

# Business for Climate Action



## **A business view on climate-related challenges and opportunities**

with a collection of practical examples  
from econsense member companies



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# 1 Introduction

## 1.1 Climate change and the role of business

The effects of climate change are materializing faster than expected and extreme weather will strike as climate change takes hold: Heavier rainfall, fiercer storms and intensifying droughts are among the key risks of climate change as outlined by the Intergovernmental Panel on Climate Change (IPCC), the body of the world's leading climate scientists convened by the United Nations.<sup>1</sup>

These developments put not only environmental and societal, but also economic development at risk. And costs of inaction will be high. Climate change is a key risk deserving business attention, strategy and action. According to the World Economic Forum's 2017 Global Risk Assessment Report<sup>2</sup>, climate change is one of the highest-impact risk to business and presents major implications both inside individual companies and across the full supply chain. Key business functions can be undermined by the impacts of climate change. Thus, effective measures are needed to mitigate emissions and to adapt to the effects of climate change. Mitigation involves taking action to slow climate change by reducing greenhouse gas emissions. For companies, this means taking actions to reduce the greenhouse gas emissions attributable to operations, products and services. Adaptation involves taking action to respond to the effects of changes in climate. For companies, this means taking actions to minimize and respond to the effects of climate change on the organization.

Business have a special role in addressing climate change: On one hand, companies are emitters of GHG in the course of their value creation. On the other hand, companies play a pivotal role in combating climate change as a source of finance and as a driver of innovation and technological development. Climate goals will not be achieved without companies. Yet, companies can not do it alone. Governments are asked to foster policies that ensure competitiveness, economic growth and jobs, thus enabling business to use their innovative power to protect the climate and enable the transition towards a sustainable world economy.<sup>3</sup>

This publication addresses the complexity of how business is approaching climate change. A range of practical examples and activities of business on climate mitigation and adaptation outlines the progress that is already made in tackling climate change.

## 1.2 The policy framework: Paris Agreement and SDGs

In autumn 2015, the world has set powerful new milestones to tackle climate change: The Paris Agreement sets the path for the world community to reduce greenhouse-gas emissions and the United Nation's 2030 Agenda shapes a new global vision and outlines action to combat climate change as one

of its main goals. With the 2030 Agenda and the Paris Agreement, the global community highlights its commitment to combat climate change.<sup>4</sup>

The Paris Agreement entered into force on 4 November 2016.<sup>5</sup> For the first time, countries around the world have committed to tackle climate change together. The Paris Agreement sets a long-term goal to keep the average global temperature increase to well below 2°C, with all countries pursuing efforts to keep the temperature rise below 1.5°C. The Agreement also aims to achieve emissions neutrality in the second half of the century. Furthermore, the Paris Agreement accelerated action on market-based mechanism, established a framework for a new era in climate action and laid the foundation for future cooperation amongst countries.

### Carbon pricing

Putting a price on carbon can be an essential step to combat climate change, mitigate risks and capitalize on opportunities. Carbon pricing is a financial tool for reducing risks, costs and greenhouse gas (GHG) emissions. It provides a mechanism to reflect the social, environmental and economic costs of climate change, which can then be used in financial decision-making. A price on carbon creates the foundation for carbon markets so countries and companies can reduce their greenhouse gas emissions most cost-effectively. There are two types of carbon pricing: explicit (such as emissions trading systems and carbon taxes) and implicit (such as feed-in tariffs, petroleum taxes etc). The best policy mix depends on different national circumstances, such as the structure of the industry and of the energy system. However, development of national and regional carbon pricing initiatives can lead to carbon leakage.<sup>6</sup> For an effective pricing of carbon, a global system is needed.<sup>7</sup>

New business opportunities can arise when carbon pricing leads to efficiency investments in industry or other areas of the economy. Carbon pricing systems encourage innovation and help ensure sustained economic competitiveness. Leading businesses already recognize this, and have disclosed to CDP that they support carbon pricing policies and are building a carbon price into their business operations and investment decisions as a way to prepare for a low-carbon economy. Many companies put an internal price on their carbon emissions in order to reach their emission reduction goals, to reduce their risk and to reallocate capital towards investments or areas of business that will be profitable in a low-carbon economy.<sup>8</sup> According to CDP, 437 companies used an internal price on carbon in 2015 and more than 500 additional companies plan to implement a price on carbon in 2017.<sup>9</sup>

Addressing climate change can be considered an integral element of sustainable development. Climate change will affect the achievability of any future development goals through its impacts on areas such as agriculture, water and health, and through its many indirect impacts.<sup>10</sup> The Agenda 2030 not only calls for measures to reduce GHG-emissions and mitigate the risk of climate change, but also to strengthen resilience and adaptive capacity to climate-related hazards and natural disasters. Adaptation and mitigation options can help address climate change, but are not sufficient by itself to address the versatile risks climate change is imposing. Delivering on the promise of global development commitments requires building resilience to the growing impacts of climate change and disasters. Despite current drawbacks in national politics,<sup>11</sup> business is committed to tackle climate change, to manage resulting risks and to initiate counter measures.

### 1.3 The global context

Climate change is a global challenge that does not respect national borders. Emissions anywhere affect people everywhere. Climate change is a global challenge on which everyone must act. Business has a key role to play in addressing

the challenges of climate change as they provide investment, innovative technologies and products. By bringing their expertise to bear business can accelerate the development and use of low-carbon technologies worldwide.

Innovative initiatives from business are part of the global shift that will open up large-scale opportunities that can combat climate change along the entire value chain. Business need to get resilient and help build resilient communities. Business play an important role in increasing resilience at a local level and thus supporting the development in their operating countries.

However, neither business nor government can achieve the needed emissions reduction by acting independently. Success will depend equally on governments playing their part at the local and national level. Every country will need to tailor their policies to match their unique national contexts and requirements. Governments will also need to work together across the globe to address this inherently global challenge. Commitments must be efficiently and effectively mobilized and managed. By an innovation-friendly and predictable global framework, governments can leverage business' contribution and support the transition to a low carbon economy.<sup>12</sup>

**Table 1: Overview of climate-related risks<sup>16</sup>**

**Physical risks** are those related to damage inflicted on infrastructure and other assets, such as factories and supply-chain operations by the increased frequency and intensity of extreme weather events. Physical impacts of extreme weather events can have a negative effect on utilities and infrastructure and result e.g., in high material damage to buildings or significant crop losses in agriculture. Physical climate impacts also refer to longer-term shifts in climate patterns, e.g., rising average temperatures that may cause sea-level rise or chronic heat waves (e.g., resulting in risks to worker health and safety, loss of biodiversity, etc.)

**Regulatory risks** refer to any government action prompted by climate change. This can take many forms, including rules that add costs or impede specific business activities, subsidies in support of a competitor, or withdrawal of subsidies. In many industries, government plays a crucial role in setting the rules of the game; with climate change in mind, many of those rules are changing.

**Shareholders** and investment managers are increasingly asking companies about their policies on climate change. Not fulfilling these requests can result in decreasing investments. Investors are asking for disclosure of carbon emissions and starting to lodge concerns about “stranded” assets—those that become unusable due to climate-policy regulation or physical climate change.

As climate change is gaining visibility among consumers, companies might find themselves at a disadvantage if they fail to respond to climate change concerns. Companies could expect to lose market share if they are seen to be behind competitors in addressing climate risks. In the climate-change context, **reputational risk** can be understood as the probability of profitability loss following a company's activities or positions that the public considers harmful. A poor reputation on climate can hurt sales through consumer boycotts or local community protests, can damage investor relationships and can make the company less attractive to current or future employees.

**Market risks** include the increasing price volatility of raw materials and other commodities, resource shortages, delays in the supply of materials, changing demand for products, losing market shares etc.

## 1.4 From risk to resilience: A business case

The disruptions associated with climate change bring many risks. Ignoring climate change will cost \$369 trillion by the end of next century.<sup>13</sup> Climate change will have significant impacts across many sectors and business. So how will companies tackle these risks? Transparency and understanding around climate-related risks and opportunities are needed to support long-term, successful and sustainable value creation.

### 1.4.1 Addressing and tackling risks

Climate change can affect business and their value chain in many ways, directly and through indirect or systemic impacts.<sup>14</sup> Many companies are exposed to direct and indirect climate risks as outlined in Table 1.<sup>15</sup>

Companies recognize the risks that climate change poses, not only for their operations and facilities, but also to their supply chains and suppliers, employees, customers, and people living in the areas in which they operate. To manage risks, companies have to understand the full measures of their effect on products, operations and supply chains.

Anticipating and responding to risks is business-as-usual for all sectors. But climate change adds to complexity, as it creates new risks and amplifies or alters existing risks. To identify how changes in the likelihood or magnitude of, for example, extreme weather events may affect their business, companies are building on existing business risk assessment activities. Based on the business activities, companies can prioritize options and measures to take and integrate them into enterprise-wide risk management systems.

In order to manage climate-related risks, the most basic approach for business is to climate proof their own footprints and value chains and to utilize innovative products and services. Companies can start by assessing the potential impacts of climate shocks and stresses on operations, assets, supply chains, logistics, workforce, productivity, competitiveness and markets. Additional measures could include business continuity planning, incorporating robustness and redundancy into value chains and production systems and improving safety measures for workers. While some of the described risks are familiar (e.g., new products displace older ones), responding to climate-related pressures can change the entire context in which a business operates, not just a specific segment.<sup>17</sup>

The ability to perceive of and respond to climate risks can mean the difference between success and struggle. A company that manages climate-related risks more effectively than others in its industry may gain a competitive advantage.

### Disclosure of climate-related risks

Companies already report on their climate-related information in various initiatives. To enhance disclosure of climate-related information, the Task Force on Climate-related Financial Disclosures (TCFD) was formed at the request of G20 nations.<sup>18</sup> The TCFD is a first global body of corporations and investors to recommend consistent, comparable climate risk disclosure in financial filings worldwide. The TCFD released its report in June 2017 including 11 key recommendations. The recommendations of the TCFD are a step towards a more consistent, comparable, and reliable disclosure of climate-related information and have the potential to facilitate more informed business and investment decision-making. Field-testing of the recommendations will now be crucial to assess the applicability of the recommendations in companies worldwide, to clarify open questions and to advance the disclosure and use of climate-related information.

### The role of financial service providers

By taking climate-related risks into account within the framework of their financial and insurance transactions, financial service providers contribute to the advancement of adaptation measures and the consideration of climate-related risks in the real economy.<sup>19</sup> For instance, insurers and reinsurers calculate and insure their clients' risks of weather-related damage. By assuming risks, they can assist companies coverage of damage risks. The practice of considering the relevant climate risks in the calculation of insurance premiums puts a price on climate risk. This contributes to the promotion of economic behavior that reduces climate-related risks on the part of those insured. Moreover, the consideration of such risks within the framework of credit checks and investment decisions can generate incentives for avoiding and reducing climate risks in the real economy.

### 1.4.2 Building greater resilience: a strategic approach

By incorporating climate risks into ongoing risk management activities and by periodically updating their understanding of the risks and their responses, companies are laying the groundwork for learning and developing resilience strategies and capacities over time. Many companies are crafting strategies for climate resilience – a measure of ability to maintain operation and to stay successful in the face of climate change. Resilience can be understood as the ability of a company to survive disruption and to anticipate, adapt, and flourish in the face of change.<sup>20</sup> The important component of this definition is that it incorporates short-term disruption and long-term trends. Being resilient is not just about survival and bouncing back, but about being able to thrive.<sup>21</sup> Thus, a company can be called resilient if it

- has the capacity to react to climate stress (including preparation, management and recovery)
- can react adversely and adapt to the current or anticipated implications and effect of climate change and
- can use changing conditions to develop more positive and regenerative capacity and to advance sustainable development.

As resilience increases, the degree of damage due to the potential effects of climate change decreases. In the new climate reality, businesses that can innovate and take advantage of the low-carbon transition globally will be the ones that secure a sustainable future (see Table 2). Digital innovation,

research and development (R&D) and the development of new products and services can increase resilience along the whole supply chain.<sup>22</sup>

While changes associated with a transition to a lower-carbon economy present significant risk, they also create significant opportunities for organizations focused on climate change mitigation and adaptation solutions.<sup>23</sup> Companies increasingly recognize opportunities to expand operations and increase their market share through developing climate-resilient products and services.<sup>24</sup> Efforts to mitigate and adapt to climate change produce opportunities for companies, for example, through resource efficiency and cost savings. Climate-related opportunities will vary depending on the region, market and industry. For example, investments in low-carbon and carbon-neutral energy technologies can reduce the energy intensity of economic development, the carbon intensity of energy, GHG emissions and the long-term costs of mitigation. Similarly, new technologies and infrastructure can increase the resilience of human systems while reducing adverse impacts on natural systems. Investments in technology and infrastructure rely on an enabling policy environment, access to finance and technology and broader economic development that builds capacity. In this context, it is important that companies work across their value chain, and with local governments and stakeholders, to ensure that actions taken will result in an appropriate level of resilience.

Managing carbon risks and increasing resilience to the effects of climate change is a business imperative. Businesses are already taking bold and ambitious action to help create the trans-

Table 2: Overview of climate-related opportunities for business<sup>25</sup>

Policy actions around climate change continue to evolve. Companies that make an informed effort to reduce emissions will find themselves in a better position to **meet regulations** that have been and will be put in place.

Companies addressing such issues and answering shareholders' questions may find their **reputation boosted** by making such efforts and strategy public and stand to gain market share at the expense of those companies seen as lagging in commitment. Demonstrating to shareholders that the impacts of climate change are being managed can provide reputational benefits.

Organizations that pro-actively seek opportunities in new markets may be able to diversify their activities and **better position** themselves for the transition to a lower-carbon economy. By understanding how climate risks affect operational performance business can make **better investment decisions**.

Companies can realize value from climate action. For example, investment in increasing efficiency across production and distribution can **reduce cost** in the longer term. Sales of new or growing sales of existing climate-friendly products can lead to an increase in revenues.

Front runners in **climate-friendly and greener products** are likely to gain increasing market share and may improve their competitive position.

**Innovative technologies** are assisting in the transition to a low carbon economy. There is high growth potential for low carbon technologies.

formative change we need: Companies are active in several initiatives with the goal to support the transition to a low carbon economy, take steps to address climate risks, use related opportunities and build greater resilience into their operations, supply chains, preparedness policies, and risk management plans. Furthermore, companies are proactively calibrating their strategies for climate-related risks and opportunities.

Companies are experiencing a diverse range of benefits from engaging in actions that increase climate resilience. These benefits include the ability to better manage and mitigate risks, decreased costs, increased profits, new markets, and a reputation as a good corporate citizen.<sup>26</sup>

There is no one-size-fits-all approach to climate change. Each company's approach will depend on its particular business and should mesh with its overall strategy. Many companies are starting to think about climate change-related risks and opportunities in a similar manner to other business risks and opportunities. Companies need to make decisions that take proper account of uncertainty, that properly account for the longer term trajectory of climate change policy but that are sufficiently robust and flexible to respond to the inevitable changes in the business, market and policy context in which they work. The companies that will be best positioned to respond to the inevitable business and societal stresses imposed by climate change will be those that recognize climate change as a strategic driver of business value, that take a longer term view of the business implications of climate change and that built climate change into their capital investment decisions.

In the next chapters, practical examples on how companies implement climate strategies, contribute to climate mitigation and adapt to the effects of climate change are outlined.

#### **We Mean Business coalition**

We Mean Business is a coalition of private and public actors that recognizes that the transition to a low carbon economy is the only way to secure sustainable economic growth and prosperity for all. 768 companies from all over the world are committing to bold climate action through the coalition's initiatives so far. The platform encourages innovations and helps ensure sustained economic competitiveness by promoting supportive policies. Currently, 14 ecosystem member companies are engaging in the We Mean Business coalition. A recent report by We Mean Business shows how bold climate action, supported by smart policy, can keep the temperature rise below 2°C.<sup>27</sup>

## **2 Climate strategy and targets**

Many companies have set targets to reduce their greenhouse gas emissions and have worked with their suppliers and customers to reduce their emissions and adapt to changing conditions. Furthermore, tackling climate change is increasingly seen as a strategic issue for companies and as a means for the creation of long-term sustainable value. Many companies have adopted comprehensive energy and climate strategies, committed to effective environment action and made commitments to turn their operations carbon-neutral in the future. By eliminating a vast majority of their carbon emissions and by offsetting remaining GHG-emissions, several companies aim to achieve net CO<sub>2</sub> emissions of zero and minimize their impact on the climate in the next decades.

Companies are augmenting and implementing their own commitments to decarbonize and thus contribute to the national commitments made by the countries in which they operate. Example 1, 2 and 3 display business leadership on climate change. Companies need top-level support for such a comprehensive climate change strategy that leverages expertise across the company.

#### **Carbon neutrality and 'net zero emissions'**

What does carbon neutrality and 'net zero emissions' mean? The core meaning of both is the need to achieve ecological balance between activities that emit climate pollution and processes that reduce the impact of that pollution to zero or close to zero. The term carbon neutrality is used to describe the action of organizations or business to remove as much carbon dioxide equivalents from the atmosphere as each put in to it. The overall goal of carbon neutrality is to achieve a zero carbon footprint. At its core, firms would calculate their overall carbon footprint; reduce that as much as possible, largely through energy efficiency; and then offset<sup>28</sup> any residual emissions that cannot yet be removed, so that their net emissions equal zero.<sup>29</sup>

## **3 Business contribution to climate change mitigation**

Global warming has to be limited to below 2°C compared to the average temperature in pre-industrial times to prevent the most severe impacts of climate change and possibly catastrophic changes in the global environment. Preventing further climate change is a key priority for the European Union. Europe is working hard to cut its greenhouse gas emissions

substantially in the coming years. By 2030, the EU wants to cut greenhouse gas emissions by at least 40% compared with 1990, to generate at least 27% of total energy consumption from renewable energy and to increase energy efficiency by at least 27%.<sup>30</sup> By 2050, the EU aims to cut its emissions substantially – by 80-95% compared to 1990 levels. Similarly, the German government made the commitment to reduce total greenhouse gas emissions by at least 55 % by 2030 and to reduce greenhouse gas emissions by 80 to 95 percent by 2050 compared to 1990 levels.<sup>31</sup> By pursuing these targets, the German government will make an appropriate contribution to implementing the commitment made in Paris, also with a view to the goal set out in the Paris Agreement of achieving global greenhouse gas neutrality in the second half of the century.

Business plays an important role in mitigating GHG emissions. Mitigation efforts can include a wide range of activities. Different mitigation technologies and practices are in place and specific measures strongly depend on the specific sector and country of operation:

1. **Improve resource efficiency:** Optimized, resource-efficient industrial production significantly contributes to tackling climate change. Improved productivity of resource use, reduced energy use and increasing energy efficiency and the development of low-carbon urban infrastructure also provides economic benefits by reducing costs.
2. **Use of low-carbon energy** (see Examples 4 to 8): Promoting a switch towards the use of energy from renewable resources allows a replacement of carbon-intensive energy sources and significantly reduce GHG-emissions.
3. **Innovative technologies and practices** (see Examples 9 to 16): Deploying low-carbon technologies and practices contributes to reducing GHG-emissions, e.g., by cutting transport emissions through the use of alternative motor technologies and fuels. Information and communications technology (ICT) can help cut global emissions and help companies and consumers to use and save energy more intelligently.<sup>32</sup>
4. **Waste reduction:** Recycling and waste prevention are critical to reducing greenhouse gas emissions (e.g., reducing emissions from energy consumption, incinerators, landfills and increasing storage of carbon in trees).
5. **Utilization of carbon** (see Examples 17 and 18): In many applications, carbon cannot be readily substituted or will remain an indispensable ingredient. Carbon capture and utilization (CCU) could be an important alternative mitigation strategy in a circular economy. CCU refers to the utilization of CO<sub>2</sub>, which may delay carbon emissions to the atmosphere while reducing the consumption of the original feedstock and avoiding the emission of other substances associated to them.

## 4 Business and climate change adaptation

Adaptation means recognizing and preparing for climate change impacts like water stress, coastal flooding, community health issues or supply chain disruptions, among other issues. Adaptation addresses impacts that are observed today and prepares us for impacts occurring in the future. It includes actions to reduce adverse effects from climate change and to anticipate opportunities for the development of new products and processes that are more climate friendly.

Companies recognized that they need to “adapt” to changes that a warming world is creating in countries where they source, produce and sell their products. Business contributions to climate change adaptation play a very important role in supporting sustainable development and efforts to build a green economy, while also promoting a company’s viability, profitability and competitive edge.

Adaptation measures can involve the elevation of infrastructure and particularly exposed facilities (e.g., based on prediction of storm surge levels during hurricanes in flood prone areas) (see Examples 21 and 22), the adaptation of existing products and production process to a changing environment (see Example 19) etc. Corporate adaptation offers many business opportunities and benefits, such as a reduction of cost incurred from disasters, enhanced liability management, employee protection, increased market shares through new products and services and access to new financing streams. In the long term, risk management could call for changes to supply chains (to build in geographic variability or redundancy), including moving away from suppliers and/or locations that are highly exposed. By adapting to more volatile conditions, business can also help vulnerable communities to become more resilient. However, adaptation measures are often not categorized and communicated as climate change adaptation. They may be framed as “sustainable supply chain management or “disaster risk reduction” or “community engagement projects”.

Climate change adaptation poses complex challenges for business, due to the

- uncertainty associated with the timing and magnitude of projected changes and
- interconnections between risks and impacts.

The dual uncertainty concerning the future climate and the impacts of climate change on systems must be taken into consideration in the implementation of adaptation policies.

Business has to develop an understanding of the risks and opportunities associated with climate change, identify and analyze climate-related risks and include according measures into their business activities (see Example 20). Climate forecasting, for example, can highlight high-level risk probabilities

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by region, such as for flood, drought, or sea-level rise, and for long-term changes in such factors as temperature, humidity, or rainfall patterns. Such scenario analysis can help reveal which parts of the company are vulnerable.

Climate risks affect every step of the supply chain from raw materials extraction, through manufacturing and logistics to consumer distribution. One single approach or definition is not going to meet the various needs given the number of contexts in which businesses work. Corporate action to adapt to climate change will involve many ideas and strategies – many of which are still being developed.

## 5 Closing thoughts

Responding to climate change is not only the right thing to do, but it also makes good business sense. The efforts of companies are driven by what they see as significant opportunities to become a more efficient business, to manage critical short- and long-term risks to the company, to reduce costs and to provide greater value to customers. While uncertainties exist about precisely how climate change will manifest over the coming years and decades, leading companies are recognizing that action is necessary. Turning the Paris Agreement into action will require innovation and finance of business and an accelerated deployment of low-carbon and efficient technologies.

Business will play a crucial role in building an alternative future, but it will need the creation of a stable (policy) environment. To proactively respond to climate risks, business need to be provided with unambiguous, consistent and predictable policies and market frameworks to accelerate innovations and investments in sustainable technologies and infrastructure. To unleash the necessary technological solutions around the world, governments need to provide an unambiguous long-term direction and certainty by defining consistent and predictable framework conditions globally. This will foster market-oriented and cost-effective approaches to reduce CO<sub>2</sub> emissions while encouraging healthy competition among technologies.

## Endnotes

- 1 The Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC) provides a clear and up to date view of the current state of scientific knowledge relevant to climate change.
- 2 World Economic Forum (2017): The Global Risks Report 2017, 12th Edition. The report is available at <http://wef.ch/risks2017>
- 3 B20 Taskforce Energy, Climate and Resource Efficiency (2017): A Climate for Change Embracing the Transition towards Energy-Efficient, Climate and Resource-Friendly, Competitive Economies, see <https://www.b20germany.org/documents/policy-papers/>
- 4 SDG 13 of the Agenda 2030 links to the Paris Agreement.
- 5 The Paris Agreement entered into force on 4 November 2016, thirty days after the date on which at least 55 Parties to the Convention (accounting in total for at least an estimated 55 % of the total global greenhouse gas emissions) have deposited their instruments of ratification, acceptance, approval or accession with the Depositary.
- 6 Carbon leakage refers to a situation in which productions and the associated emissions shift to jurisdictions with less stringent carbon pricing policies.
- 7 In this context, the B20 proposes to establish an intergovernmental G20 Carbon Pricing Platform as a forum for strategic dialogue. This platform should facilitate alignment, support, and action to establish operational rules and modalities for international carbon pricing mechanism and to create the necessary transparency across national policy-makers.
- 8 B20 Taskforce Energy, Climate and Resource Efficiency (2017): A Climate for Change Embracing the Transition towards Energy-Efficient, Climate and Resource-Friendly, Competitive Economies, for information visit <https://www.b20germany.org/documents/policy-papers/>
- 9 This number is based on information provided by CDP, see <https://www.cdp.net/en/campaigns/commit-to-action/price-on-carbon>.
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- 17 McKinsey (2015): How companies can adapt to climate change.
- 18 The recommendations of the TCFD can be found here: <https://www.fsb-tcfd.org>.
- 19 Not every climate risk is a climate change risk. So far, it is primarily historical data that is incorporated into the calculation.
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- 21 See 'Overview of climate Resilience' by Second Nature, see <http://second-nature.org>.
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- 26 UN Global Compact and UNEP (2012): Business and Climate Change Adaptation: Toward resilient companies and communities.
- 27 CDP and We Mean Business (2016): The Business End of Climate Change - How bold corporate action supported by smart policy can keep temperature rise below 2°C. For more information visit [www.wemeanbusinesscoalition.org/](http://www.wemeanbusinesscoalition.org/)
- 28 Offsetting describes the practice of removing carbon dioxide emissions from the atmosphere by funding carbon projects that lead to the destruction of greenhouse gas emissions, the prevention of their release into the atmosphere or the sequestration of carbon dioxide.
- 29 EY (2012) How should business approach carbon neutrality? The solutions and benefits.
- 30 European Commission (2014): A policy framework for climate and energy in the period from 2020 to 2030.
- 31 Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (2016): Climate Action Plan 2050: Principles and goals of the German government's climate policy.
- 32 GeSi (2015): SMARTer2030 – ICT Solutions for 21st Century Challenges, see <http://smarter2030.gesi.org/>

**Example 1:**

**Siemens will be carbon-neutral by 2030**



As first multinational industrial corporation of its size, Siemens has committed to carbon neutral operations by 2030. Already by 2020, the carbon footprint shall be cut in half, based on 2.2 million metric tons in fiscal year 2014. To achieve this, Siemens invests more than EUR 100 million within the next three years to improve energy efficiency of production sites and buildings.

Innovative technologies like energy management systems, automation in buildings and production as well as energy-efficient drive systems will play a significant role. This will lead to an annual reduction of energy costs of more than EUR 20 million.

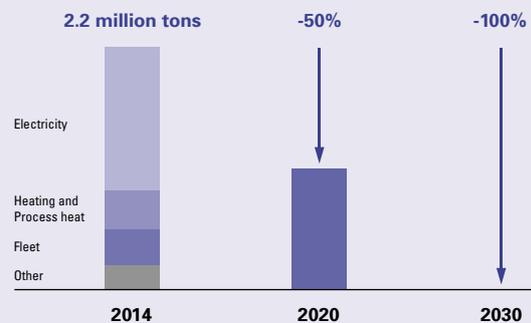
“Reducing our carbon emissions is not just an expression of our understanding of corporate responsibility, but it also makes sense from a business perspective”, said Joe Kaeser, President and Chief Executive Officer of Siemens AG. To achieve the goal, Siemens focuses on three further levers: Utilizing decentralized energy systems like photovoltaics in own facilities. Also, with its global car fleet, Siemens moves towards low-emission vehicles and concepts for e-mobility. Last but not least, Siemens will source electricity more and more from renewable sources, i.e. wind parks, in order to safeguard a clean energy mix.

Siemens has started this program in 2015: Up to now, approximately EUR 40 million have been invested at 15 locations. An important step was also the construc-

tion of Siemens’ new corporate headquarters building in Munich city center. The building complies with the highest standards for environmental-friendly and resource-efficient construction.

Besides those initiatives on climate protection in its own operations, Siemens provides a major lever to its customers: Technologies and solutions in the area of energy efficiency and renewable energy generation are bundled in the „Environmental Portfolio“. In fiscal year 2016, its revenue was EUR 36 billion or 45% of the company’s total revenue. Those products and solutions facilitated an abatement of carbon emissions at customers of 521 million metric tons. That equals to half of Germany’s annual carbon emissions.

**Siemens’ path to long term CO<sub>2</sub>-Neutrality**



## Example 2:

### SAP to go carbon neutral by 2025



On May 6, 2017, SAP announced its new target to become carbon neutral by 2025. The commitment is another milestone on SAP's journey to become a role model of a sustainable company in line with the company's vision and purpose to help the world run better and improve people's lives. SAP embraces the United Nations Sustainable Development Goals (SDGs). By becoming a carbon neutral company, SAP supports goal No. 13, "Climate Action".

The carbon neutral target is a logical consequence of SAP's long-term greenhouse gas (GHG) avoidance strategy: In 2008, the world's largest provider of enterprise application software announced to reduce CO<sub>2</sub> emissions back to levels of 2000 by 2020, despite company growth. In 2014, SAP launched its green cloud strategy, shifting to 100% renewable electricity in all data centers and facilities (see also Example 5). The next step is to achieve carbon neutral operations by 2025. In pursuit of this ambitious goal, SAP will continue existing initiatives and programs to drive efficiency and innovation to avoid and reduce GHG emissions, following our approach "avoid – reduce – compensate".

Why did SAP set this ambitious carbon neutrality goal? It builds further credibility and helps maintain SAP's leadership position in the sustainability space (e.g., SAP is Software Industry Leader in the DJSI and oekom rankings). External stakeholders are expecting ambitious goals - especially socially responsible investors (SRIs). Further, customers, partners, analysts, public authorities, employees and job candidates value companies according to their climate protection strategies.

2025	SAP becomes carbon neutral
2017	<ul style="list-style-type: none"> <li>Commitment to set Science Based Targets for 2050</li> </ul>
2016	<ul style="list-style-type: none"> <li>1.500 leasing bicycles and 850 e-cars</li> <li>50 sites ISO 140001 certified</li> <li>Carbon pricing for business flights</li> <li>Carbon neutral fuel card for company cars</li> </ul>
2015	<ul style="list-style-type: none"> <li>Green events through 100% renewable energy use</li> <li>Data Center Sustainability Award 2015 at Datacloud Europe Congress</li> </ul>
2014	<ul style="list-style-type: none"> <li>Introduction of Green Cloud by powering all SAP data centers and facilities with 100% renewable electricity</li> <li>Member of RE100 initiative</li> <li>Commitment to 20% e-cars in company carfleet by 2020</li> </ul>
2013	<ul style="list-style-type: none"> <li>3 million Euro invested in Livelihoods Fund</li> <li>Launch of Sustainability Dashboard</li> </ul>
2012	<ul style="list-style-type: none"> <li>First ISO14001 certification in Italy and Markdorf</li> <li>100% recycling paper in Germany</li> <li>Climate Leadership Award presented by the U.S. Environmental Protection Agency (EPA)</li> </ul>
2011	<ul style="list-style-type: none"> <li>Carpooling solution TwoGo</li> <li>Climate neutral train travel in Germany</li> <li>First time included in the Carbon Disclosure Leadership und Carbon Performance Leadership Indexes</li> </ul>
2010	<ul style="list-style-type: none"> <li>"LEED Platinum" certification for SAP America's Headquarters in Newtown Square</li> <li>Launch of abatement cost curve</li> </ul>
2009	<ul style="list-style-type: none"> <li>Carbon reduction target to reduce emissions back to levels of 2000 by 2020</li> </ul>
2008	<ul style="list-style-type: none"> <li>First sustainability report making emissions transparent</li> </ul>

Example 3:

**Bosch Rexroth – Dual strategy reduces CO<sub>2</sub> emissions**



With a dual strategy, Bosch Rexroth has shown that energy consumption can be reduced without compromising productivity. The company uses energy-efficient automation solutions to help machine manufacturers and users reduce energy consumption in production. At the same time, Rexroth, a specialist for drive and control technology, uses its expertise to optimize its own plants.

**Formula for energy-efficient production**

To increase the energy efficiency of machines and plants, the company has developed its own system – Rexroth 4EE (Rexroth for Energy Efficiency). This system is based on four levers:

- A systematic, comprehensive view of the entire automation system. This includes project planning, simulation, and consulting (energy system design)
- Energy-efficient products and systems (efficient components) with optimized efficiency
- Energy recovery and storage of energy that has not yet been utilized
- Demand regulation (energy on demand)

This system can be applied throughout the life cycles of machines and plants, from initial planning and operation to retrofitting. Energy savings of up to 30 percent are frequent, and can even reach 80 percent in individual cases.

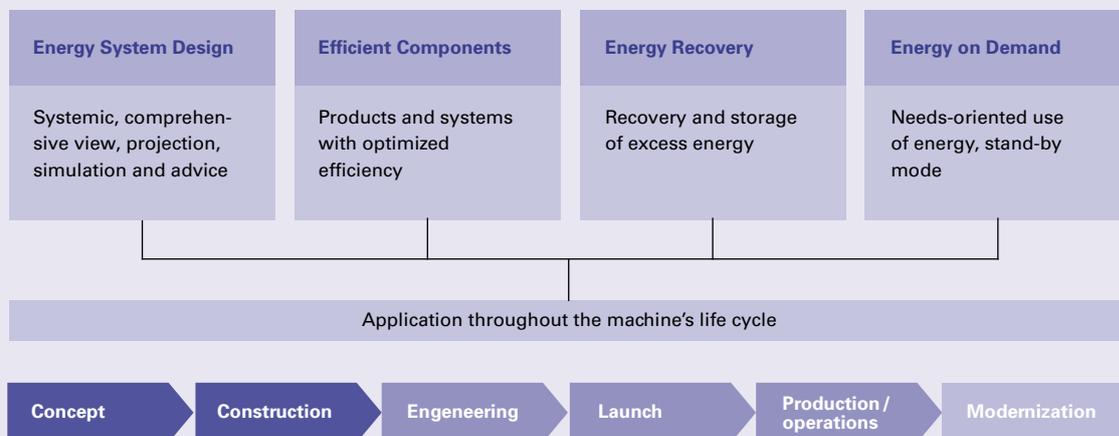
**The Rexroth dual strategy**

Like many of its customers, which have voluntarily committed to reducing energy consumption and emissions, Bosch Rexroth faces the challenge of reducing energy consumption in the manufacturing process at its 52 manufacturing locations, and of preventing emissions.

To this end, the internal Rexroth GoGreen project was launched. Besides saving energy through machine automation, this project also considers the potential of using thermal energies such as waste heat, and of networking machines and infrastructure.

Within the framework of GoGreen, Rexroth’s plants are its main internal customers: the company not only develops innovative products, it uses them at its own facilities and then develops them further. By using its own systems and components at these plants, Rexroth can establish best practices, and this strengthens its credibility as an energy efficiency advisor for its customers.

The GoGreen project team has analyzed more than 50 production plants and developed hundreds of measures. More than 400 have been implemented since 2012. At all of its manufacturing plants, Bosch Rexroth has reduced CO<sub>2</sub> emissions by 60,000 tons per year. In most cases, the measures paid for themselves within two to three years. This means that the necessary investments have been offset by energy cost savings of several million euros each year.



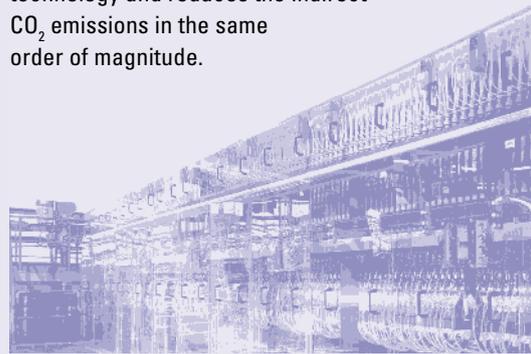
### Example 4:

#### Energy-saving chlorine production – Chlorine-alkali electrolysis with innovative cathode technology



The electro-winning of chlorine is today one of the most energy intensive processes in the chemical industry. Large amounts of chlorine are used for the production of plastics and polymers, but also for pharmaceuticals or the production of photovoltaic panels for solar power generation. At the moment chlorine is mostly produced in the so-called membrane process. The new ODC-technology (oxygen depolarized cathode method) has been jointly developed by thyssenkrupp with Covestro (formerly Bayer MaterialScience). It can reduce the energy demand. In chlorine production by up to 25% compared to standard membrane

technology and reduces the indirect CO<sub>2</sub> emissions in the same order of magnitude.



**Example 5:**

**Promoting the use of renewable energy – RE100 initiative**

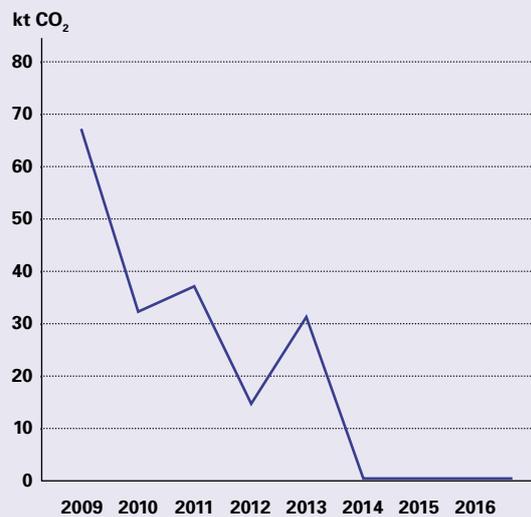


The private sector accounts for around half of the world's electricity consumption. Switching this demand to renewables will accelerate the transition to a low carbon economy. To support this transition, many companies have signed the RE100 pledge. The RE100 is a global initiative that brings together leading companies committed on working to massively increase demand for – and delivery of – renewable energy. There is a strong business case for renewables: As well as delivering on emission reduction goals, renewable power can help manage fluctuating energy costs, provide energy security, increase competitiveness and improve reputation.\* RE100 showcases business action, while working with others to address barriers and develop transparent reporting mechanisms. RE100 is part of the We Mean Business coalition.

Given the significance of its electricity consumption (e.g., due to energy-intensive data centers), SAP decided to power its operations worldwide with 100 percent renewable electricity. Through energy efficiency and the increase procurement of green electricity, SAP has been able to reduce greenhouse gas emis-

sions of its data centers to zero globally. The company has reached its RE100 goal of powering all facilities and data centers by 100% renewable electricity already in 2014.

**Greenhouse gas emissions from SAP's data centers**



\* Find out more about the RE100 initiative here: <http://there100.org/re100>

### Example 6:

#### Transition to sustainable energy with SAP



Energy accounts for approximately 60% of total greenhouse gas emissions. Therefore, SAP is committed to support increased energy efficiency and the transition to sustainable energy:

United Energy in Melbourne, Australia, is reducing overloads and providing fair energy homes and businesses with SAP HANA. Real-time insight has allowed United Energy to identify previously undetected patterns and respond quickly. All data is in one place, driving well-informed business decisions and helping the company deliver energy efficiently and effectively.

Energie Steiermark, the fourth-largest power provider in Austria, is partnering with SAP to reliably deliver green energy to its customers. The jointly built internal solution called “Info Mobil” enables technicians

to work more efficiently and all staff to reach customers with excellent service more quickly. The result is a more economical operation on all levels while going paperless and supporting Energie Steiermark’s ambition to protect the environment.

Energy provider RheinEnergie, based in Cologne, Germany, initiated a lighthouse advanced metering infrastructure (AMI) pilot project that is expected to set a precedent for other energy suppliers across the country. Using SAP® AMI Integration for Utilities software, it paved the way for greater transparency, empowering 25,000 households around Cologne to conserve energy, make a positive contribution to the environment, and cut costs.

**Example 7:****Renewable energies for reducing CO<sub>2</sub> emissions in rail traffic**

An important instrument Deutsche Bahn is using to reduce CO<sub>2</sub> emissions in rail traffic is the expansion of renewable energies such as wind and water. In 2015, the proportion of renewable energies in the railway power mix was already at 42% – the majority of it from hydropower. This high proportion is the result of the purchase of renewable energies for green offerings in DB long-distance travel. Since April 2013, BahnCard holders, bahn.business customers, and those holding point-to-point season tickets have been riding CO<sub>2</sub>-free with 100% green power in the IC and ICE trains. Passengers without the BahnCard can also use green power for their travel by paying a premium of one euro per person per route to book the “Umwelt-Plus” ticket. DB staff on work-related or private trips also travel

with renewable energy, and S-Bahn Hamburg customers have been riding with 100% green power since 2010. Cargo traffic also enjoys climate-friendly travel with Eco Plus if customers add it to their booking. For these green tickets, the necessary quantity of electricity is calculated and the corresponding amount of green power purchased. By 2050, all DB rail traffic is expected to be CO<sub>2</sub>-free.



### Example 8:

#### **“Energiewende” and the transition into a sustainable future energy system – thyssenkrupp grid-scale Advanced RedoxFlow battery system (ARFB) and efficient alkaline water electrolysis (AWE)**



Changing energy carriers from fossil (coal, oil, gas) to renewables, especially wind and solar, requires a complex system change in many areas. Classical grids are characterized by high availability and resilience based on adequate grid structure and pre-planned and controlled power generation. Most renewable energies however are volatile. To ensure again reliability and resilience of the system irrespective of weather and time of year, additional technologies and the cooperation of all actors are needed: incumbent and emerging power producers, grid operators and small and large power users alike.

Essential will be grid-scale storage systems, integrated in either central or decentral grids, including storage at the generation sites to optimize grid operation. thyssenkrupp’s state-of-the-art electrochemical technologies makes our redox flow batteries a safe and simple modular solution for the world’s large-scale energy storage needs – up to the gigawatt hour range. It stores electricity as chemical energy as any typical battery system, with the main difference that power and capacity are completely separated and can be scaled flexibly in either way. Hence, scaling of capacity is not a linear function as for example in Lithium-Ion technology. thyssenkrupp RedoxFlow batteries can very quickly adapt to the prevailing need and switch from charging to discharging in fractions of a second. Efficiency is up to 80 percent. The thyssenkrupp Advanced RedoxFlow bat-

tery system (ARFB) is a significant breakthrough in flow battery technology, as it scales up at the world’s largest battery cell size, allowing economic and competitive solutions for large scale storage, high depth-of-discharge levels, many charge/discharge cycles and storage times beyond 4 hrs.

An alternative solution for storing vast amounts of energy is the conversion of power into hydrogen, by splitting water into its constituents by electrolysis using renewable electricity. Hydrogen can transfer renewable electricity into the gas grid (Power-to-Gas) or provide a fuel for future fuel cell mobility. In addition, industrial carbon footprints need to be significantly reduced. Hydrogen typically is generated by reforming natural gas, creating ten tons of CO<sub>2</sub> per ton of H<sub>2</sub>. Hydrogen produced by electrolysis and renewable energy has a zero-carbon footprint. And, innovative chemical synthesis, provided by thyssenkrupp as Carbon2Chem®, is able to recycle industrial carbon emissions into valuable new feedstock like ammonia, methanol or synthetic natural gas. For decades, thyssenkrupp has been the global market leader for industrial scale electrolysis for many applications. thyssenkrupp’s reliable and efficient alkaline water electrolysis (AWE) combines the innovation power of an electrochemical market leader together with the capability of designing and executing large installation of electrochemical plants on a global scale.



**Example 9:****Lufthansa Group – Holistic and sustainable mobility concept****Lufthansa Group**

The Lufthansa Group applies a value-based management system with a central responsibility for climate and the environment. The goal is to use the necessary kerosene as efficiently as possible and to limit the environmental impact of flying. The foundation of the fuel efficiency activities is the four-pillar strategy developed by the aviation industry, which comprises different environment-relevant measures. These range from technical progress through improved infrastructure and operational measures to economic instruments. A key contribution for an eco-friendly form of current and future mobility is made by the continuous investment in a new, even quieter and more efficient Group fleet. But also the diverse programs in the operative area, such as the testing and introduction of new flying procedures, the determination of optimal routes and speeds, programs for sustainable weight reduction and the development of intelligent software tools which all help to increase fuel efficiency in flight operations. One example: Since the end of 2016, pilots have been able to display the so-called OMEGA “tracks” in all Lufthansa

cockpits. The software of the same name helps the pilots to find the shortest flight routes by evaluating and analyzing previously-flown routes. Thanks to the displayed shortcuts from earlier flights now shown on the electronic navigation map in the cockpit, in addition to the upcoming planned route, the pilots can actively query these shorter routes with air traffic control. Projected to all flights, Lufthansa can save around 8,500 tons of kerosene every year with this innovation.

Together with the aviation industry, the Lufthansa Group has for many years advocated a worldwide-valid, market-based and competition-neutral system for CO<sub>2</sub> compensation in the area of economic incentive systems. The International Civil Aviation Organization (ICAO) adopted such a system by the name of CORSIA in October 2016. With this climate protection instrument, growth-related CO<sub>2</sub> emissions in international air traffic are to be compensated from 2020 through CO<sub>2</sub> savings in climate protection projects.

### Example 10:

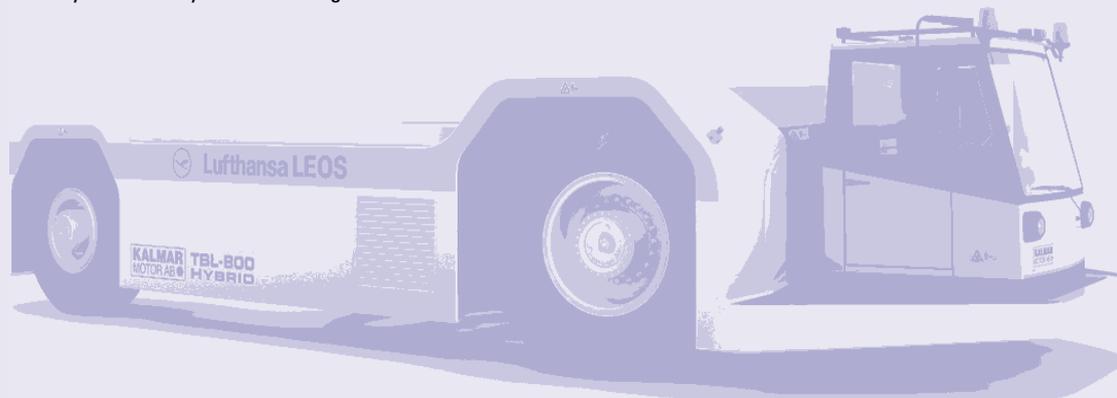
#### Lufthansa Group – Taxiing and towing with electric drive

## Lufthansa Group

The Lufthansa Group also backs innovations on the ground. In the area of e-mobility, the Group is active at Frankfurt Airport in the e-mobility initiative E-PORT AN, together with Fraport AG, the federal state of Hesse and the Electromobility Model Region Rhine-Main. The aim of the partners is to significantly reduce kerosene consumption as well as CO<sub>2</sub> and noise emissions during the taxiing and towing of aircraft. The projects of the Lufthansa Group are focused primarily on the development and testing of electrical drive technology for aircraft movements on the ground. Normally, aircraft taxi with engine power for up to five kilometers from the terminal to the take-off position. With the hybrid tractor TaxiBot, which has been co-developed by Lufthansa LEOS, this can be done largely emission-free. It can be controlled from the cockpit and taxis the aircraft to the runway without any use of the engines.

Since its approval by the European Aviation Safety Agency (EASA), the vehicle has been tested extensively in operation at Frankfurt Airport. In 2015, Lufthansa LEOS also took delivery of the first prototype of the eTug which is equipped solely with an electric drive with range extender. It is suitable in particular for the eco-friendly maintenance and positioning towing of large passenger aircraft such as the Airbus A380 or Boeing 747. A reduction of over 70 percent in CO<sub>2</sub> emissions was achieved. At the same time, energy costs and maintenance effort are reduced by around half.

Another project of the Lufthansa Group's catering specialist, LSG Sky Chefs, is focused on the development of the catering lift truck of the future on an electric basis. The first version has been in testing operation since late summer 2017.



Example 11:

**Deutsche Telekom's integrated climate strategy**



Deutsche Telekom has developed an integrated climate strategy to effectively integrate climate protection measures into core business. Deutsche Telekom Group's integrated climate strategy consists of four pillars:

- **Reducing the absolute amount of CO<sub>2</sub> emissions throughout the Group:** By the year 2020, Deutsche Telekom is planning to reduce CO<sub>2</sub> emissions by 20 percent compared to base year 2008. Key forces behind this reduction include the switch to IP-based network technology and the consolidation of our data center infrastructure as well as using modern building technology and office concepts, an efficient vehicle fleet and replacing business trips with audio and video conferences.
- **Increasing the share of green energy in use:** In 2016 our national companies in Austria, Hungary, Netherlands and Greece already obtained 100 percent of their electricity from renewable sources.
- **Increasing energy efficiency:** In order to measure the progress of our measures, Deutsche Telekom introduced two new key performance indicators (KPIs) in 2016, which are closely linked to our core business. They show our energy consumption

and our carbon footprint in proportion to the transmitted IP data volumes.

- **Sustainable products and services:** Deutsche Telekom generates a large share of European sales volume with products that provide environmental and social advantages at customer side. This means that our products can help to reduce energy consumption and CO<sub>2</sub>-emissions (39% in 2015), improve healthcare and make logistics more efficient and environmentally friendly.

The SMARTer2030 study of the Global e-Sustainability Initiative (GeSI) shows that information and communications technology may be an important part of the solution in the fight against climate change. Products such as our cloud and mobility solutions help reduce the amount of CO<sub>2</sub> emissions our customers produce. For example, a Dynamic Workplace – a cloud-based service in the B2B segment – enables a potential customer with a 35,000-strong workforce to save over 16,000 metric tons of CO<sub>2</sub>. Furthermore, Deutsche Telekom motivates their suppliers to participate in the CDP Supply Chain Program in order to report more efficiently on emissions within the supply chain.

**Sustainability benefits of a Dynamic Workplace in Germany\***

**Environmental:**



CO<sub>2</sub>-Emissions reduction

**> 16,000 tons**

of CO<sub>2</sub> emissions can be saved per year, thereby contributing to climate protection

**Economic:**



High employee cost savings

**> 15 Mio Euro**

can be saved per year due to reduced idle time and sickness days of employees

**Social:**



Work-life balance improvement

**56 hours**

can be freed up for more productive and enjoyable use

Health quality increase

**9 hours**

of the 56 hours, are freed up due to reduced sickness caused by stress

\* The environmental and economic benefits have been calculated for a client with 35,000 employees, the social benefits per employee and year

### Example 12:

#### **SAP – Technology innovation supports climate action**



Information and communication technology (ICT) plays a key role in achieving the UN SDG #13 “Climate Action” by mitigating the risk of climate change. According to #SMARTer2030, a study by the Global e-Sustainability Initiative (GeSI) and Accenture Strategy, it is possible, during the next 15 years, to hold worldwide carbon emissions to 2015 levels by digitizing business processes and applying data to decisions about resource use. ICT solutions, such as video conferencing and smart building management that SAP is applying in its own operations, could cut the projected 2030 global greenhouse gas emissions by 19%. This would amount to energy and fuel savings comparable to 25 billion bar-

rels of oil and a reduction of 12.1-gigaton carbon dioxide equivalent (GtCO<sub>2</sub>e) of greenhouse gases. This is equivalent to nearly 10 times the ICT sector’s emissions in the same period.

In a research study published just after COP21 and the Paris Agreement, SAP estimated that digital technologies can help save 7.6 Gt carbon emissions by 2030 in major industries like utilities, agriculture, and transportation. That’s a full 63 percent of the 12.1 Gt total identified in the #SMARTer2030 study that could be cut – further potential for SAP to support its customers in taking climate action.

**Example 13:****Deutsche Post DHL Group –  
StreetScooter makes delivery  
emissions free**Deutsche Post DHL  
Group

Deutsche Post DHL Group has been a pioneer in green logistics for some time now and as part of its Group-wide environmental program GoGreen, the company has bundled together an extensive and innovative range of initiatives designed to make its own business more sustainable. Deutsche Post DHL Group also offers customers a portfolio of Green Solutions to help them increase their efficiency while reducing the negative impact their business has on the environment.

Deutsche Post DHL Group is also using these initiatives to help achieve its new climate protection goal, which CEO Frank Appel announced to the world in March 2017 – to reduce all logistics-related emissions to zero by the year 2050. Four interim targets were set for 2025 on the way to this long-term goal: to increase carbon efficiency, increase the number of sales that incorporate Green Solutions, certify the lion's share of its employees as GoGreen specialists, and increase the Group's use of clean pick-up and delivery solutions for its own first and last mile services.

Electric mobility figures largely in the Group's 2025 goal of operating 70% of its delivery services with clean solutions. Deutsche Post DHL Group already makes extensive use of electric vehicles for its delivery operations as an alternative to conventional vehicles. And as the company expands their use, it is betting on its very

own innovative vehicle developed to meet the specific challenges of mail and parcel delivery operations: the StreetScooter. This fully electric compact delivery van was developed in 2012 as part of a joint project between Deutsche Post DHL Group, StreetScooter GmbH and the RWTH Aachen University. Both the Work and the Work L models have a range of at least 80 kilometers, with cargo loading capacities of 4.3 and 8 cubic meters, respectively. The StreetScooter can save around three metric tons of carbon and 1,100 liters of diesel fuel compared to conventional delivery vehicles, with the larger Work L model saving four metric tons of carbon and 1,500 liters of diesel. StreetScooters are not only charged with 100% green electricity, their quiet and pollution-free operation also helps to improve the quality of life in our cities and communities.

StreetScooter GmbH was acquired by Deutsche Post DHL Group in 2014, and series production of the vehicles began in 2016. Today, more than 3,000 StreetScooters are already deployed throughout Germany. The statistics for new e-vehicle registrations for 2016 put StreetScooter in fourth place overall for the year. And just recently the Group began selling the StreetScooter to third parties. This success story is a textbook example of the power of combining innovation with sustainability. Deutsche Post DHL Group has filled a gap in the market, developing its own environmentally friendly and efficient delivery solution and turning into a new business model in the span of just a few years.



### Example 14:

### Continental – Climate protection through “efficient mobility”

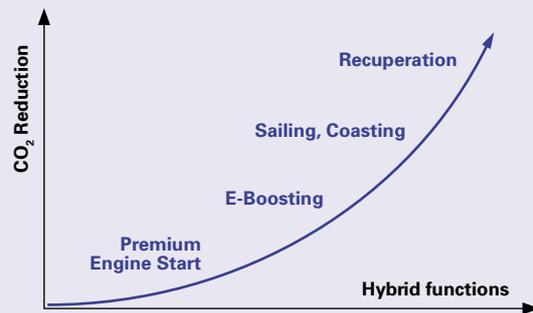


Technical innovations are indispensable for carmakers and contribute greatly to achieving climate protection goals. Comfort and driving dynamics must not be neglected, however, even in environmentally friendly vehicles. In answer to this dilemma, Continental offers a wide range of technical innovations:

It takes little effort to integrate the new “48 Volt Eco Drive” hybrid technology into the architecture of conventionally driven vehicles, and the drive also offers functions that have until now been featured only in high-voltage hybrid systems.\* This significantly reduces fuel consumption. The connection to Continental eHorizon\*\* gives the “48 Volt Eco Drive” vehicle high-resolution road data on the basis of which a controller adapts the driving strategy to the route, allowing more energy-efficient driving. The belt-driven starter generator produced by Continental is the key component of the 48-volt drive. It supports the combustion engine with additional torque and converts the braking energy into electrical energy (recuperation). Continental’s DC/DC converter couples the 48-volt electrical network with the conventional 12-volt electrical network. The new Continental technology started the series production with European carmakers in 2016.

An electrically heated catalyst supports the low-CO<sub>2</sub> 48-V hybrid strategy. The technology initiates the emissions cleaning effect earlier, which helps a gasoline engine, for example, to reduce hydrocarbon and par-

Continental’s „48 Volt Eco Drive“



ticle emissions after a cold start. For diesel engines, an additional focus is on the reduction of CO and NO<sub>x</sub> emissions. But fuel-saving driving strategies such as “sailing” when the engine is turned off can be implemented more comprehensively with the EMICAT®. The quick-working electrical heating of the catalytically coated structure ensures that the catalyst starts almost immediately when the driver pushes the gas pedal.

\* High-voltage hybrid systems allow the combustion engine to be shut down during driving (“sailing” or “coasting”) and ensure a very nice, comfortable engine start and efficient braking energy recovery (recuperation).

\*\* The eHorizon is an innovative software concept that allows intelligent, expanded use of navigation data for controlling other vehicle systems.

**Example 15:****thyssenkrupp – EnviNOx<sup>®</sup> process enables sustainable fertilizer production by stringent reduction of the “climate killer” N<sub>2</sub>O and full elimination of NOx**

Nitrous oxide (N<sub>2</sub>O) is a greenhouse gas, which contributes around 6% to anthropogenic GHG emissions and hence global warming. It is 265 times more potent than the same amount of CO<sub>2</sub> (see table 1). Human activities resulting in N<sub>2</sub>O emissions are agriculture, combustion of waste, sewage sludge and fossile raw materials as well as the production of adipic acid and nitric acid in the chemical industry. The latter are mainly for the production of fertilizers and generates around 0.5 million t N<sub>2</sub>O, equivalent to 130 million t CO<sub>2</sub> annually. The EnviNOx<sup>®</sup> process developed by thyssenkrupp enables the nearly complete removal of GHG emissions from the off-gasses of nitric acid plants. The gas is passed over a specific catalyst, which decomposes N<sub>2</sub>O in its no-toxic and non-climate relevant components ni-

trogen (N<sub>2</sub>) and oxygen (O<sub>2</sub>). The simultaneous use of a suitable reduction agent such as NH<sub>3</sub> can in parallel also decompose the ecotoxic NOx completely into harmless N<sub>2</sub> and H<sub>2</sub>O. Globally by now 30 sold EnviNOx<sup>®</sup> systems result in an annual reduction of about 20,000 t NOx and 56,000 t N<sub>2</sub>O; equivalent to 15 million t CO<sub>2</sub> annually. EnviNOx<sup>®</sup> installations can be easily retrofitted and require a rather small investment compared to the total investment in a fertilizer plant. They are well suited for climate finance projects. They enable us to break the deadlock between climate protection and combatting hunger with an intensified agriculture based on increased fertilizer use by producing fertilizers while curbing GHGs emissions.

### Example 16:

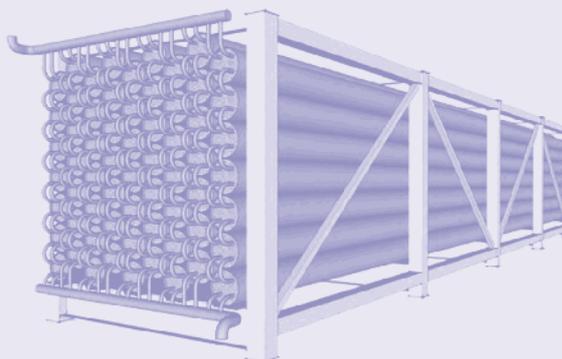
#### **Heatcrete® and Powercrete® – Enabling the energy transition via innovative concrete products for solar energy storage and underground electricity transmission**

## HEIDELBERGCEMENT

Renewable energy deployment and electrification are key pillars of the energy transition to a low carbon economy. Yet, storage and transport challenges pose a barrier to fast uptake and penetration. HeidelbergCement provides innovative products to address both issues. The temporal discrepancy between peak renewable energy supply and peak demand constitutes a challenge which calls for energy storage vehicles, especially concerning solar energy.

HeidelbergCement, together with EnergyNest from Norway, offers such a heat storage concept. The storage modules are charged during the day and are able to release thermal energy at night. Namely, special oil is pumped through the pipes, which releases its thermal energy via a heat exchanger to a second cycle with water vapour. The modules are filled with Heatcrete®, a special concrete with high thermal conductivity, facilitating the process significantly. So far, the concept has been successfully piloted in Masdar-City, close to Abu Dhabi, paving the way for more effective renewable energy storage in the future.

HeidelbergCement also offers high-performance heat-conducting concrete: Powercrete®. It is used as a bedding and backfilling material and enables energy transmission through underground high voltage (HV) and ultra-high voltage (UHV) transmission cables. By dissipating the heat being generated particularly effectively, the concrete enhances the power capability of the cable route. Thereby, Powercrete® enables effective energy transport, for instance of renewable energy. The product has already been commercialised in Germany.



**Example 17:**

**HeidelbergCement – Utilization of CO<sub>2</sub>-rich flue gas to produce microalgae on non-arable land**

**HEIDELBERGCEMENT**

Carbon Capture and Utilization (CCU) is an effective lever for decarbonisation in the cement sector. To this end, HeidelbergCement has developed a project that utilises the CO<sub>2</sub>-rich flue gas from the cement kiln in a photosynthetic process to grow microalgae. Based on R&D work at sites in Sweden, Turkey and France, HeidelbergCement is currently installing an algae farm at its plant in Safi, Morocco. Not only ideal climate conditions, but also the availability of non-arable land set the location apart, whereby emissions from land use change (LUC) are avoided altogether.

The microalgae project highlights the potential of marrying environmental and economic considerations: Producing the microalgae from flue gas not only contributes to HeidelbergCement's decarbonisation efforts, but selling them as fish feed also makes the project commercially viable. An analysis has shown that microalgae from Morocco constitute a desirable substitute for Brazilian soybeans or herring meal due to their lower carbon footprint (CF) on a like-for-like basis.

After a successful piloting phase, HeidelbergCement plans to expand the project with further investment.



Source: OmegaGreen

### Example 18:

### Carbon2Chem® Project – Turning waste gases from steelmaking into valuable feedstock for the chemical industry in a cross-sectorial approach



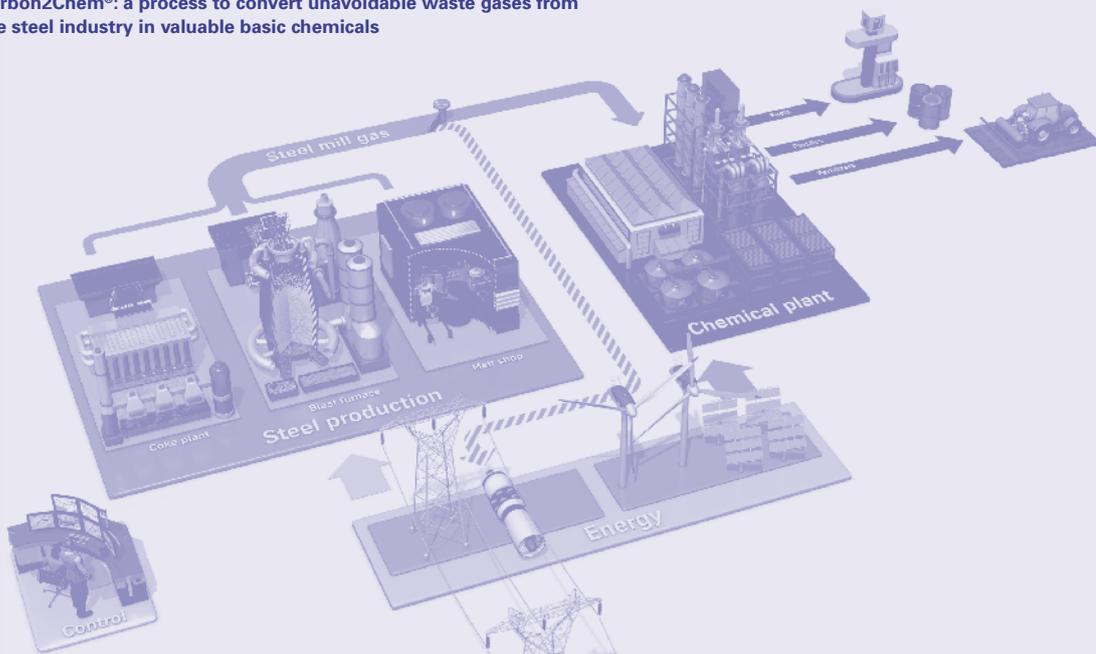
(Overview of project partners from among the econsense member companies)

In the Carbon2Chem® project industry (including many econsense members) and research partners (among others the German Max-Planck-Society) develop a process to convert unavoidable waste gases from the steel industry into valuable basic chemicals such as ammonia or methanol. This can replace the current practice of using them for electricity generation only. The process exploits that the components for base chemicals are already present in steel waste gases in larger quantities, for example carbon as carbon-monoxide (CO) and CO<sub>2</sub>, as well as nitrogen and hydrogen. Energy sources for the chemical processes

are waste heats and renewable electricity. The process can be controlled to make use of peaks. Thereby the project delivers a substantial contribution to the Energiewende and to stabilize the grid. Carbon2Chem® would allow in principle to use most of the current CO<sub>2</sub> emissions of an integrated steel plant as raw material. First commercial plants are expected after 2030.\* The project is supported by the German Ministry for Education and Research.

\* thyssenkrupp already invests today in a testing facility at its steel plant in Duisburg to support these innovations purposefully.

Carbon2Chem®: a process to convert unavoidable waste gases from the steel industry in valuable basic chemicals



**Example 19:****Bayer – Sustainable agriculture and digitalization**

Agricultural production is significantly influenced by the climate. Exceptional droughts and extreme precipitation usually have a negative impact on harvests, for example. Bayer is investing in research and development to reduce the consequences of extreme weather conditions on agriculture, such as flooding, drought, heat and low temperatures. These factors are stressful for crops and are responsible for high yield losses in numerous regions of the world. To meet these challenges, Bayer is using state-of-the-art breeding methods to develop approaches to reduce the impact of such stress. Bayer is also developing new varieties with the key goal of improving these crops' agronomic traits. The company's researchers are working to enhance quality and yield potential and to develop crops that have high tolerance of external stress factors such as drought but can also use water more efficiently. In this regard, Bayer uses latest technologies in research, ranging from conventional breeding and hybridization to genome editing.

Digitalizing of sustainable agriculture offers further potential to increase yields while using crop protection products even more efficiently. By combining

farmers' experience with the latest digital technologies, a precise analysis of current conditions can be generated for individual areas of agricultural land. This information then enables accurate application of seed, crop protection products and water, thus further minimizing environmental impacts, while at the same time optimizing productivity. Farmers can also plan the necessary steps from sowing to harvesting more effectively, which can cut the number of individual applications and reduces CO<sub>2</sub> emissions and soil compaction. In addition, using GPS controls enables more precise tractor routes, thus leading to reduced fuel consumption and ultimately lower CO<sub>2</sub> emissions.

Digitalization supports farmers make decisions, but is no substitute for their experience. This also counts for smallholder farmers for example in Asia and Africa. By using cellphone apps, even those farmers can use latest technologies to figure out in real time what diseases or pests threaten their harvests. Or they can use their cellphones to learn about sustainable farming methods and current market prices.

## Example 20:

### Site specific analysis of climate change signals for adaptation management



Robust information about the type, magnitude and course of local climate change at a specific site is crucial for an effective adaptation management. However, this information is usually not available. Local impact factors, like topography, make it difficult to transfer global or regional climate information to a specific site and introduce potentially large uncertainties in the quantification of local climate change signals. To address this problem, BASF SE together with the Climate Service Center Germany (GERICS) jointly developed the concept of a Site-Characteristic Climate-Fact-Sheet, which summarizes information about climate parameters that are important for a specific production site. Expert judgement of signal strength and confidence in the projected local changes are provided for each parameter by a simple classification scheme, which facilitates the integration of this information in existing risk management processes at the individual

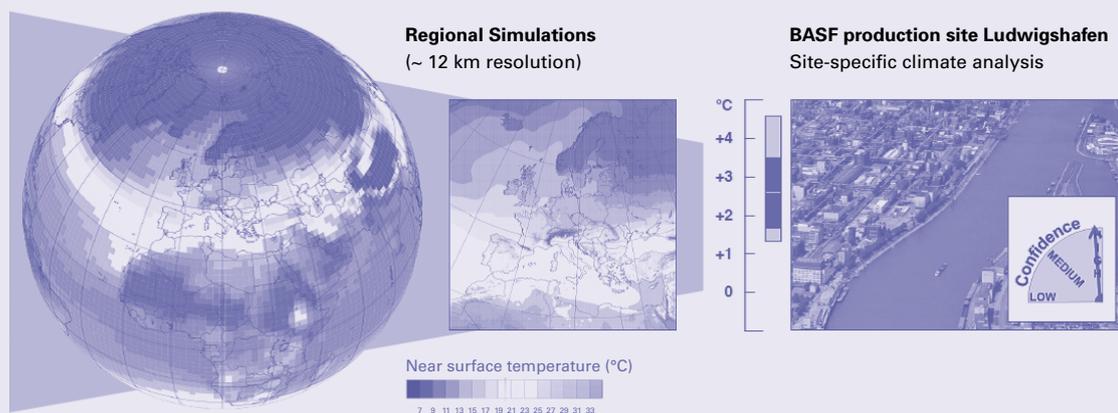
Site-Characteristic Climate-Fact-Sheet



sites. The concept has been realized in a pilot project for the main production site of BASF SE in Ludwigshafen, based on 24 regional climate simulations.

#### From global climate projections to a site-specific analysis of climate change signals:

**Global Simulations**  
(~ 200 km resolution)



The graph shows the projected temperature on a global (left) and regional scale (center) for the period 2071-2100. The site-specific analysis (right) includes information about the median and percentiles of the derived local temperature change for the period 2071-2100 relative to 1971-2000. Additionally, the confidence in the signal is visualized by a simple indicator figure.

**Example 21:****Deutsche Bahn adapts to climate change**

The recent extreme weather events caused massive operational limitations for the Deutsche Bahn in some places, resulting in large direct costs for repairs to the damaged systems. This was in addition to reduced revenue and additional costs for compensating customers. That is why this issue is important to Deutsche Bahn, which is working closely with governmental authorities and ministries. The goal is to generate well-founded estimates of the effects of climate change on Deutsche Bahn's means of production. This analysis should and in many cases must become better suited to providing information necessary for decisions concerning adaptation measures than it has so far been.

The first step was therefore to determine possible impacts of climate change for individual Bahn departments based on various weather parameters. For instance, high temperatures and heat waves can lead to track deformation, electronic signal box equipment failure, or increased incidence of embankment fires. Intense or prolonged rainfall could lead to embankment slides or lines being undercut or flooded.

In the past, storms have caused a great deal of damage to high-profile and suspended systems such as

overhead line masts and signals. Falling trees have been a primary cause of damaged overhead lines and blocked tracks.

The second step will be to look back at extreme weather conditions that have already taken place and analyze their specific effects on the Bahn's means of production. This means that both internal and external data, such as that from the Deutscher Wetterdienst, Germany's weather service, will be evaluated intensively.

The results should identify areas (such as lines, systems, and subsystems) that are especially vulnerable to the impacts of extreme weather events. Ideally, these areas can be isolated by means of geographical location measures on climate maps in order to determine the urgency of and costs arising from implementing adaptation measures. Priorities can be established to facilitate decision-making about potential adaptation measures. A first effect of these ongoing analyses will be a review of the strategy for maintaining vegetation on railway embankments with a focus on minimizing the disruption and damage emanating from that source.

Example 22:

DuPont™ Storm Room™



*The miracles of science™*

The DuPont™ Storm Room™ with Kevlar® aramid fiber is an above-ground, indoor tornado and hurricane shelter engineered to withstand EF-5 tornadoes and Category 5 hurricanes. Designed by DuPont, it meets and exceeds FEMA\* and ICC\*\*-500 standards for tornado and hurricane shelters.



\* Federal Emergency Management Agency  
\*\* International Code Council