies.
- Narrative that explains why a company uses particular metrics and indicators in climate-related financial disclosures and what companies intend to communicate with them. For example, where metrics show GHG emissions reductions, an accompanying narrative is useful in explaining how the reductions (for example from efficiency measures, direct intervention by the company or changes in the regulatory landscape) were achieved and whether the reductions contribute to particular corporate targets. This enables investors to assess productivity and how proactive companies are in relation to climate mitigation action.
- Information about investments made in climate mitigation, adaptation and innovation activities in absolute and relative terms so that they can identify the relative proportion of investment of capital and R&D expenditure into climate-specific areas.
- Information that facilitates the comparison of climate-related metrics from one reporting period to another. Therefore, it is useful to present climate-related metrics alongside results for previous reporting periods so that users can analyze trends.
- Restatements of disclosures reported in prior years, including climate targets, where there have been divestments and acquisitions, detection of errors and changes in policies that affect performance over time.

### Examples: Metrics and targets

**Figure 39: DSM's climate-related operational metrics, used to evaluate and manage the risks and opportunities related to climate change**
Royal DSM Integrated Annual Report 2018

| | **2018** | 2017 | 2016 | 2015[1] | 2014[1] |
|---|---|---|---|---|---|
| **Energy and greenhouse gases** | | | | | |
| Energy use (in PJ) | 20.8 | 23.6 | 22.6 | 20.9 | 39.1 |
| Energy efficiency improvement (in %) versus 2015 | 5.1 | 3.8[2] | 2[3] | | |
| Greenhouse gas emissions scope 1 + 2, location-based (in $CO_2$ equivalents x million tons) | 1.38[4] | 1.57 | 1.5 | 1.1 | 4.2 |
| Greenhouse gas emissions scope 1 + 2, market-based (in $CO_2$ equivalents x million tons) | 1.23[4] | 1.50 | 1.4[3] | | |
| **Emissions to air** | | | | | |
| Volatile Organic Compounds (x 1,000 tons) | 4.9 | 6.6 | 8.9 | 3.1 | 4.2 |
| Nitrogen oxide ($NO_x$) (x 1,000 tons) | 0.5 | 0.7 | 0.8 | 0.4 | 1.5 |
| Sulfur dioxide ($SO_2$) (x 1,000 tons) | 0.09 | 0.28 | 0.33 | 0.04 | 0.08 |

[1] DSM completed several material acquisitions and divestments over the period 2013–2015. The figures presented here are not restated for the effect of this activity and so do not accurately represent our environmental trends. For more information on our environmental footprint, please visit the company website.
[2] The 2017 number has been adjusted positively because of improved data quality.
[3] 2016 was the first year of reporting; consequently, there are no comparative figures for the previous years.
[4] Including a one-time effect of large plant shutdowns, estimated at roughly 150 kt. These effects will not occur in 2019.

**Figure 40: Sumitomo Chemical's environmental protection costs**
Sumitomo Chemical Sustainability Data Book 2018

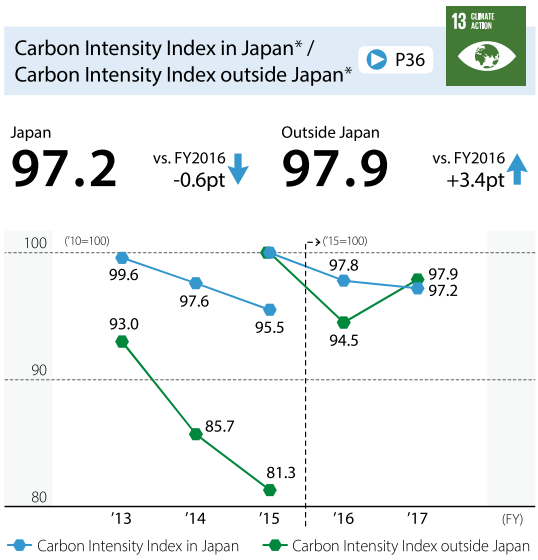
(Billion yen)

| Classification | | Details of Major Initiatives | FY2016 | | | | FY2017 | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Non-consolidated | | Consolidated | | Non-consolidated | | Consolidated | |
| | | | Investment | Expenses | Investment | Expenses | Investment | Expenses | Investment | Expenses |
| Facility area costs | | | 4.0 | 16.0 | 5.2 | 26.6 | 1.6 | 16.8 | 3.5 | 28.2 |
| Breakdown | Pollution prevention costs | Prevention of air pollution, water pollution, soil contamination, noise pollution, odors, ground subsidence, etc. | (2.5) | (10.9) | (3.5) | (15.2) | (1.2) | (11.8) | (2.6) | (16.5) |
| | Global environmental protection costs | Energy saving, prevention of global warming, ozone layer depletion, and other measures | (1.3) | (0.3) | (1.5) | (3.4) | (0.1) | (0.2) | (0.4) | (3.4) |
| | Resource recycling costs | Resource saving, water saving and rainwater usage, waste reduction/disposal treatment, recycling, etc. | (0.2) | (4.9) | (0.2) | (8.1) | (0.3) | (4.8) | (0.5) | (8.3) |
| Upstream / Downstream costs | | Green purchasing, recycling, recovery, remanufacturing and appropriate treatment of products, recycling costs associated with containers and packaging, environmentally friendly products and services, etc. | 0 | 0 | 0 | 0.3 | 0 | 0 | 0 | 0.3 |
| Administrative costs | | Costs associated with environmental education, environmental management systems, the monitoring and measuring of the environmental impact of business activities and products, environmental organization operations, etc. | 0 | 0.8 | 0 | 1.3 | 0 | 0.7 | 0 | 1.3 |
| R&D costs | | Development of products with attention to environmental safety, research into energy-saving processes, etc. | 0 | 6.8 | 0 | 6.8 | 0.1 | 3.9 | 0.1 | 4.0 |
| Administrative costs | | Protection of the natural environment and enhancement of its scenic beauty and greenery, support for community initiatives aimed at environmental protection, support for environmental preservation groups, environment-related paid contributions and surcharges, etc. | 0 | 0.5 | 0 | 0.8 | 0 | 0.5 | 0 | 0.8 |
| Environmental remediation costs | | Environmental rehabilitation of contaminated environments and other environmental damage, reserve funds to cover environmental recovery, etc. | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Total | | | 4.0 | 24.0 | 5.3 | 35.9 | 1.7 | 21.9 | 3.6 | 34.6 |

**Figure 41: Solvay's disclosure of certain climate-related operational metrics**
Solvay Annual Integrated Report 2018

| | | Units | Trends | 2018 | 2017 | 2016 | 2015 | 2014 |
|---|---|---|---|---|---|---|---|---|
| | **Energy** | | | | | | | |
| ✓low | Primary energy consumption | Petajoules low heating value (PJ) | ↘ | 127 | 130 | 138 | 175 | 179 |
| | Secondary energy purchased | Petajoules low heating value (PJ) | ↘ | 45 | 49 | 53 | 63 | – |
| | Total energy sold | Petajoules low heating value (PJ) | ↗ | 23 | 22 | 23 | 26 | – |
| | Fuel consumption from non-renewable sources | Petajoules low heating value (PJ) | ↗ | 101 | 100 | 104 | 107 | 100 |
| | Fuel consumption from renewable sources | Petajoules low heating value (PJ) | ↗ | 4 | 3 | 4 | 5 | – |
| ✓low | Energy efficiency index – Baseline 100% in 2012 | % | ↘ | 93 | 94 | 94 | 96 | 99 |

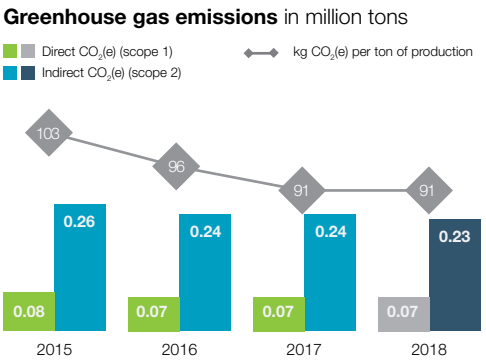
**Figure 42: Sumitomo Chemical's disclosure of carbon intensity**
Sumitomo Chemical Sustainability Data Book 2018




The reason for the deterioration in the intensity index of $CO_2$ emissions outside Japan in fiscal 2017 is due to factors such as new and expanded plant facilities. Sumitomo Chemical is working to improve this index, both inside and outside Japan, putting greater focus on saving energy.

* Index reflects the total production plants of Sumitomo Chemical and its major Group companies that share $CO_2$ emission intensity index reduction goals.

**Figure 43: AkzoNobel disclosure of Scope 1 and 2 GHG emissions**
AkzoNobel Annual Report 2018




Total greenhouse gas emissions made up of direct emissions from processes and combustion at our facilities and indirect emissions from purchased energy.

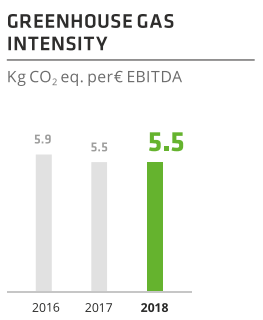
## Figure 44: Sumitomo Chemical's disclosure of Scope 3 GHG emissions
Sumitomo Chemical Sustainability Data Book 2018

**Status of Scope 3 GHG Emissions**

| Category | Emissions (Thousands of Tonnes of $CO_2e$) |
|---|---|
| 1. Purchased goods and services ★ | 1,985 |
| 2. Capital goods | 111 |
| 3. Fuel- and energy-related activities not included in Scopes 1 and 2 ★ | 290 |
| 4. Upstream transportation and distribution ★ | 57 |
| 5. Waste generated in operations ★ | 28 |
| 6. Business travel | 7 |
| 7. Employee commuting | 8 |
| 8. Upstream leased assets | <1 |
| 9. Downstream transportation and distribution | <1 |
| 10. Processing of sold products | — |
| 11. Use of sold products ★ | 44 |
| 12. End-of-life treatment of sold products | 945 |
| 13. Downstream leased assets | — |
| 14. Franchises | — |
| 15. Investments | — |
| Total | 3,475 |

Notes:
- For Scope 3 data, indirect greenhouse gas emissions from business activities throughout the supply chain are calculated separately by category and then added together.
- Calculated for Sumitomo Chemical and Group companies listed on stock indices in Japan (Sumitomo Dainippon Pharma Co., Ltd.; Koei Chemical Co., Ltd.; and Taoka Chemical Co., Ltd.).
- Category 4 does not include Taoka Chemical Co., Ltd.

## Figure 45: Solvay's disclosure of its GHG intensity
Solvay Annual Integrated Report 2018

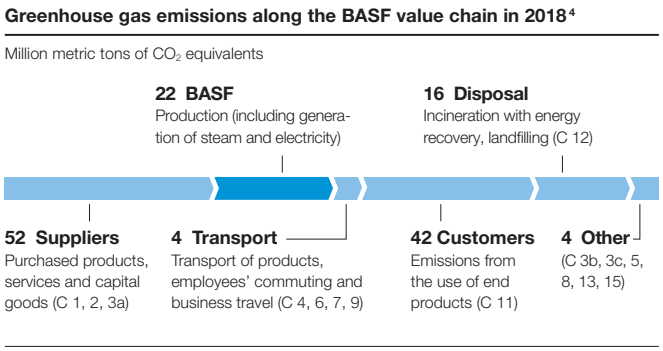



## Figure 46: AkzoNobel's cradle-to-grave carbon footprint
AkzoNobel Annual Report 2018

**Environmental**

| Area | Unit | 2014 | 2015 | 2016 | 2017 | 2018 | Ambition 2020 |
|---|---|---|---|---|---|---|---|
| **Value chain** | | | | | | | |
| Total $CO_2$(e) emissions (cradle-to-grave) | million tons | 17.5 | 15.9 | 15.3 | 16.3 | 15.5 | – |
| Renewable raw materials | % organic RM | 7 | 6 | 6 | 5 | 5 | – |

**Figure 47: BASF's GHG emissions along its value chain**
BASF Annual Report 2018




4 BASF operations including the discontinued oil and gas business; according to Greenhouse Gas Protocol, Scope 1, 2 and 3; categories within Scope 3 are shown in parentheses

**Figure 48: AkzoNobel's eco-premium solutions with customer benefits in % of revenue**
AkzoNobel Annual Report 2018

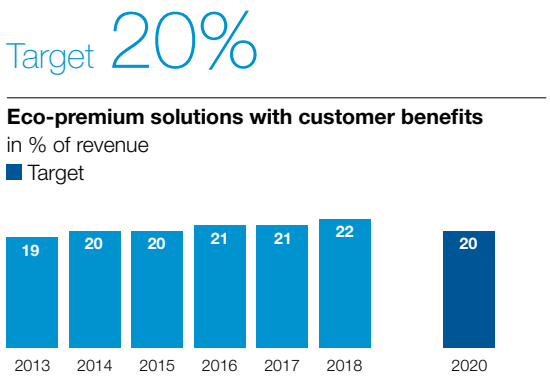



**Figure 49: BASF's 2020 goal for increasing sales from Accelerator products**
BASF Annual Report 2018

**Products and solutions**

| | 2020 goal | Status at end of 2018 | SDGs | |
|---|---|---|---|---|
| Increase the proportion of sales generated by products that make a substantial contribution to sustainable development (Accelerator products) | 28% | 27.7% | SDG 3, 8, 9, 12, 13 | 🕮 |

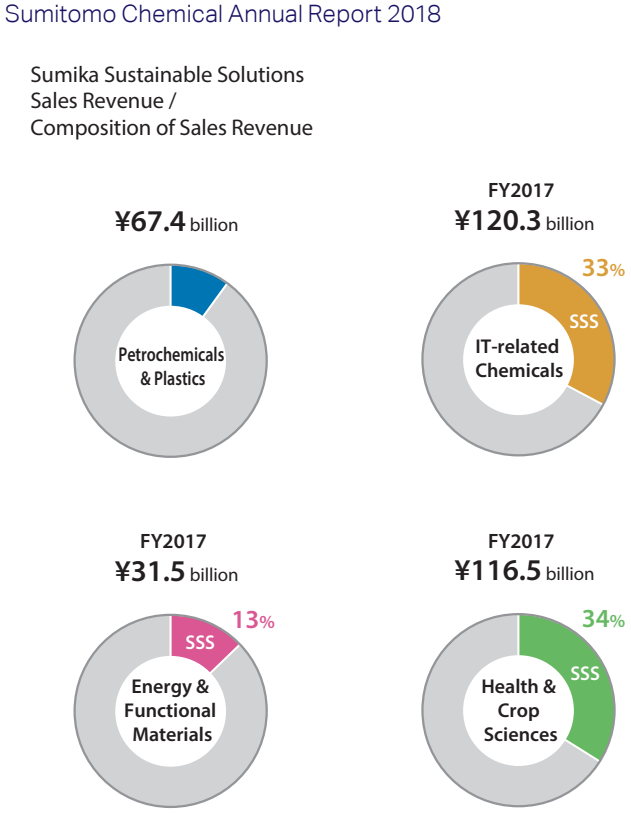
**Figure 50: DSM's disclosure on sales from Brighter Living Solutions**
Royal DSM Integrated Annual Report 2018

**Sustainability statements – Brighter Living Solutions**

| | 2018 | 2017 | 2016 | 2015 | 2014 |
|---|---|---|---|---|---|
| Brighter Living Solutions sales as % of net sales (underlying business) | 62[1,2] | 62 | 63[3] | | |

1 Excluding temporary vitamin effect, see table on page 65.
2 For a small percentage of sales (approximately 2% of sales) classified as BLS, the environmental impact is considered 'best in class' together with other solutions.
3 2016 was the first year of reporting; consequently, there are no comparative figures for the previous years.

**Figure 51: Sumitomo Chemical's disclosure of Sumika Sustainable Solution revenue as a proportion of business unit revenue**
Sumitomo Chemical Annual Report 2018




## Figure 52: Sumitomo Chemical's disclosure around climate change action metrics and targets

Sumitomo Chemical Sustainability Data Book 2018

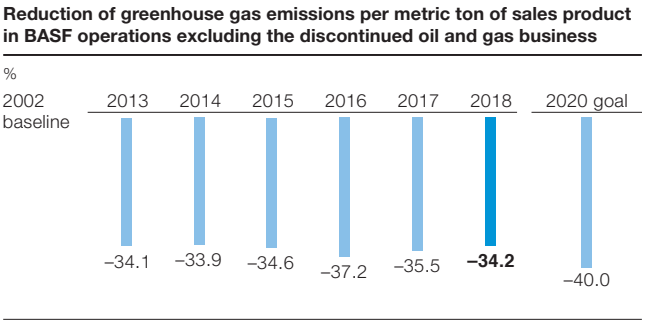
Goal achieved or steadily progressing: ○ Goal not achieved: △

| Items | | Boundary | Fiscal 2017 Goals | Fiscal 2017 Results | Evaluation | Fiscal 2018 Goals | Page |
|---|---|---|---|---|---|---|---|
| Environmental Protection / Climate Change Action | Climate Change Action | | | | | | |
| | Improve unit $CO_2$ emissions from energy use | Sumitomo Chemical | Improve 15% by 2020 compared to 2005 levels | Improved by 20.4% relative to fiscal 2005 | ○ | Improve 15% by 2020 compared to 2005 levels | pp. 34–44 |
| | | Sumitomo Chemical and Group companies in Japan | Improve over 1% per year on average | Improved by 2.8% relative to fiscal 2015 | | Improve over 1% per year on average | |
| | | Group companies overseas | Improve over 1% per year on average | Improved by 2.1% relative to fiscal 2015 | | Improve over 1% per year on average | |
| | Improve unit energy consumption | Sumitomo Chemical | Improve unit energy consumption 15% by fiscal 2020 compared to 2005 levels | Improved by 21.3% relative to fiscal 2005 | ○ | Improve 15% by 2020 compared to 2005 levels | |
| | | Sumitomo Chemical and Group companies in Japan | Improve over 1% per year on average | Improved by 2.1% relative to fiscal 2015 | | Improve over 1% per year on average | |
| | | Group companies overseas | Improve over 1% per year on average | Improved by 2.4% relative to fiscal 2015 | | Improve over 1% per year on average | |
| | Improve unit energy consumption in the logistics division | Sumitomo Chemical*1 | Improve over 1% per year on average | Improved by an annual average of 0.2% relative to the fiscal 2006 standard | △ | Improve over 1% per year on average | |

*1 Within the scope of specified shippers according to the definition stipulated under the Act on the Rational Use of Energy

## Figure 53: BASF's metrics and targets to assess GHG emissions per metric ton of sales product

BASF Annual Report 2018



# 4 Scenario analysis

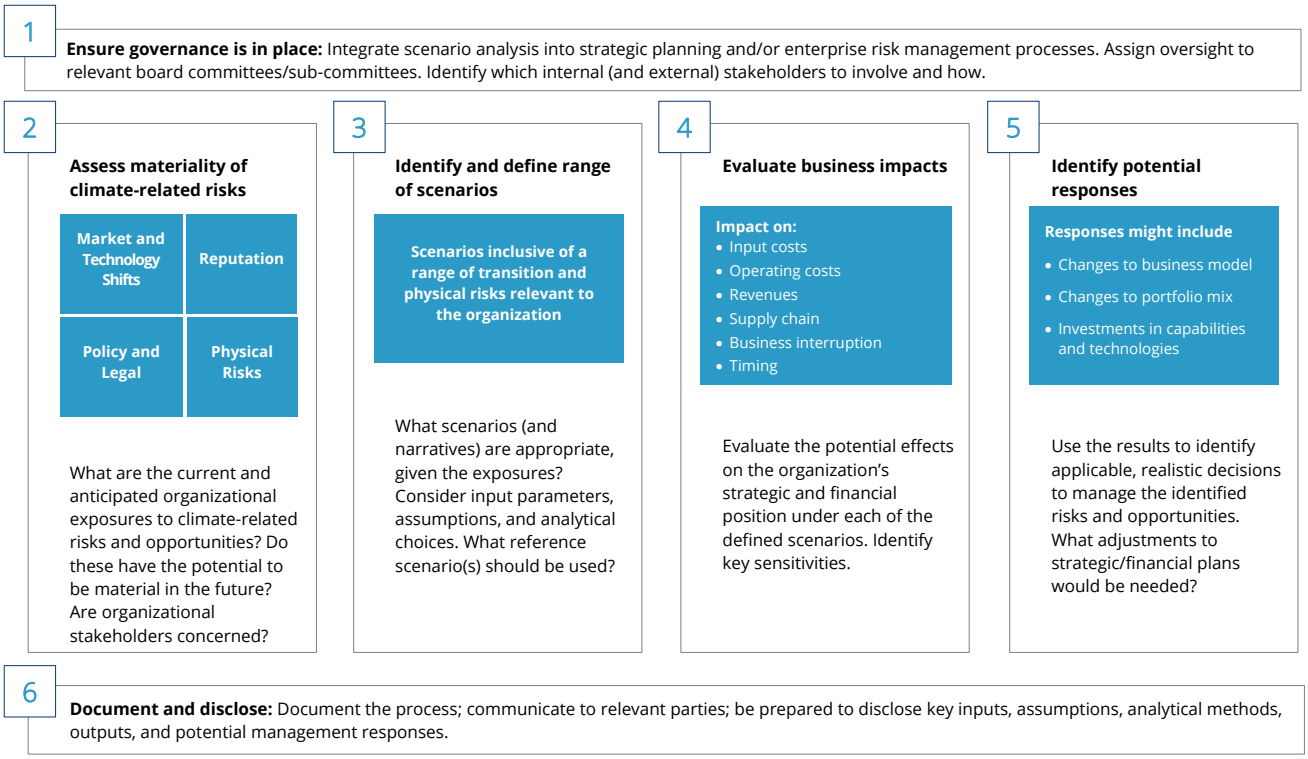
## TCFD RECOMMENDATION FOR STRATEGY C

In their strategy recommendations (part c), the TCFD encourages companies to "describe the resilience of the organization's strategy, taking into consideration different climate-related scenarios, including a 2°C or lower scenario."

The TCFD describes scenarios as "hypothetical constructs and not designed to deliver precise outcomes or forecasts. Instead, scenarios provide a way for organizations to consider how the future might look if certain trends continue or certain conditions are met."

The TCFD's 2019 Status Report found that recommendation strategy (c) attracted the lowest level of disclosure in all jurisdictions and in all three years since 2016. In common with the TCFD's conclusions, the Forum identified scenario analysis as the most challenging aspect of the recommendations and decided to prioritize scenario analysis in their work plan. The Forum has developed an illustrative approach to scenario analysis that builds on the process outlined in the TCFD's Technical Supplement on Scenario Analysis (Figure 54). The Forum's approach is not prescriptive. Rather, the Forum has developed it to recognize particular features of the chemical industry that are relevant when conducting scenario analysis.

**Figure 54: A process for applying scenario analysis to climate-related risks and opportunities**
TCFD Technical Supplement: The use of scenario analysis in disclosure of climate-related risks and opportunities



## SCENARIO ANALYSIS – CHALLENGES FOR THE CHEMICAL SECTOR

The chemical sector faces two main challenges in the application of scenario analysis. First, the number and variety of products manufactured by the chemical industry makes the scope of scenario analysis difficult to identify.

Secondly, the sector operates across the entire value chain and its products and services are integral to almost all other industries: 95% of all manufactured products rely on its products. This means that multiple trends affecting other industries also affect the chemical industry directly and indirectly and the sector needs to calibrate scenario analysis accordingly.

Figure 55 illustrates the sector value chain and some of the products it makes and sectors that it serves.

## APPROACH TO SCENARIO ANALYSIS

### CURRENT STATUS

As with other industries, the chemical sector has no standard approach to climate-related scenario analysis in response to the TCFD's recommendations.

The sector currently uses climate scenarios to a limited extent. Forum members undertake short- to medium-term forward planning exercises based on sensitivity to a range of variables, including commodity prices and market demand. Some Forum member companies use scenarios to support the analysis of risk to a carbon price or water scarcity. The Forum welcomes the opportunity to develop the use of scenarios to support the analysis of medium- and longer-term climate-related risks, opportunities and strategic resilience.

The Forum has therefore developed an initial approach to scenario analysis in the sector based on boxes 2, 3 and 4 of Figure 54 above. The Forum's suggested approach primarily intends to address the challenges described above and to support the development of scenario analysis practices. The approach is illustrative and companies can adapt it to their particular needs.

The TCFD explains that scenario analysis is a tool to assess strategic resilience to climate-related risks. At this stage on the TCFD implementation path, the Forum concludes that scenario analyses are most beneficial in informing strategy development and risk assessment. Over time, the Forum expects these internal practices to support useful external disclosures to investors about the resilience of the business.

**Figure 55: The chemical sector value chain**
WBCSD Chemical Sector SDG Roadmap

| Raw materials | → Basic chemicals | → Chemical intermediaries | → Formulated products and product materials | → Customers of the chemical sector |
|---|---|---|---|---|
| | • Olefins (ethylene, propylene, butylene)<br>• Aromatics (benzene, toluene, xylenes)<br>• Chlor-Alkali (chlorine, caustic soda)<br>• Methanol<br>• Bio-based materials (e.g. sugars, starches, natural oils and acids)<br>• Others (e.g., ammonia, phosphorous) | • Commodities<br>• Differentiated commodities<br>• Technical specialities | • Plastics and Engineering Resins<br>• Extruded films, pipes, profiles, coatings, sheets, foams<br>• Blow-molded parts<br>• Injection molded parts<br>• Composites<br>• Synthetic Fibers<br>• Rubber Products<br>• Paints & Coatings<br>• Adhesives & Sealants<br>• Lubricants<br>• Water Treatment Products<br>• Cleaning Products<br>• Industrial Chemicals<br>• Flame Retardants<br>• Many others... | • Automotive/ Transportation<br>• Consumer Products<br>• Packaging<br>• Building & Construction<br>• Recreation/sport<br>• Industrial<br>• Medical<br>• Pharmaceuticals<br>• Personal care<br>• Textiles<br>• Electrical/electronics<br>• Aircraft/aerospace<br>• Food<br>• Bio-based materials |

## AN ILLUSTRATIVE APPROACH TO SCENARIO ANALYSIS

### HIGH-LEVEL SUMMARY

A. Conduct a scoping exercise to determine what to analyze in order to conduct a strategic resilience assessment and how different business units, product lines and assets are relevant to the assessment. This builds on step 2 in Figure 54

B. Identify relevant scenarios to analyze strategic resilience according to the purpose and scope defined above

C. Evaluate the business impacts of climate change in different scenarios

D. Develop the company's strategic response to the evaluation above

E. Document and disclose inputs and outputs of scenario analysis

### A. Defining the scope of analysis – What to analyze in order to conduct and report on strategic resilience assessment

For chemical companies, one of the most challenging aspects of conducting climate scenario analysis is determining how to scope the analysis, meaning deciding which parts of the business and value chain to prioritize for assessment and why/how they are most relevant to an analysis of strategic resilience.

Step 2 in Figure 54 involves assessing the materiality of climate-related risks. The Forum believes that a two-part approach to assessing materiality is helpful for the purposes of the scoping exercise. The first part considers business materiality generally; many companies are likely to conduct a materiality assessment as part of their standard annual compliance process. The second part aims to identify the most significant climate risks and opportunities to the business.

1. Business materiality – Which parts of the business (assets, business units or product lines) are most crucial for the long-term strategic resilience of the company? For example, which parts are important growth areas, significant contributors to revenue or important operational assets?

2. Climate materiality – Which climate risks and opportunities are most likely to have a material impact on the business? This includes consideration of both physical and transition related risks on supply chains, operations and markets.

Determining the timescales over which to analyze resilience is an important part of the scoping exercise. The materiality of climate-related risks is likely to change over time and companies should update the scoping exercise as circumstances change. Scenario analysis is useful where the timeframe extends beyond the horizon of the business planning cycle and considers the lifespan of the company's assets.

Companies should apply the scoping exercise across the whole value chain, considering potential climate impacts on supply chain, operations and markets for different products. Tables 3 and 4 below provide some guiding questions for the scoping of the parts of the business to include in scenario analysis.

#### Scoping for transition risk

Forum members consider transition risks to present the most pressing near-term threat to resilience. Table 3 provides guiding questions to assess which parts of the business are vulnerable to transition risk or may benefit from transition opportunities, taking into consideration the whole value chain.

**Table 3: Scoping for transition risk**

| PART OF VALUE CHAIN | QUESTIONS TO GUIDE SCOPING |
|---|---|
| Supply chain | • Is the low-carbon transition likely to affect feedstock availability and price? |
| Direct operations | • What is the relative carbon intensity of production processes? In principle, the more carbon intensive the process, the more likely it – or the associated business unit – will be within the scope of transition risk scenario analysis.<br>• What are the geographic vulnerabilities to the low-carbon transition? For example, what is the current and anticipated energy and climate regulatory environment in jurisdictions within which the company operates? What impact might it have on transport and logistics? |
| Downstream markets | • Are the emissions associated with use of the product high?<br>• Does the product sell into markets likely to face significant change under a low-carbon transition, such as transport or energy-intensive manufacturing processes?<br>• Are changing customer preferences associated with a low-carbon transition likely to affect the product? |

### Example from Solvay

To assess impacts on markets, we initially focused on a limited number of business units which are potentially the most impacted by the transition to a low carbon economy, selected on the basis of three criteria:

- Contribution to energy consumption and GHG emissions of the group;
- Exposure to markets affected by a low carbon transition: building and construction, automotive;
- GHG emissions in our product portfolio (SF6, HFA).

### Scoping for physical climate risk

The Forum believes that, over time, physical risks could affect business and strategic resilience, particularly in high-warming scenarios. Table 4 provides possible questions to consider when scoping strategic resilience to physical risks, taking into consideration the whole value chain.

While the exercise for scoping resilience to physical risks should take account of the whole value chain, it may be helpful to start by focusing on company-owned assets while scenario analysis and reporting practices are being developed.

**Table 4: Scoping for physical climate risk**

| PART OF VALUE CHAIN | QUESTIONS TO GUIDE SCOPING |
|---|---|
| Supply chain | • Which feedstocks are critical?<br>• Do feedstocks have unique/single sources or multiple suppliers?<br>• How are these materials transported to production facilities? How long is the transportation step from supplier to production facility? What are the modes of transportation? |
| Direct operations | • Are sites resilient to extreme weather events, including droughts, heatwaves, storm surges and flooding?<br>• Are the production processes water intensive? |
| Downstream markets | • How does climate change impact the potential for market growth in different regions?<br>• How could climate change affect demand in existing markets? |

The Forum welcomes the guidance on first-order and second-order impacts provided in the European Bank for Reconstruction and Development (EBRD) report Advancing TCFD guidance on physical climate risks and opportunities as described in Figure 56.

**Figure 56: First- and second-order impacts**
European Bank for Reconstruction and Development (EBRD): Advancing TCFD guidance on physical climate risks and opportunities

**First-order impacts are direct hazards from climate change, both acute and chronic, that are measurable in physical terms (degrees Celsius, millimeters of rain, sea temperature, acres burned, and so on) and that affect specific regions or locations, often within a discrete timeframe (days, weeks, years). These hazards are relevant for all economic and human activities.**

**Second-order impacts include all impacts of climate change on economic, human and ecosystems beyond the boundaries of the corporation. These may include changes in the availability of natural resources, agricultural productivity, and the geographic distribution of species, disruption to transport, changes to global trade routes, migration, and macroeconomic indicators such as GDP, employment and interest rates. Unlike direct climate hazards, second-order impacts are difficult to predict and even harder to mitigate through traditional approaches to risk management.**

Although the Forum recognizes the importance of first-order physical risks, members believe that the wider disruption to society caused by second-order impacts in high warming scenarios is likely to overshadow these impacts. When scoping physical risks and opportunities, companies can assess both first- and second-order impacts depending on what they consider material to the business. However, given the difficulty in predicting and mitigating second-order impacts, it may not be practical or useful to include them all.

On completion of the scoping exercise, companies should be able to identify:

- Business segments, units, product lines, of strategic importance and most vulnerable to climate risk and/or greatest potential for leveraging climate-related opportunities
- The geographies, supply chain tiers, in which those businesses and product lines operate
- The timescales over which to apply analysis

The next step is to identify scenarios that are most relevant to the scope and purpose of the analysis.

**B. Identify range of scenarios matched to the purpose and scope of the analysis**

The Forum supports the use of both rapid low-carbon transition scenarios (with a 1.5 to 2°C outcome) and higher-emissions scenarios that anticipate a higher warming outcome (>3°C) and more significant physical impacts. Scenarios should represent alternative plausible future outcomes. Considering at least two scenarios encourages companies to test the resilience of their business strategy under a range of possible future states.

In order to simplify scenario analysis, the Forum suggests that transition and physical risks are assessed separately, using appropriate scenarios for each category of risk respectively.

**Low-carbon transition scenarios for analysis of resilience to transition risks**

The Forum favors the broad approach of using publicly available scenarios as a starting point for resilience analysis. In particular, the Forum supports the use of International Energy Agency (IEA) scenarios as they are detailed, quantified and publicly available. The IEA provides information on energy mix, energy demand and prices; but it lacks information on some other features that might be relevant to chemical companies' resilience assessment, for example shifting consumer preferences. If there are gaps in the IEA scenarios that limit the analysis of particular issues within the scope of the exercise, it is possible to supplement public scenarios with other sources. Companies may also bring their own insights and analyses of particular markets or products in order to complement public scenarios, such as possible demand behaviors and consumer preferences.

As well as identifying appropriate scenarios, the *TCFD's Technical Supplement on Scenario Analysis* recommends that, as part of the scenario analysis process (Step 3, Figure 54), companies should consider which input parameters, assumptions and analytical choices best support their analyses. An indicative list of parameters and assumptions is provided in Figure 3 of the TCFD's Technical Supplement on Scenario Analysis, which is replicated in this report at Appendix 2: Key considerations.

To build on the work of the TCFD, Forum members prepared Table 5 below, which itemizes the scenario features they consider to be most useful for chemical companies when building transition scenarios. Table 5 also lists organizations that produce information on particular features of scenarios. Due to the chemical sector's diversity, companies should prioritize these and other attributes according to what is material to their specific portfolio.

**Table 5: Useful scenario features for chemical companies**

| CATEGORY | ATTRIBUTES | POTENTIAL SOURCES OF INFORMATION |
|---|---|---|
| Socio-economic | Population<br>GDP growth<br>Urbanization<br>Education<br>Industrial production | Oxford Economics<br>International Monetary Fund (IMF)<br>World Trade Organization (WTO)<br>Organization for Economic Co-operation and Development (OECD)<br>World Bank<br>IHS Markit<br>Shared Socioeconomic Pathways (SSP) |
| Commodity prices | Natural gas price<br>Crude oil price<br>Electricity prices | IEA<br>Oxford Economics<br>The Energy Transition Risk Project |
| Energy | Energy demand<br>Proportion of renewable<br>Energy efficiency | IEA<br>Oxford Economics<br>International Renewable Energy Agency (IRENA)<br>The Energy Transition Risk Project<br>IHS Markit<br>DNV GL (Energy Transition Outlook) |
| Policy | Carbon price<br>Carbon-related legislation | IEA<br>IRENA Remap<br>Shell<br>The Energy Transition Risk Project |
| Technology (related to operation of chemicals plants) | Carbon capture and storage/ use | Deep Decarbonization Pathways Project<br>New Climate Economy<br>IEA Technology Roadmaps<br>The Energy Transition Risk Project<br>IHS Markit |
| Customer industries | Changing markets:<br>Automotives<br>Buildings<br>Energy<br>Food/packaging<br>Land use | IEA<br>Shell<br>Bloomberg NEF<br>IHS Markit |

Climate-related transition scenarios present a series of assumptions and attributes describing developments relating to policy, market dynamics and commodity prices, among many other variables. The following example attributes are taken from different sources considered relevant to chemical companies:

**Example attributes of a 2°C transition scenario**

- Carbon prices increase globally (estimated to reach $63/tCO2 by 2025 and $140/tCO2 by 2040 in advanced economies)[22]
- A shift in energy demand to lower-carbon and renewable energy sources reduces the crude oil price but raises the natural gas price
- Increased uptake of fuel-efficient light-duty vehicles and electric vehicles increases demand for plastics and batteries
- The cost of shipping fuel increases

### Physical climate risk scenarios

The Forum believes that the Intergovernmental Panel on Climate Change (IPCC) physical risk scenarios are most appropriate for assessing physical risks – in particular RCP8.5, which is a high-emissions scenario characterized by increasing GHG emissions that lead to high atmospheric GHG concentrations. Physical climate scenarios fix the amount of GHG concentration in the atmosphere and analyze resulting changes in temperature, precipitation, drought, wildfires and sea level rise, among a range of other variables. The following are example attributes for a physical climate scenario:

**Example attributes of a 4°C physical climate scenario**

- The frequency of acute impacts of climate change, such as extreme weather (storms and floods) and the severity of drought events and wildfires increase
- The severity of impacts increases, which depresses economic growth in particularly vulnerable countries and regions
- Chronic climate changes, including increased temperature and water stress, reduce the availability and quality of water in some regions and reduce operational effectiveness

### C. Evaluate business impacts based on scenario analysis to assess business resilience

Once a company has selected the climate scenarios and attributes it will use for the strategic resilience analysis, the next step is to map out the potential business impacts, such as changes to input costs and supply chain, operating costs, operational integrity and business continuity and revenues. The company may express impacts in financial terms (taking into consideration the four major categories of financial impact identified by the TCFD – revenues, expenditures, assets and liabilities, and capital and financing) and non-financial terms.

As a starting point, the evaluation process could involve considering how climate change might impact those parts of the business within scope of the exercise, assuming that the current strategy and business model continues and/or that any costs associated with climate impacts are not passed on to customers but are absorbed by the business. The process of evaluating the business impacts of climate change provides a high-level, qualitative and directional assessment that can help companies prioritize efforts to further analyze and manage the potential impacts identified. For example, the evaluation process might highlight where it is necessary to conduct or commission modeling work to understand the impact of climate change on prices and demand for particular assets, products or feedstocks.

Figure 57 illustrates the potential impacts of a carbon price on a specialty chemicals company. Figure 58 illustrates the potential impacts of physical risks such as changing precipitation patterns, extreme variability in weather patterns and a chronic rise in the global mean temperature.

#### Example from BASF

We identified the circular economy as a key contributor to a low-carbon economy. In order to evaluate the potential impact on BASF due to different levels of action on the circular economy in our customer industries, we conducted a scenario analysis using a "moderate," "progressive" and business as usual (BAU) scenario. We identified key drivers of change across three major customer industries and established a set of assumptions about the direction and magnitude of change, based on extensive literature search. These included, for example, the number of shared cars (automotive), renovation rate (construction) and percentage of arable land where precision farming is applied (consumer goods).

We evaluated the impact of each circular economy scenario by calculating the impact on sales in each strategic business unit (SBU) compared with BAU. Results were shared internally with SBUs and were used to develop a strategy regarding the circular economy, which was presented to the Board of Directors alongside the scenario analysis results.

**Figure 57: Illustrative impacts of high carbon price on a speciality chemical company in a 2°C scenario**

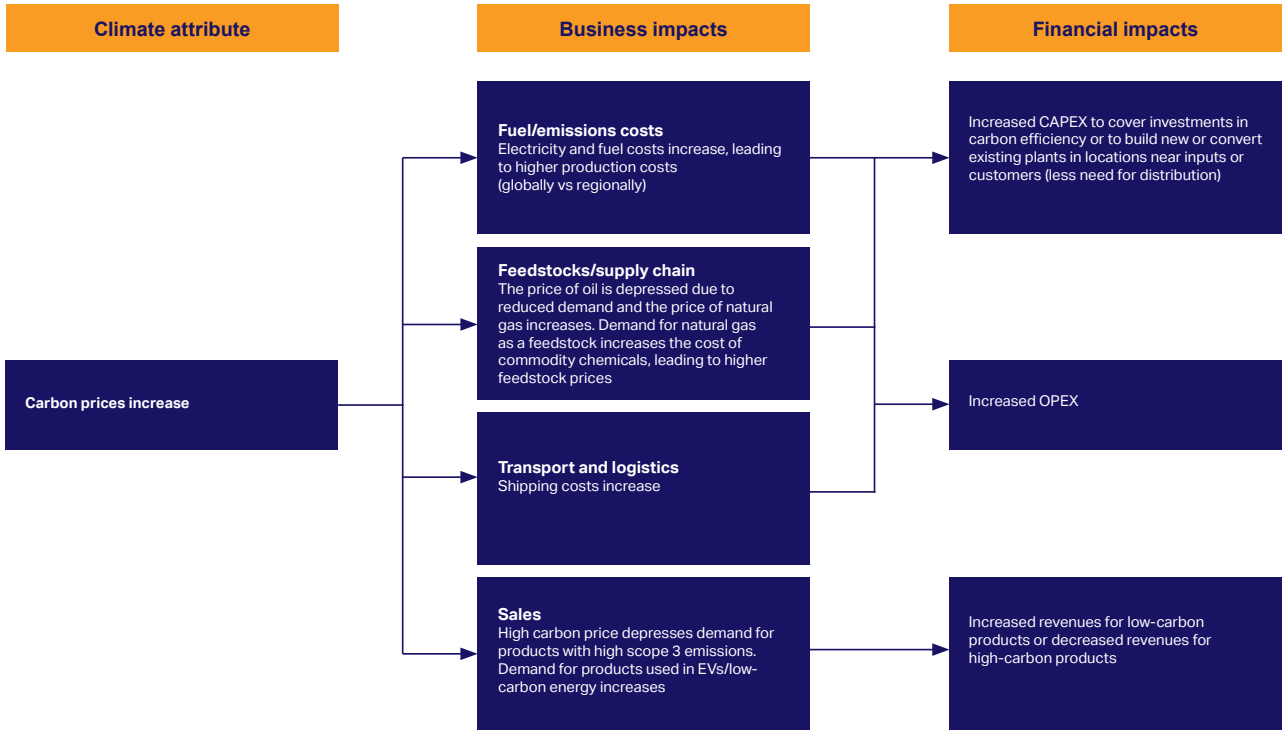
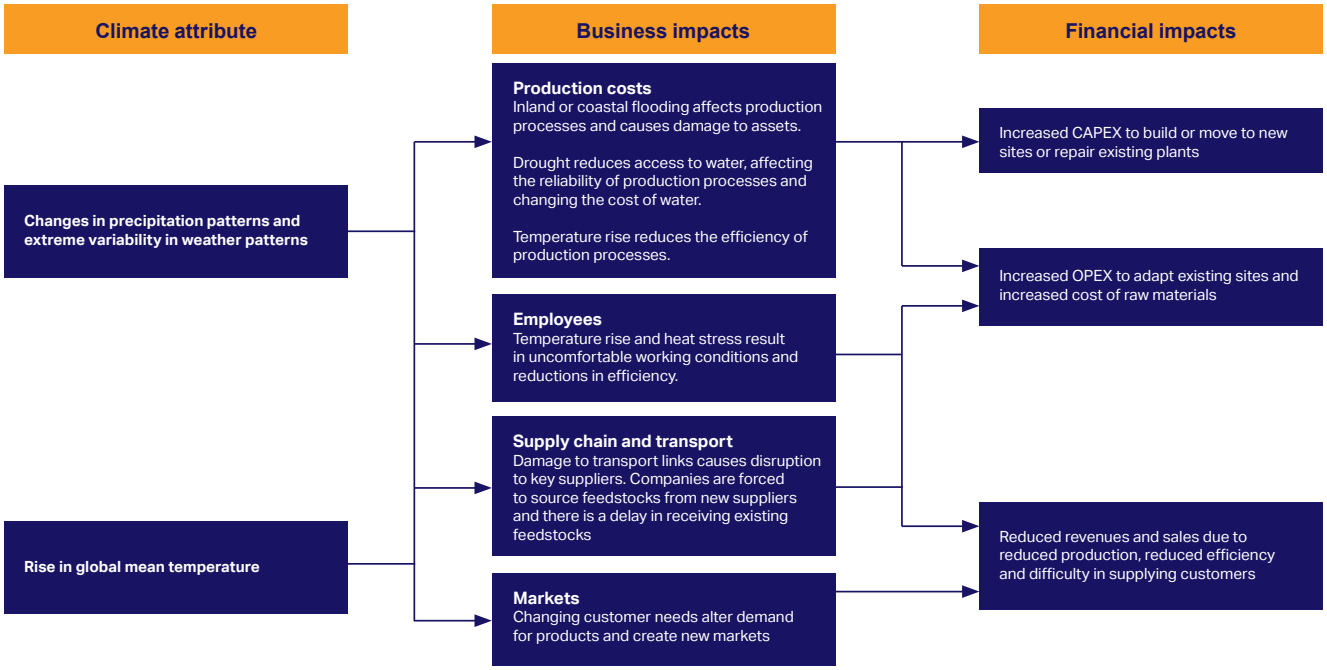


**Figure 58:** Illustrative chronic and acute climate impacts on a chemical company in a 3-4°C scenario




Numerous tools, maps and models are available to assist physical risk analysis. Table 6 includes several examples of publicly available tools, maps or models that companies can use to inform their assumptions about the future. Most Forum member companies are conducting water risk site assessments. For example, in 2018 DSM completed water risk assessments at 100% of its material water sites, identifying risks related to water quality, changing local regulations and limitations in local infrastructure.[23]

### Example from Solvay

Analysis of each physical risk draws on different sources and experts.

For example:

- Analysis of flood and hurricane risk is conducted with our insurers;
- Analysis of water scarcity is conducted by our Health, Safety and Environment (HSE) team and the Sustainability team using the WRI Aqueduct tool.

**Table 6:** Publicly available tools, maps or models

| CATEGORY | POTENTIAL SOURCES OF INFORMATION |
|---|---|
| Global tools assessing climate risks | WBCSD Water Tool,[24] World Resources Institute Aqueduct tool,[25] UNEP Global Risk Data Platform,[26] SwissRe CatNet,[27] Aon Catastrophe Insight[28] |
| Regional or national models and studies | European Environment Agency,[29] United States EPA[30] |

### D. Strategic response

Having analyzed the business impacts that could materialize in different scenarios, companies need to identify appropriate strategic responses in order to mitigate risks and capitalize on opportunities. These can include changes to the business (e.g., research and development priorities, product portfolio development, strengthening supply chain resilience) and to financial planning (e.g., investments in new technology, new markets) aimed at future-proofing the company and supporting its strategic resilience.

Climate-related financial disclosures are useful where they provide information about how and why the reporting company's strategy is, or is expected to be, resilient to the impacts of climate change.

### E. Document and disclose

Chemical companies are on an implementation path and in the early stages might provide a more qualitative description of how they have analyzed and assessed resilience under climate scenarios.

As companies progress, investors are looking for more detailed quantitative disclosures on inputs, assumptions and outputs of scenario analysis.

#### USER PERSPECTIVES

Users recognize that scenario analysis presents challenges for chemical companies and that companies are in the early stages of using climate scenarios to assess resilience. Users need to understand the building blocks of a company's assessment, including key parameters, variables and assumptions. However, disclosures on the implications of scenario analysis (e.g., how companies expect demand for products to change under different scenarios, how business priorities may change) and the strategic response of companies (e.g., portfolio development, investments in new technologies) must complement this. Users wish to see companies outlining a pathway to achieving their desired outcome/objectives, demonstrating that they are taking a strategic view.

5

# Conclusion

# 5 Conclusion

**The chemical sector is both a major source of emissions and central to the wider low-carbon transition. It has the potential to reduce GHG emissions in its own operations and to enable emissions reductions across the economy.**

Forum member companies are already implementing the TCFD recommendations and enhancing their disclosures. This report highlights current practices. Forum members are integrating climate change into governance processes and strategy across different business functions. Similarly, risk management disclosures demonstrate that climate-related risks are part of company-wide enterprise risk management processes. Forum members are also responding to climate-related opportunities through the marketing and development of sustainable product solutions and are responding to climate-related risks by improving energy efficiency and working to reduce GHG emissions across operations and supply chains. Climate-related operational metrics and targets support disclosures relating to these strategic changes.

Forum members are committed to enhancing disclosures over time in order to provide clear and useful information to aid investors and other users. Currently, a gap exists between what preparers are able to provide in their disclosures and the expectations of some users.

Users particularly value more detailed information on:

- The resilience of companies under different climate scenarios
- The potential impacts of physical climate risks on specific material assets and the security of supply of feedstocks
- The strategic actions companies are taking in response to climate risks and opportunities, including changes to product portfolio, R&D activity and capital expenditure

Users would value further information on the sustainability of companies' product portfolios, including the outcomes products contribute to and the allocation of R&D spending for climate adaptation and mitigation products.

Next steps for the chemical sector:

As the Forum progresses along the TCFD's implementation path, members expect to develop reporting in the following areas:

- **Scenario analysis to assess long-term risks and opportunities under future climate states:** Forum members welcome opportunities to collaborate and share knowledge to advance the use of scenario analysis in the chemical sector. Forum members look forward to the availability of enhanced data sources to enable the assessment of physical risks to assets and supply chains and are committed to integrating more modeling information about climate-related physical risks into scenario analyses as it emerges.
- **Sustainable product impacts and financials:** Forum members expect to enhance the level of disclosure linking product portfolios to specific sustainability outcomes, for example, climate change mitigation and adaptation, and hope to provide more financial disclosures connected to sustainable products, such as capital expenditure, R&D investments and revenues over time.

Given the urgent need to address climate change and the important role of the chemical sector in the transition, the Forum is supportive of the TCFD's ambition and recommendations.

Forum members are committed to enhancing their climate-related disclosures through interaction with other companies in the sector and with users. Enhanced disclosures will provide investors with the relevant information to support informed and efficient capital-allocation decisions. Strategies that embed climate change and clear and transparent disclosures will also enable companies to manage the risks and capitalize on the opportunities presented by the low-carbon transition.

# 6 Appendices

## APPENDIX 1: ILLUSTRATIVE EXAMPLES

**Figure 59: Illustrative examples of relevant metrics from the materials and buildings group**
TCFD Report Annex: Implementing the Recommendations of the Task Force on Climate-related Financial Disclosures

**MATERIALS AND BUILDINGS GROUP METRICS - ILLUSTRATIVE EXAMPLES**

| Financial Category | Climate-Related Category | Example Metric | Unit of Measure | Alignment | Rationale for Inclusion | Metals and Mining | Chemicals | Construction Materials | Capital Goods | Real Estate |
|---|---|---|---|---|---|---|---|---|---|---|
| Revenues | Risk Adaptation & Mitigation | Revenues/savings from investments in low-carbon alternatives (e.g., R&D, equipment, products or services) | Local currency | CDP: CC3.2, 3.3, CC6.1<br>SASB: IF0403-1 | New products and revenue streams from climate-related products and services and the return on investments of CapEx projects that create operational efficiencies. | ■ | ■ | ■ | ■ | ■ |
| Expenditures | Risk Adaptation & Mitigation | Expenditures (OpEx) for low-carbon alternatives (e.g., R&D, technology, products, or services) | Local currency | GRI 302-5 | Expenditures for new technologies are needed to manage transition risk. The level of expenditures provides an indication of the level to which the future earning capacity of the core business might be affected. | ■ | ■ | ■ | ■ | ■ |
| Expenditures | Energy/Fuel | Total energy consumed, broken down by source (e.g., purchased electricity and renewable sources) | GJ | SASB: IF0402-02<br>GRI: 302-1 | The metals and mining industries are energy- and emission-intensive industries. Buildings also account for a large portion of energy and fuel consumption, particularly in relation to heating. Understanding the levels of energy consumption by source provides an indication of the potential impact of regulatory measures in relation to the use of certain energy sources as well as the transition risks in a low-carbon economy scenario. | ■ | ■ | ■ | ■ | ■ |
| Expenditures | Energy/Fuel | Total fuel consumed—percentage from coal, natural gas, oil, and renewable sources | GJ | SASB: NR0302-04 | | ■ | ■ | ■ | ■ | ■ |
| Expenditures | Energy/Fuel | Total energy intensity—by tons of product, amount of sales, number of products depending on informational value | GJ | GRI 302-3 | In the transition to a low-carbon economy, the energy-efficiency levels achieved in production provide investors with an indication of the vulnerability of the product portfolio to transition risk and thus earning capacity. | ■ | ■ | ■ | ■ | ■ |
| Expenditures | Water | Percent of fresh water withdrawn in regions with high or extremely high baseline water stress | Percentage | SASB: NR0401-05 | Water stress can result in increased cost of supply, factual inability to produce, and/or legislation to regulate water withdrawal for production. The percent withdrawn in high water-stress areas informs the risk of significant costs or limitations to production capacity. | ■ | ■ | ■ | ■ | ■ |
| Assets | Location | Area of buildings, plants or properties located in designated flood hazard areas | Percentage probability, costs to insure in local currency | GRESB: Q15.1, 15.2<br>SASB: IF0401-13, 02-13 | Flooding risks can result in physical damage to properties, affecting their serviceability. Understanding the potential impacts of flooding risks and the related financial implications informs investors about potential changes to the earning capacity of real estate portfolios. | ■ | ■ | ■ | ■ | ■ |
| | | | Square meters or acres | SASB: IF0402-13 | | | | | | |
| Assets | Risk Adaptation & Mitigation | Investment (CapEx) in low-carbon alternatives (e.g., capital equipment or assets) | Local currency | GRI 302-5 | Investments in new technologies are needed to manage transition risk. The level of investment provides an indication of the level to which the future earning capacity of the core business might be affected. | ■ | ■ | ■ | ■ | ■ |

## APPENDIX 2: KEY CONSIDERATIONS

**Figure 60: Key considerations: Parameters, assumptions, analytical choices and impacts**
TCFD Technical Supplement: The Use of Scenario Analysis in Disclosure of Climate-Related Risks and Opportunities

| Parameters/Assumptions | Analytical Choices | Business Impacts/Effects |
|---|---|---|
| **Discount rate** – what discount rate does the organization apply to discount future value? | **Scenarios** – what scenarios does the organization use for transition impact analysis and which sources are used to assess physical impact both for central/base case and for sensitivity analyses? | **Earnings** – what conclusions does the organization draw about impact on earnings and how does it express that impact (e.g. as EBITDA, EBITDA margins, EBITDA contribution, dividends)? |
| **Carbon price** – what assumptions are made about how carbon price(s) would develop over time (within tax and/or emissions trading frameworks), geographic scope of implementation, whether the carbon price would apply only at the margin or as a base cost, whether it is applied to specific economic sectors or across the whole economy and in what regions? Is a common carbon price used (at multiple points in time?) or differentiated prices? Assumptions about scope and modality of a $CO_2$ price via tax or trading scheme? | **Quantitative vs. qualitative or "directional"** – is the scenario exercise fully quantitative or a mix of quantitative and qualitative? | **Costs** – what conclusions does the organization draw about the implications for its operating/production costs and their development over time? |
| **Energy demand and mix** – what would be the resulting total energy demand and energy mix across different sources of primary energy e.g. coal/ oil/ gas/ nuclear/renewables (sub-categories)? How does this develop over time assuming supply/end-use efficiency improvements? What factors are used for **energy conversion efficiencies** of each source category and for end-use efficiency in each category over time? | **Timing** – how does the organization consider timing of implications under scenarios e.g. is this considered at a decadal level 2020; 2030; 2040; 2050 | **Revenues** – what conclusions does the organization draw about the implications for the revenues from its key commodities/ products/ services and their development over time? |
| **Price of key commodities/products** – what conclusions does the organization draw, based on the input parameters/ assumptions, about the development over time of market prices for key inputs, energy (e.g. coal, oil, gas, electricity)? | **Scope of application** – is the analysis applied to the whole value chain (inputs, operations and markets), or just direct effects on specific business units / operations? | **Assets –** what are the implications for asset values of various scenarios? |
| **Macro-economic Variables** – what GDP rate, employ-ment rate, and other economic variables are used? | **Climate models/data sets** – which climate models and data sets support the assessment of climate-related risks? | **Capital Allocation/ investments –** what are the implications for capex and other investments? |
| **Demographic variables –** what assumptions are made about population growth and/or migration? | **Physical risks** – when assessing physical risks, which specific risks have been included and their severity (e.g., temperature, precipitation, flooding, storm surge, sea level rise, hurricanes, water availability/ drought, landslides, wildfires or others)? To what extent has the organization assessed the physical impact to its portfolio (e.g. largest assets, most vulnerable assets) and to what extent have physical risks been incorporated in investment screening and future business strategy? | **Timing –** what conclusions does the organization draw about development of costs, revenues and earnings across time (e.g. 5/10/20 year)? |
| **Efficiency –** to what extent are positive aspects of efficiency gains/clean energy transition/physical changes incorporated into scenarios and business planning? | To what extent has the impact on prices and availability in the **whole value chain** been considered, including knock on effects from suppliers, shippers, infrastructure, and access to customers? | **Responses –** what information does the organization provide in relation to potential impacts **(**e.g. intended changes to capital expenditure plans, changes to portfolio through acquisitions and divestments, retirement of assets, entry into new markets, development of new capabilities etc.)? |
| **Geographical tailoring of transition impacts** - what assumptions does the organization make about potential differences in input parameters across regions, countries, asset locations, and markets? | | **Business Interruption due to physical impacts** – what is the organization's conclusion about its potential business interruption/productivity loss due to physical impacts both direct effects on the organization's own assets and indirect effects of supply chain/product delivery disruptions? |
| **Technology** – does the organization make assumptions about the development of performance/cost and resulting levels of deployment over time of various key supply and demand-side technologies (e.g. solar PV/CSP, wind, energy storage, biofuels, CCS/CCUS, nuclear, unconventional gas, electric vehicles, and efficiency technologies in other key sectors including industrial and infrastructure)? | | |
| **Policy** – what are assumptions about strength of different policy signals and their development over time (e.g. national headline carbon emissions targets; energy efficiency or technology standards and policies in key sectors; subsidies for fossil fuels; subsidies or support for renewable energy sources and for CCS/CCUS) | | |
| **Climate sensitivity assumptions** - assumptions of temperature increase relative to $CO_2$ increase? | | |

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## ABOUT WBCSD

WBCSD is a global, CEO-led organization of over 200 leading businesses working together to accelerate the transition to a sustainable world. We help make our member companies more successful and sustainable by focusing on the maximum positive impact for shareholders, the environment and societies.

Our member companies come from all business sectors and all major economies, representing a combined revenue of more than USD $8.5 trillion and 19 million employees. Our global network of almost 70 national business councils gives our members unparalleled reach across the globe. WBCSD is uniquely positioned to work with member companies along and across value chains to deliver impactful business solutions to the most challenging sustainability issues.

Together, we are the leading voice of business for sustainability: united by our vision of a world where more than 9 billion people are all living well and within the boundaries of our planet, by 2050.

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**World Business Council**
**for Sustainable Development**

Maison de la Paix
Chemin Eugène-Rigot 2B
CP 2075, 1211 Geneva 1
Switzerland

www.wbcsd.org