



MEASURING AND MANAGING ENVIRONMENTAL EXPOSURE

A BUSINESS SECTOR ANALYSIS OF NATURAL CAPITAL RISK

IN FOCUS

Natural capital is the global stock of natural resources, including soil, clean air and groundwater, as well as biodiversity. By many objective scientific and macro-economic indicators it is becoming increasingly clear that natural capital is being depleted at a far faster rate than the planet can replenish it – and with consequences that extend well beyond the direct effects on the environment.

There is growing awareness, both in the media and public, of how this is affecting the planet and these concerns are increasingly entering the political and economic sphere. The business community is not only having to confront these concerns, but it also faces the direct consequences of natural resource depletion, be it through water shortage or new legislation around greenhouse gas emissions, for example.

Every business impacts, and depends, on natural capital, so the topic is steadily moving up the agendas of companies worldwide.

Allianz Global Corporate & Specialty (AGCS) wants to support businesses on their journey to finding solutions for these issues. In this report, we analyze the natural capital risks that business sectors and companies face. Specifically, the research takes a closer look at seven risks (see *page 11*) posed by the five natural capital factors – biodiversity, greenhouse gas emissions (GHG), non-GHG emissions, waste and water – for 12 selected sectors.

Measuring And Managing Environmental Exposure: A Business Sector Analysis Of Natural Capital Risk is one of the most comprehensive, data-driven reports available on the topic. The findings are based on an extensive literature review, analysis of data from independent research provider, MSCI ESG Research, covering natural capital risks in operations and supply chains of more than 2,500 companies, 72 qualitative desktop reviews of companies and in-depth interviews with insurance, risk management and sustainability professionals. Together, this provides a critical appraisal of the natural capital risks and levels of mitigation as they are currently perceived¹.

By providing this new risk perspective to a wider audience, AGCS intends to stimulate further debate among insurance management, risk management and corporate sustainability professionals to better understand and manage natural capital risks in practice.

¹ Risks relating to the final products and services of companies have not been included in this report, due to a lack of consistent data



CONTENTS

04	Executive summary
06	Introduction
08	Sector comparison
12	Sector profiles: natural capital risk analysis
25	How do natural capital risks materialize?
27	What is next?
28	Research methodology
29	Bibliography
30	Allianz Global Corporate & Specialty business scope
31	Contact us

EXECUTIVE SUMMARY

Businesses are increasingly confronted with the consequences of natural capital depletion, be it through water shortage or new legislation around greenhouse gas emissions. Yet, while more companies are assessing their natural capital footprint as part of their growing awareness of their role in natural resource depletion, many are failing to explore the related risks and mitigation options available.

\$4.7
trillion

Estimated annual cost of the top 100 environmental impacts for the global economy in social costs, lost ecosystem services and pollution²

This report provides a critical appraisal of natural capital risk and of the levels of mitigation in 12 selected sectors. The research analyzes seven types of risk (see page 11) that businesses confront around the five natural capital factors of biodiversity, greenhouse gas emissions, non-greenhouse gas emissions, water and waste.

MOST SECTORS ARE EXPOSED TO NATURAL CAPITAL RISKS

For comparison and analysis, AGCS classified sectors as belonging to one of three categories:

- **Danger zone:** sectors where risks are generally greater than mitigation
- **Middle zone:** sectors where risks are roughly matched to mitigation
- **Safe haven:** sectors that generally do not seem to face high risks and/or are reasonably well prepared

Sectors in the danger zone: According to the analysis, four sectors find themselves in this zone when using the risk methodology from AGCS. In addition to **oil and gas** and **mining**, which are

widely believed to have high levels of risk, two other sectors appear in this zone: **food and beverage** and **transportation**. Overall, due to their inherent natural capital footprint, it is harder for these sectors to mitigate their risks; however, innovative risk solutions could be more strenuously applied.

Sectors in the middle zone: According to the AGCS risk methodology, seven sectors are in the middle zone: High levels of risk are evident for the **automotive, chemical, clothing, construction, manufacturing, pharmaceutical** and **utilities** sectors. Overall, AGCS believes that companies in these sectors need to be aware of their risk profile and work actively on mitigation to manage individual natural capital risks in their operations and supply chains.

Sectors in the safe haven: Only one sector can be found in the safe-haven zone. **Telecommunications** is a good example of a low risk service-related sector where companies typically position themselves as solution providers for natural capital risks that affect their customers – i.e. by providing communication to avoid the carbon dioxide generated from business travel.

² Trucost, TEEB for Business Coalition, Natural Capital At Risk: The Top 100 Externalities of Business, April 2013

UNDERSTANDING NATURAL CAPITAL RISKS

AGCS research shows that natural capital risks rarely come without warning, but gradually build up over time in three subsequent phases, (see page 25).

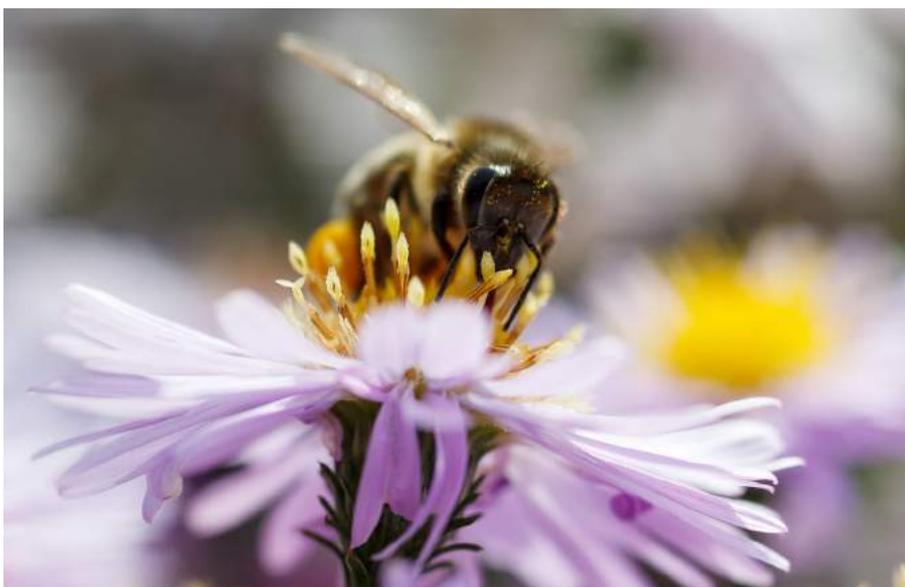
In the first phase a growing awareness can be observed, generally triggered by changes in either the physical natural environment, public opinion or court rulings or legal changes. As a matter of good practice, companies need to proactively investigate potential risks stemming from these trends and assess the extent that these risks could affect the company's operations or even business model.

In the second phase, natural capital risks will start affecting individual companies in their supply chain, their own operations or at site-level, either through regulation, growing social pressure or resource scarcity. For a company, a risk in this phase requires mitigation through reactive steps in risk management.

In the last phase, once the risk cannot be mitigated, it materializes. Companies can suffer from material and immaterial damage such as liability costs, increased production costs, lost profit or business interruption. Depending on the scenario, the impact of these damages can be significant and long-lasting. In this third phase, efforts to handle the risks should be directed to minimizing their impact through crisis management.

HOW CAN COMPANIES PREPARE?

Most companies have effective risk management and insurance systems in place that can be used to address natural capital risks. Rather than reinventing the wheel, companies can broaden the scope of these systems beyond financial and operational risk management – for example, when opening a new plant, natural capital risks such as future water availability and the emerging emissions regime should also be taken into account. One of the challenges is balancing traditional risk management focused on the present with the management of emerging risks arising in the mid- to long-term. Future and non-financial risks are often overlooked as companies are expected to deliver short-term performance targets. It can be difficult to quantify these types of risks to shareholders.



What does natural capital mean?

The concept of natural capital defines the global stock of natural resources, which includes soils, air, water and all living organisms. Natural capital assets provide companies with a wide range of resources and services that are, in most cases, free or underpriced. Natural capital can be seen as an extension of the economic notion of capital, (resources which enable value creation) to goods and services provided by the natural environment.³ Natural capital often also provides services like erosion control, water catchment and pollination by insects, which in turn ensure the long-term viability of other natural resources.⁴

Although this review is primarily focused on the business risks of natural capital, it is also important to acknowledge the opportunities companies can seize. Companies that respond best to natural capital risks are also likely to be those that can most readily grasp the opportunities.

At the same time, companies must account increasingly for natural capital risks and disclose them to governmental agencies, investors and other stakeholders. This may prove to be a challenge as generally accepted reporting and disclosure requirements are yet to be developed.

AGCS believes companies that are willing to invest in natural capital risk management will be best-equipped to keep damages under control and seize opportunities in an increasingly resource-constrained world.

³ It should be mentioned that this concept is also subject to a moral/ethical discussion around monetization and the related assumptions (for example: what is the intrinsic value of human health or animal species?). Please note that this debate will not be reflected in more detail in this document. However, it should be mentioned that an important thought behind quantification/monetization is the idea that it has the potential to strengthen and support the understanding of companies to act responsibly and in a sustainable manner. The natural capital concept and related methodologies are at the same time not intended to replace ethical or moral reflection or actions from individuals or organizations

⁴ Definition based on the [Natural Capital Protocol](#)

INTRODUCTION

This review addresses natural capital risk and levels of mitigation at a sector level to focus more attention from business leaders and other decision-makers on the subject.

The key messages from science and macro-economics are becoming increasingly clear and commonly accepted. We know that we are depleting our natural capital faster than the earth can replenish it with consequences that extend far beyond the direct effects on the environment. As a result, our economies are at substantial risk from the effects of climate change, pollution, water shortage and loss of biodiversity.

Businesses around the world are increasingly confronted with the implications, be it directly through local water shortage and extreme weather conditions, or indirectly by resource scarcity, regulatory action, liabilities or supply chain disruptions. Every business impacts and depends on natural capital to some degree and AGCS research shows that the topic is steadily moving up corporate agendas. However, the nature and extent of the associated risks for sectors and individual companies are far from clear.

ECONOMIC IMPACT INCREASINGLY CLEAR

Scientific and economic analysis offers an increasingly clearer picture of the economic benefits of natural capital and the related costs in case of loss or damage.

In 2007, the German government proposed at the G8+5 countries meeting in Potsdam to analyze the global economic benefit of biological diversity. The subsequent ground-breaking study, **The Economics of Ecosystems and Biodiversity (TEEB)**, estimated the global problem of biodiversity loss and ecosystem degradation in economic terms. The TEEB study focused largely on deforestation and calculated the cost at US\$2 trillion to \$4.5 trillion per year.

According to the United Nations-backed Principles of Responsible Investment (PRI) and corporate environmental research group Trucost,

the cost of environmental damage caused by the world's largest 3,000 companies was estimated at \$2.15 trillion (2010). Another study by the PRI and Trucost found that biodiversity and ecosystem damage could cost the world \$28.6 trillion (£18.2 trillion), or 18% of global economic output, by 2050.⁵ These damages are often called "externalities" and are not accounted for in the bottom line. The 2013 **Natural Capital at Risk** report estimated the cost of the top 100 environmental impacts for the global economy at \$4.7 trillion per year in social costs, lost ecosystem services and pollution. The most significant impacts are greenhouse gas emissions (36%), water use (26%) and land use (25%).⁶

Predictions of annual losses due to climate change range from 1% of global GDP a year if strong and early action is undertaken to at least 5% if economies fail to act.⁷ According to the Intergovernmental Panel on Climate Change report, **Climate Change 2014: Mitigation of Climate Change**, efforts to stabilize levels of greenhouse gas emissions would require investments of about \$13 trillion through 2030.⁸ According to the International Energy Agency, switching from fossil fuels to low-carbon sources of energy will cost \$44 trillion by 2050.⁹

GROWING AWARENESS AMONG COMPANIES AND INVESTORS

As a result, the business community is experiencing increasing public and regulatory pressures from governments and non-governmental organizations. For example, due to tighter regulations and social and political pressures, certain sectors face greenhouse gas regulation and pricing.

In the last couple of years, companies have become more aware and active in the discussion around natural capital, for example, through the **Natural Capital Coalition (NCC)**. The coalition is a global multi-stakeholder collaboration that brings

5 Trucost News, "[Putting a price on global environmental damage](#)" October 2010

6 Trucost, TEEB for Business Coalition, *Natural Capital At Risk: The Top 100 Externalities Of Business*, April 2013

7 The Stern Review on the Economics of Climate Change, 2006

8 MIT Technology Review, May 15, 2014

9 Energy Technology Perspectives, May 2014

A timeline of selected key milestones in the evolution of natural capital valuation

<p>The TEEB Interim Report was released. It provided evidence for significant global and local economic losses and human welfare impacts due to the ongoing losses of biodiversity and ecosystems degradation. The report focused largely on forests and looked at the extent of losses of natural capital taking place as a result of deforestation and degradation.</p>	<p>Puma reported the first environmental profit and loss account on its 2010 data.</p>		<p>At the Rio+20 summit held in Brazil a 'national capital declaration' was launched as well as UINEP FI Principles for Sustainable Insurance – a global framework for the insurance industry to address environmental, social and governance risks and opportunities.</p>	<p>The Natural Capital Coalition (NCC) announced the selection of two consortia, managed by the World Business Council for Sustainable Development and the International Union for Conservation of Nature, to develop the Natural Capital Protocol.</p>	<p>The Dow Jones Sustainability Index added a number of natural capital-related questions to its corporate questionnaire.</p>	<p>According to RobecoSAM, out of around 200 sampled companies, 35% already developed or completed impact valuation. Another 53% self-declared their work on or with impact valuation. Only 12% of companies did not indicate work on or with impact valuation.</p>	<p>The 2018 Global Risks Perception Survey from the World Economic Forum ranked highly the following environmental risk factors: biodiversity loss, ecosystem collapse and the failure of climate change mitigation and adaptation.</p>
<p>2007</p>	<p>2010</p>		<p>2013</p>	<p>2015</p>		<p>2017</p>	
<p>2008</p> <p>The TEEB study was launched by Germany and the European Commission in response to a proposal by the G8+5 Environment Ministers in Potsdam, to develop a global study on the economics of biodiversity loss.</p>	<p>2011</p> <p>Trucost together with the Principles for Responsible Investment released a report that estimated the cost of environmental damage caused by the world's largest 3,000 companies in 2008.</p>	<p>2012</p> <p>World population reached 7 billion.</p>	<p>The Natural Capital Coalition (formerly the TEEB for Business Coalition) announced a project to develop a harmonized protocol for valuing natural capital – the Natural Capital Protocol.</p>	<p>2014</p> <p>Governments reach the universal agreement to reduce carbon emissions at the COP 21 UN Climate Change Conference in Paris.</p>	<p>2016</p> <p>The NCC released the Natural Capital Protocol. The protocol provides a standardized framework for organizations to identify, measure and value their direct and indirect impacts and dependencies on natural capital.</p>	<p>2018</p> <p>The World Forum on National Capital was held in Scotland, where government representatives, environmental experts and business leaders discussed how natural capital principles can inform decisions for a better world.</p>	

Source: Allianz Global Corporate & Specialty

together leading initiatives and organizations to harmonize approaches to natural capital. In 2016, the NCC released the Natural Capital Protocol, a framework to help business to generate trusted information to aid managers in making better informed decisions around natural capital.

Since its publication, hundreds of companies across sectors and geographies have started applying the protocol to their business with many also making this known publicly. Some frontrunners have started quantifying and monetizing their impact on the environment and wider society and linking it to their financial performance.

The capital markets – investors, analysts, rating agencies – are increasingly factoring natural capital considerations into their investment decisions. In 2016, the Dow Jones Sustainability Index added natural capital-related questions to its corporate questionnaire.

Moreover, investors and portfolio managers are looking for ways to align their portfolios with the United Nations' 17 Sustainable Development Goals (SDGs), which include global aspirations around water, waste and climate change. In December 2017, more than 200 institutional investors committed to increase the pressure on the world's 100 biggest corporate greenhouse gas emitters to combat climate change.

While the macro-economic impact is increasingly clear and awareness among companies and investors is growing, relatively little is known about which parts of the

economies are exposed to risk. Therefore, there is a need for further analysis at a sector level.

To share AGCS' unique risk management perspective on natural capital risks and to raise awareness among businesses for a better understanding of the risk dimension, AGCS conducted an in-depth study to identify key natural capital risks for 12 selected, exposed sectors. In this report, AGCS analyzes the risks of five natural capital factors: **biodiversity, greenhouse gas emissions (GHG), non-greenhouse gas emissions (non-GHG), water and waste** in these sectors. AGCS seeks to simplify the concept of natural capital risk by distinguishing between dependencies and impact on natural capital – the related risks for the company translating into business interruption and liabilities. This is one of the first global data-driven reports on natural capital risks, featuring in-depth desktop reviews and interviews with sustainability and risk management professionals.

After this introduction to natural capital and the related risk concept, the study elaborates on the research scope and structure regarding the 12 sectors, as well as their overall comparative scoring on risk exposure and mitigation related to natural capital risks. Detailed sector profiles allow for a more granular view. Finally, the research dives into the risk materialization factors for natural capital risks and the possible solutions a company could consider to reduce these risks. AGCS' aim is to explore the risk dimension of natural capital and put it on the agenda for further discussion.

SECTOR COMPARISON

NATURAL CAPITAL RISK EXPOSURE

The graph below shows the allocation of 12 sectors regarding their overall risk (related to impact and dependencies) and mitigation (awareness and preparedness of the sector) on seven researched risks (see page 11) relating to five natural capital factors. The higher the sector is ranked on the y-axis, the greater the average perceived natural capital risk for companies in the sector. The more to the right a sector is ranked on the x-axis, the greater the average related mitigation of companies in the sector in face of these risks.

For comparison and analysis, AGCS classified sectors in the following categories:

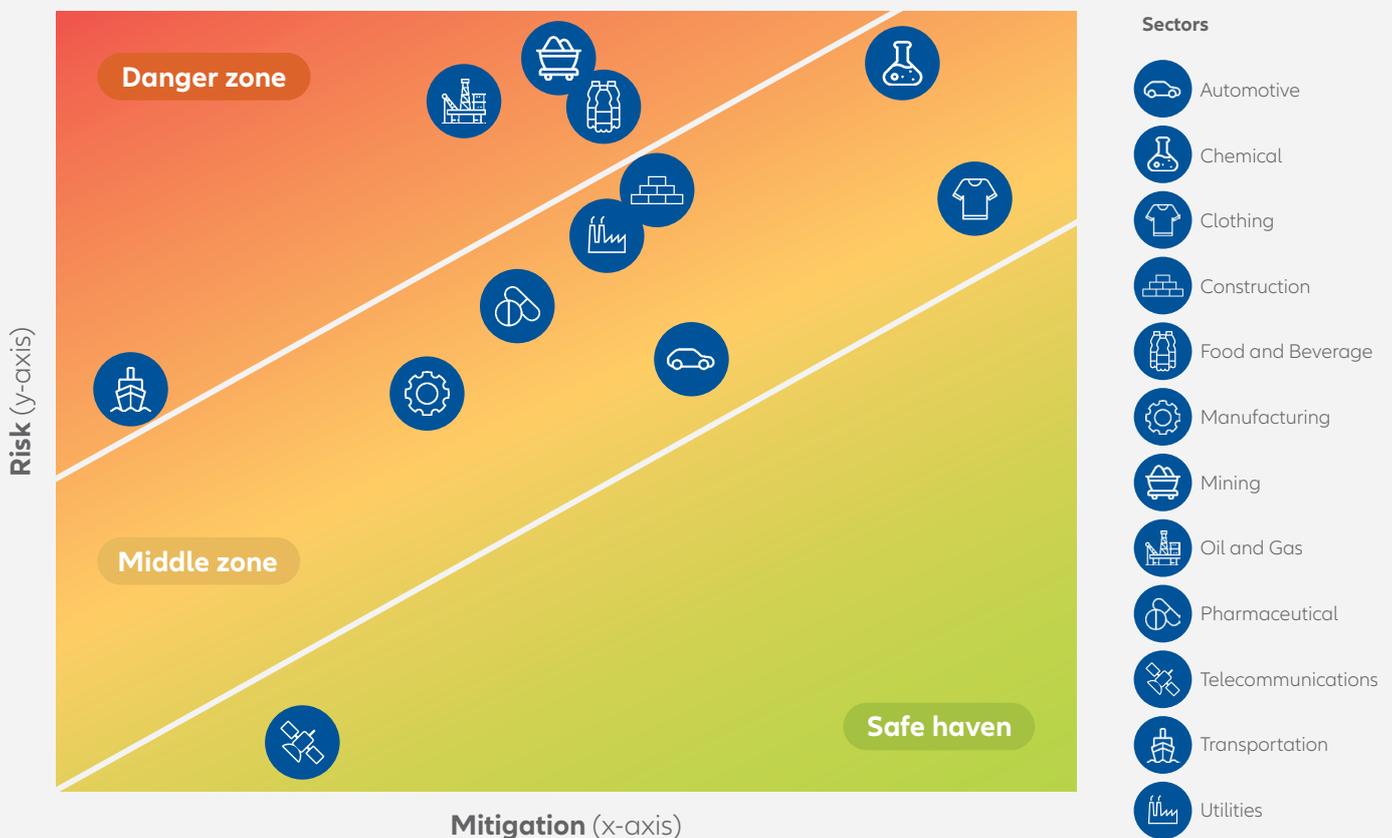
- **Danger zone:** sectors where risks are generally greater than mitigation
- **Middle zone:** sectors where risks are roughly matched to mitigation
- **Safe haven:** sectors that generally do not seem to face high risks and/or are reasonably well prepared

This results in a sector map combining the overall level of risk stemming from the seven natural capital risks that sectors confront versus mitigation responses to these challenges.¹⁰

“The WBCSD believes that advancing a framework and building capacity to foster sustainability-conscious enterprise risk management is a critical step toward building the long-term prosperity of companies and the societies on which they depend.”

World Business Council for Sustainable Development (WBCSD), Sustainability and Enterprise Risk Management: The first step towards integration

Sector comparison of natural capital risks and mitigation



¹⁰ The aim of the sector analysis in the report is to give a strong indication of each featured industry's overall exposure to natural capital risk, rather than that of individual companies. This is because there are significant differences in how companies in each sector address and mitigate natural capital risk. For example, in the utilities sector, the levels of risk exposure and management regarding GHG and non-GHG emissions can range from low-emitting companies who manage the impact well to heavy emitters with little emission management. It is important to acknowledge that there are natural capital risk-conscious companies operating in sectors ranked in the danger zone.



Sectors in the danger zone

According to the risk methodology of AGCS, four sectors find themselves in the danger zone. In addition to **oil and gas** and **mining**, which are widely believed to be at risk, two other sectors appear in this zone: **food and beverage** and **transportation**.

Companies in both the oil and gas and mining sectors typically operate at the very beginning of the value chain and provide materials, such as ores, oil and gas, to other industries with a lower risk profile. The natural capital risks are relatively high due to the inherent nature of the business. While compliance and management

play a key role for these sectors, it's obviously more challenging for them to mitigate their natural capital risks. AGCS believes that other forms of risk mitigation, such as integration of natural capital considerations into strategic business decisions and innovative enterprise risk management, will become more important.

The transportation sector falls into this zone because of its relatively low mitigation despite its relatively high natural capital risk exposure, in particular because of the impact on biodiversity and the impact through

greenhouse gas emissions (GHG) and non-GHG emissions. This calls for additional measures in the sector, such as emissions control or mitigation measures to reduce the impact on flora and fauna.

The food and beverage sector is marked by high dependency and impact exposure to natural capital risk in its supply chains. Little analysis has been conducted on the dependencies of the agriculture value chain. Companies in this sector should pay more attention to the management of natural capital risk in the supply chain.



Sectors in the middle zone

According to the AGCS risk methodology, seven sectors are in the middle zone:

The **construction, utilities, clothing** and **chemical** sectors are all exposed to a high level of risk. The chemical sector is in this zone due to its high level of mitigation. The sector has implemented comprehensive environmental management systems and is typically under strict government oversight.

The clothing sector has a similar risk level and has been historically active in mitigation, perhaps spurred by early

champions like Puma, which pioneered the use of Environmental Profit and Loss (E P&L) statements. The profiles of the **manufacturing**, construction and utilities industries can be explained by their heavy industry processes and related impacts. In an increasingly resource-constrained world, AGCS believes liability and business interruption solutions for non-traditional risks will increasingly be required.

The **pharmaceutical** and **automotive** sectors have a medium risk profile, yet the risk management differs as the

automotive sector is more advanced in this regard due to public and social pressures. The pharmaceutical sector is faced with emerging risks associated with the impact and dependency on water and biodiversity, such as the effect of possible medical waste from production.

Overall, companies in these sectors need to be aware of their risk profile and work actively on mitigation to manage their individual natural capital risks in their operations and supply chains.



Sectors in the safe haven

Only one sector is found in the safe-haven zone. The **telecommunications** sector is a good example of a low risk

service-related sector, where companies typically position themselves as solution providers for natural capital risks that affect their

customers; for example, enabling smart grid power solutions to avoid unnecessary carbon dioxide emissions from energy generation.

Embankment Project for Inclusive Capitalism – broadening the view on other forms of capital

While (listed) companies are subject to financial reporting that enables investors to monitor their financial key data, activities related to, for example, intellectual or natural resources are not explicitly and consistently reported in financial terms to investors. That is why Allianz joined the **Embankment Project for Inclusive Capitalism** together with over 30 other leading organizations. The aim of the project is to identify and develop metrics which will measure outcomes for significant areas of value creation, beyond purely financial value. The project will collaborate with other initiatives to ensure alignment as far as possible and build on accepted frameworks, standards, methods and leading best practices.

➤ [See details of the Embankment Project](#)

“Understanding natural capital risk and opportunities is essential for businesses to position themselves in an increasingly resource-constrained world.”

Dr. Dorothy Maxwell, Director of the TEEB for Business Coalition, 2013

Natural and social capital at Allianz

Allianz is actively investigating the concept of environmental and social impact evaluation. With a diverse business model and a service-based product, understanding both the positive and negative externalities of the different parts of Allianz business is challenging. It is actively developing a methodology to understand these impacts in the different parts of its business. The aim of this initiative is to demonstrate the positive environmental and social impacts of insurance for customers and society more effectively, as well as to understand if this type of strategic tool can offer benefits to decision-making in its business.

CONDUCTING THE ANALYSIS

In this section of the report, the natural capital risks as outlined in the literature and corporate disclosures have been aggregated, analyzed and quantified by sector.

The overall sector ranking has been conducted using a literature review of the 12 sectors and a qualitative desktop review of 72 companies within these sectors. For the detailed sector views, AGCS conducted a data analysis of 2,500 companies spread across the globe in the 12 sectors of focus in cooperation with MSCI ESG Research, its partner on Environmental, Social and Governance (ESG) data and analysis.

As there is no explicit and specific rating data available on the risks and mitigation measures relating to natural capital, data proxies were selected for the analysis and weighting. These were aligned with the insights from the qualitative desktop review of the sectors and companies where relevant and possible. The main reason for using MSCI ESG Research data is that it is one of the most comprehensive databases on corporate sustainability. Additionally, several in-depth company interviews were conducted to validate aggregated findings, as well as company and sector findings.

It should be noted that the assessment has limitations since the research is based on sector research and self-reported company data with varying degrees of scope, quality and specificity. In addition, AGCS has not covered the full spectrum of natural capital risks as we omitted areas where data was limited and the literature was unavailable or lacked relevance. The research identifies risks in the supply chain and a company’s own operations, whereas product use was not considered due to a lack of reliable data. Nonetheless, this review offers a meaningful contribution to the understanding of natural capital risk.

Definition of risk: Within the sector overview and the detailed profiles, the perceived level of risk from high to low describes how far a sector on average is affected by a given risk. As indicated by the literature on the sector, as well as qualitative and quantitative company data, AGCS ranked the individual and aggregated risks.

Definition of mitigation: The mitigation score provides an indication of the perceived level of mitigation, indicating whether sectors are actually aware of and prepared to manage the seven natural capital risks which are part of this report. As indicated by literature on the sector, as well as qualitative and quantitative company

data, AGCS ranked the individual and aggregated mitigation available for risks.

AGCS then calculated the respective detailed scores per sector by calculating a weighted score for the seven risks and related mitigation aspects around the five natural capital factors.

SEVEN RISKS SURROUNDING THE FIVE FACTORS OF NATURAL CAPITAL

Biodiversity



– **Dependency on biodiversity:** The dependency a company has on flora and fauna, ranging from direct resource input (such as wheat, cotton, biomass, but also cattle or fish) to indirectly related biodiversity services (such as pollination by bees).



– **Impact on biodiversity:** The impact a company has on flora and fauna by destroying or limiting the quality and amount of flora and fauna through its activities, either directly (such as extinction of a certain species) or indirectly (such as damaging the resistance of fauna through toxic emissions).

Greenhouse gas emissions



– **Impact through greenhouse gas (GHG) emissions:** This could be directly through a company's production process or indirectly in its supply chain or consumption of products (such as during the extraction, refining and consumption of oil/oil-based products).

Non-GHG emissions



– **Impact through non-GHG emissions:** This could be directly through a company's production process or indirectly in its supply chain or consumption of products (such as nitrogen oxides [NO_x] during the extraction and burning of coal).

Waste



– **Impact a company has through its waste:** This could be directly through its production processes or indirectly in its supply chain or by consumption of products (such as electronic waste or packaging waste in a supply chain).

Water



– **Dependency on water:** The dependency a company has on sufficient amounts of clean water for its production processes and in its supply chain (such as irrigation for crops or cooling water).



– **Impact on water:** The impact a company has through the amount of water it extracts, as well as through water pollution. This can be directly through the production process, as well as through its supply chain (such as the affluent discharge or water extraction for crops).

For more detailed definitions on terms and categories used, **see page 28**.

Given the way AGCS calculated both the risk and mitigation levels, the relative position of a sector is more important than its precise position on the heatmap. Its purpose is to provide a

relative position across sectors and to facilitate discussion. The findings per sector are comparable among each other regarding the risk/mitigation axis and comparable within a sector profile to allow for an analytical discussion of material issues within and among sectors.

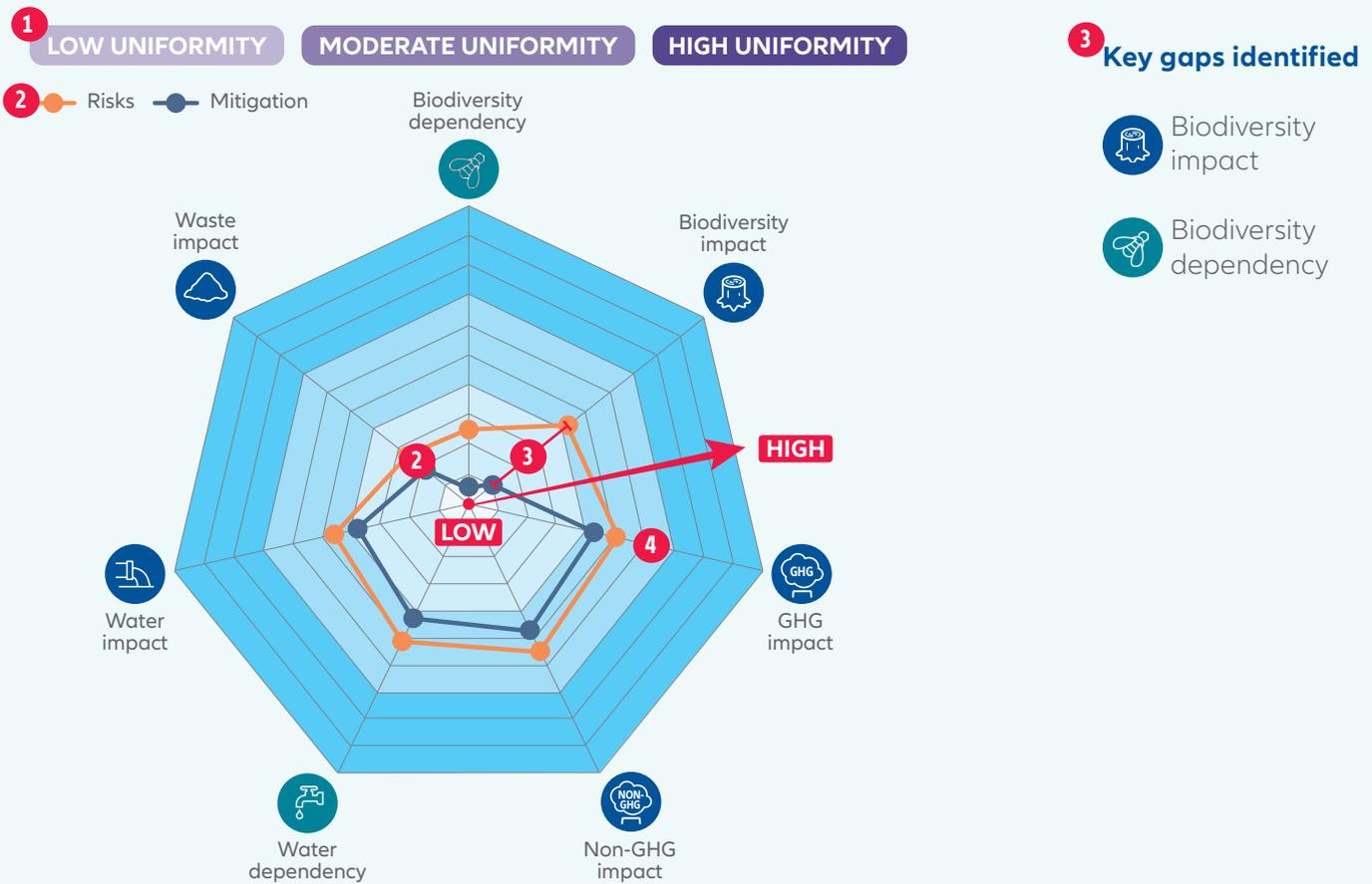
SECTOR PROFILES

NATURAL CAPITAL RISK ANALYSIS

How to read the spider graph

The example graph below indicates the average level of natural capital risk and mitigation within a sector, distinguishing between the seven risks around the five natural capital factors. The farther a risk or mitigation dot is located away from the center, the higher the respective risk/mitigation on this specific risk is. Within this graph, the relative gap between the risk/mitigation dot illustrates the level of potential risk exposure.

Automotive sector natural capital risk analysis



- 1** Uniformity describes how consistent the different risk and mitigation profiles of companies within a sector are. In sectors with high uniformity, risk and mitigation profiles between companies are more alike; in sectors with low uniformity, profiles are less alike.
- 2** Risks are indicated by the orange thread and mitigation by the blue.
- 3** Significant gaps are identified by the distance between the blue and orange points on each outward bound strand of the spider graph.
- 4** The scale of the graph goes from low to high with the center of the spider graph representing the lowest value. A darker color indicates a higher value.



MIDDLE ZONE

AUTOMOTIVE

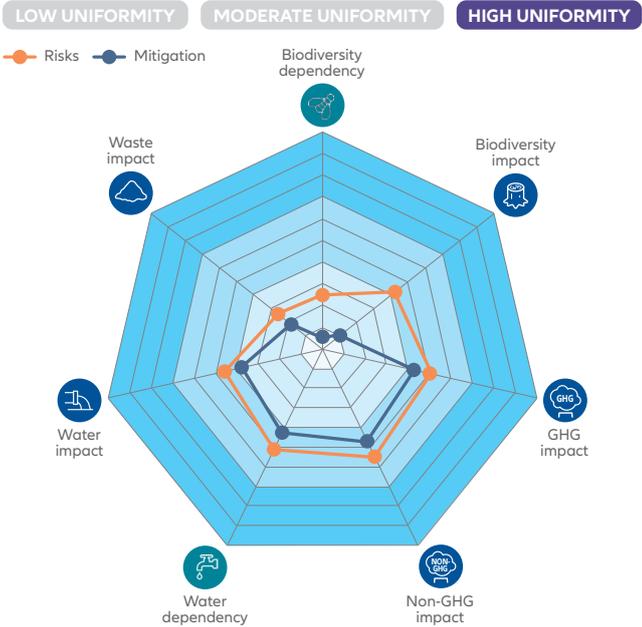
More than other sectors, automotive has been pressed to improve its environmental performance. The traditional sector has not only gradually increased its output of hybrid and electric models, it has also reduced GHG and other emissions in its complex international supply chain. The sector is advanced in the evaluation of its impacts, yet for some reason does not explicitly link these activities to natural capital initiatives.

For this publication, AGCS focuses on the natural capital risks related to the production of motor vehicles and parts, as well as the global supply chain, excluding risks associated with the product itself. The sector engages and collaborates with a wide range of stakeholders (for example, international policymakers, academia and investors) on these risks. Overall, the awareness and preparedness to address and mitigate these risks is relatively high.

“High emissions of criteria air pollutants brings heavy regulatory scrutiny and higher costs of operation, while handling chemicals carries the possibility of accidental spills and releases which pose risks to workers, local communities and local ecosystems.”

MSCI ESG Research Industry Report: Auto components (August 2017)

Automotive sector natural capital risk analysis



Key gaps identified

- Biodiversity impact
- Biodiversity dependency

Risk scenario example for an automotive company



Social and political pressures increase on a supplier due to its biodiversity impact (toxic releases to the environment), which leads to a supply chain interruption for several automotive companies. Costly technical measures to clean up the releases and prevent future spills are implemented to remedy the situation.



MIDDLE ZONE

CHEMICAL

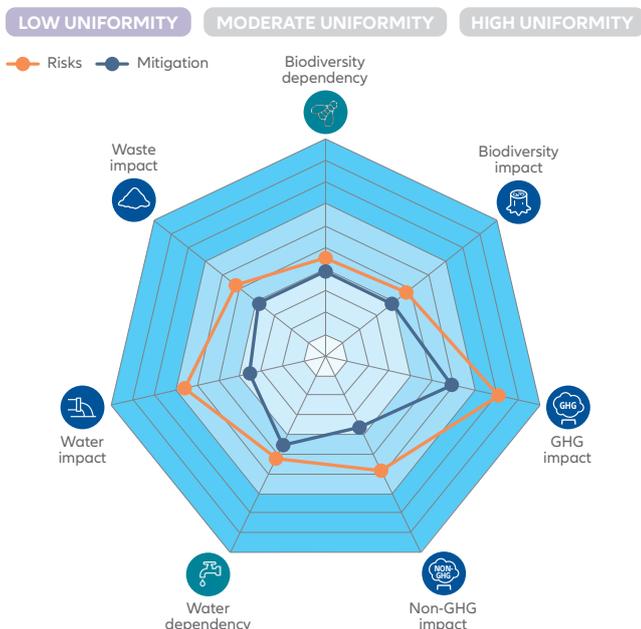
The chemical sector encompasses chemical companies around the globe dealing with commodity, diversified and specialty chemicals. The sector is characterized by complex supply chains and interlinkages.

The chemical sector is relatively exposed to social and regulatory pressures, less so to political pressure. The sector is mainly exposed to natural capital impact risks, such as water, waste and emissions to air. These extend from the core operations to the supply chain. Chemical companies are often well aware of their environmental impact and manage it accordingly with corporate risk management and technical measures.

“Measuring our impact on the environment in monetary terms improves the understanding of the relevance of specific environmental impacts compared to other impacts assessed in our Value-to-Society approach. Using a monetary unit for economic, social and environmental impacts improves our understanding of their interdependencies along value chains. At BASF, impact valuation is systematically applied at corporate level. It provides a frame to better understand our total benefits and costs to society, to support decision-making processes and to inform strategy development together with our risk management.”

Christian Heller, Senior Manager Corporate Sustainability Strategy, BASF SE

Chemical sector natural capital risk analysis



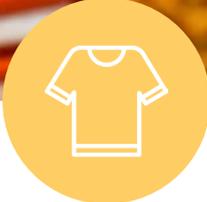
Key gaps identified

- Water impact
- GHG impact
- Non-GHG impact
- Waste impact

Risk scenario example for a chemical company



Due to increasing legal and political pressures, GHG and non-GHG air emissions are capped in one country. This affects an operating entity based there and leads to a business interruption in the short term as the production processes need to change over time to reduce emissions. The technical refurbishment creates additional costs for the operating entity.



MIDDLE ZONE

CLOTHING

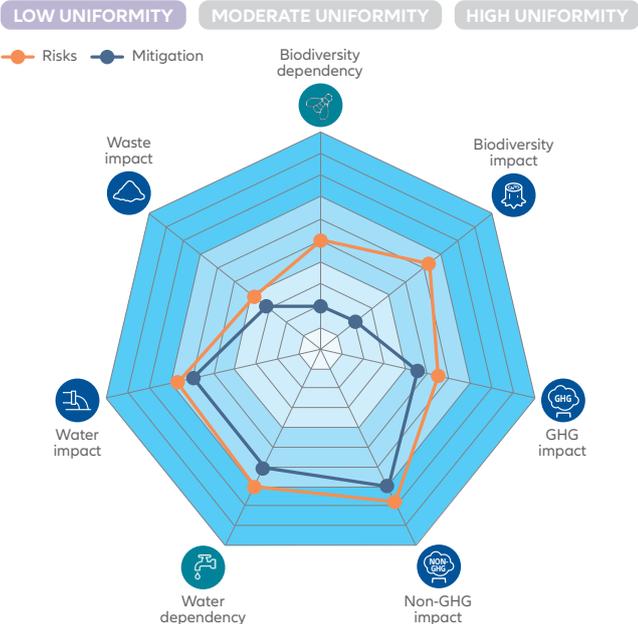
The sector is dominated by a relatively small number of multinational retail companies that have significant influence along the entire value chain. The production of raw materials and clothing usually takes place in developing and emerging markets, therefore some of the risks are not always visible initially.

While the clothing sector is moderately exposed, compared with other sectors, when it comes to natural capital risk, the awareness of, and preparedness to, mitigate the issues are relatively high. This may be explained by the direct reliance on natural capital and the early and visible action of some individual companies.

“Within the textile, apparel, and luxury goods industry, leather and cotton, are identified as raw materials with the most significant environmental impact. Leather hides are associated with a high carbon footprint due to deforestation and methane emissions linked to cattle ranching. Apparel goods’ environmental impact is primarily attributed to high intake of water and pesticides in cotton crop production.”

MSCI ESG Research Industry Report: Textile, Apparel, And Luxury Goods (September 2017)

Clothing sector natural capital risk analysis



Key gaps identified

- Biodiversity impact
- Biodiversity dependency

Risk scenario example for a clothing company



Cotton monocultures in a specific geographical location are rapidly expanding and involve allegations of land-grabbing, pesticide use and excessive water use. Social and political pressures create a reputational risk for the cotton producer. Court cases against the alleged land-grabbers are filed by activists, creating a liability for the company. At the same time, water overuse creates an instability of supply and increasing costs. enterprise risk management (land acquisition) and technical measures (water management) are needed to manage growth sustainably.



MIDDLE ZONE

CONSTRUCTION

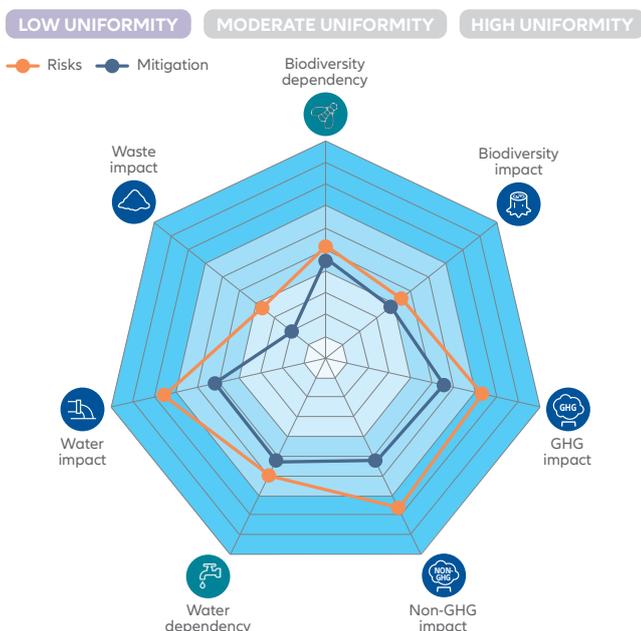
The construction sector encompasses the production of building and construction materials, as well as the actual construction and engineering of buildings and infrastructure. Like the manufacturing sector (see page 18), companies in this sector vary greatly in terms of size and setup. Investments in infrastructure and a property boom in many parts of the globe means that the sector has performed reasonably strongly in the past decade on a global average.

The sector is confronted with social and regulatory pressures and, in some cases, political influence. The reliance on natural construction materials, such as wood, can create supply chain risks when scarcity occurs. At the same time, deforestation is likely to have a negative impact on biodiversity. Technical mitigation plays a limited role in the sector, while corporate risk management plays a more important role.

“Cement production is among the most carbon-intensive manufacturing activities, however, despite potential for regulatory pressure to reduce carbon emissions in the future, only 44% of companies in the set have long-term carbon reduction targets beyond 2020.”

MSCI ESG Research Industry Report: Construction Materials (November 2017)

Construction sector natural capital risk analysis



Key gaps identified

- Non-GHG impact
- Water impact
- GHG impact
- Waste impact

Risk scenario example for a construction company



A cement producer is active at multiple locations worldwide with carbon dioxide (CO₂)-intensive processes. The producer faces legal action as the company is seen as a liable driver of climate change and its adverse effects. As the company is one of the largest emitters of CO₂, social and political opinion surrounding the trial creates additional pressure to minimize CO₂ emissions.



DANGER ZONE

FOOD AND BEVERAGE

The food and beverage sector covers a wide range of companies involved in processing raw food materials, as well as packaging and distributing them. The industry is fragmented and production is divided among many companies. Due to its nature, the industry heavily relies on agricultural products that are expected to be impacted by climate change in the coming years.

The food and beverage sector tends to be characterized by biodiversity impacts and dependencies on natural capital risk factors at the same time. All types of risks are relatively high, while mitigation is present throughout all aspects. The highest risk scores for this sector relate to water dependency followed by waste impact.

While the food and beverage sector is moderately exposed compared to other sectors when it comes to natural capital risks, awareness and preparedness to mitigate the issues are also moderate.

“Despite the significant risk of supply disruptions as a result of water stress, only 20% of MSCI All Country World Index (ACWI) Food Products companies have actually begun to address water stress in their agricultural supply chain, while 72% are only focused on operations. Eight percent do not manage water stress at all.”

MSCI ESG Research Industry Report: Food products (February 2017)

Food and beverage sector natural capital risk analysis



Key gaps identified

- Water dependency
- Biodiversity impact
- Biodiversity dependency
- Waste impact

Risk scenario example for a food company



Local flora and fauna suffers as a result of excessive fertilization and pesticides used at a supplier’s plantations. At the same time, the area becomes less fertile and more vulnerable to external environmental impacts. The supply from the plantation becomes more expensive and volatile, creating regular interruptions in the supply chain. Enterprise risk management addressing the supplier’s plantation management practices from an environmental sustainability perspective is necessary.



MIDDLE ZONE

MANUFACTURING

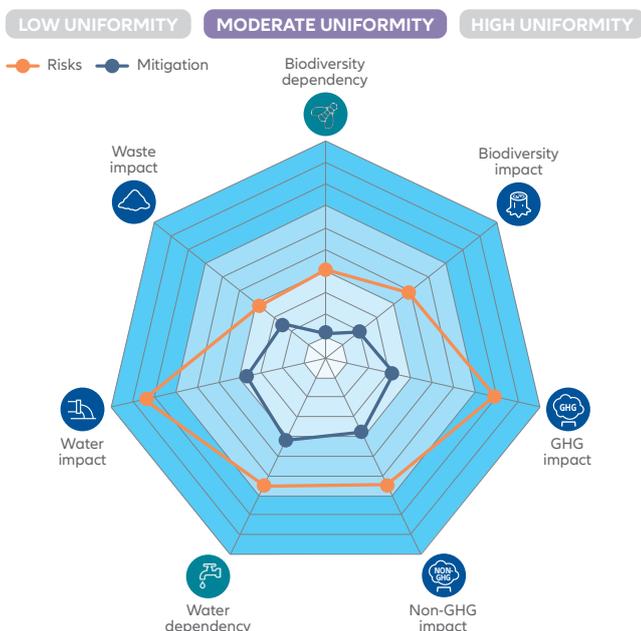
The manufacturing sector is a broad, globally-connected sector and includes primary and end products ranging from consumer to capital goods. This sector often involves long, complex and dynamic supply chains that make the natural capital risks of the sector not always visible initially.

In comparison to the mining and utilities sectors, the manufacturing sector is not experiencing the same regulatory, social and political pressures. This generally means that fewer risks will materialize in practice. At the same time, outsourcing practices, supply chain interconnectedness and dependency on raw materials, resource input and the flow of intermediate products is key to manufacturing. Natural capital risks can materialize at specific manufacturing companies through impact (production scale-down at a plant due to excessive emissions) or dependencies (production halts due to water shortage) and can also spill to downstream users of the product within the sector and beyond.

“Due to the interconnected global supply chains, our operations are dependent on water, energy and a range of raw materials and components. We are aware of the associated business risks which are addressed by our supply management function and through the integration of the circular economy principles into our business model. Not only to manage compliance, but also working together with our suppliers to create a positive impact.”

Simon Braaksma, Senior Director Group Sustainability, Royal Philips

Manufacturing sector natural capital risk analysis



Key gaps identified

- Water impact
- GHG impact
- Biodiversity impact
- Biodiversity dependency
- Non-GHG impact
- Water dependency
- Waste impact

Risk scenario example for a manufacturing company



Excessive waste from its production processes and the local incineration of toxic and non-toxic waste becomes a major issue for a company after social and political pressure. To anticipate local licensing or regulatory changes, the company implements costly technical measures to minimize the waste and has excess waste handled in specialized, remote locations according to best practice. Due to the transition phase of these measures, small-scale business interruptions occur.



DANGER ZONE

MINING

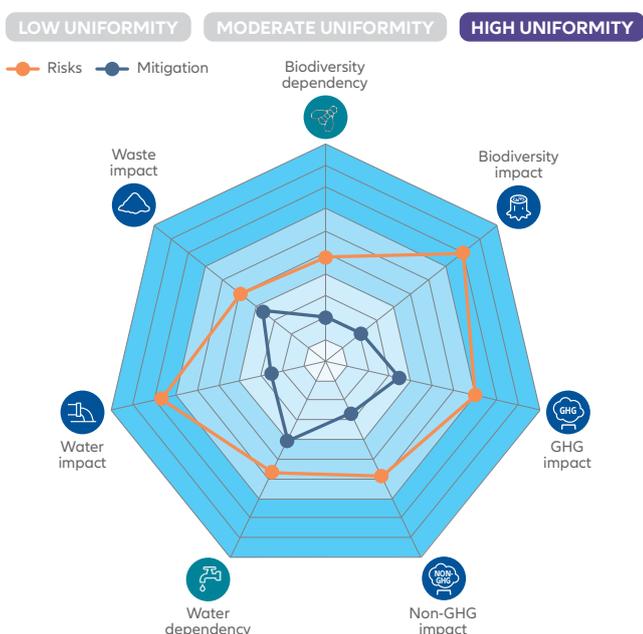
Mining encompasses the extraction of precious and non-precious metals, such as gold, bauxite, iron or copper. Mining provides key raw materials and resources for many industries. The last 10-year “raw material super cycle” ended in 2011, so it is only recently that the sector has begun to increase productivity after years of declining commodity prices.

While the mining sector seems technically well-equipped to mitigate natural capital risks, the exposure to social and political pressures can be considered high, which translates into equally high legal and regulatory pressures. To manage these formal and informal pressures and expectations, the sector needs to make further investment in technical and corporate risk management measures to handle its natural capital risk dependencies and impact – for example, ensuring the rehabilitation of landscape and biodiversity after mining operations have ceased.

“Over 91% of global iron ore production is derived in areas that are high risk for water stress, biodiversity, corruption or a combination.”

MSCI ESG Research Industry Report: Non-precious metals, mining & steel (March 2017)

Mining sector natural capital risk analysis



Key gaps identified

- Biodiversity impact
- Water impact
- GHG impact
- Non-GHG impact
- Biodiversity dependency
- Water dependency

Risk scenario example for a mining company



A local mine has an excessive impact on the watershed, both in terms of water use and pollution, as well as on local soil erosion and on flora and fauna. As a result, it faces social and political pressures that over time translate into a stricter regulatory regime and significant clean-up costs demanded via a court ruling. The company must then invest in technical and enterprise risk management measures to ensure it will keep its operating license.



DANGER ZONE

OIL AND GAS

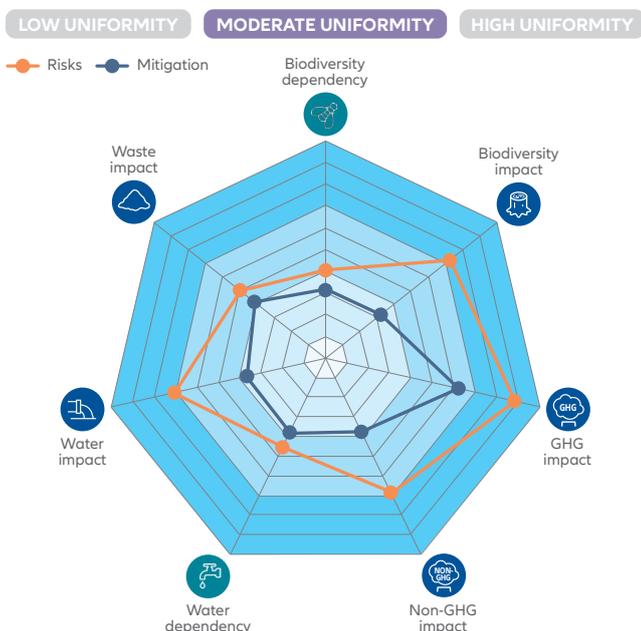
The oil and gas sector encompasses companies handling the exploration, production, refining and marketing of natural oil and gas, whether as a diversified or as an integrated entity. Oil and gas prices have seen a global downturn since 2008, resulting in considerable economic pressure in the sector to increase productivity and efficiency, while driving market consolidation.

Even more so than the mining sector, the oil and gas sector is exposed to impact and dependencies relating to natural capital risks. Regulatory, political and social pressures generally play a major role for the sector. While technical mitigation remains key, certain risks such as GHG liabilities call for other risk instruments (e.g. integrating carbon dioxide pricing in decision-making).

“Risks of increased freshwater use and oil spills as well as community opposition increase with companies focusing on unconventional shale oil and gas developments in the US.”

MSCI ESG Research Industry Report: Integrated Oil and Gas (December 2017)

Oil and gas sector natural capital risk analysis



Key gaps identified

- Biodiversity impact
- Water impact
- Non-GHG impact
- GHG impact

Risk scenario example for an oil and gas company



An upstream oil and gas company suffers repeated spills, which affect the local water table and flora and fauna. Local opposition against the operator increases and the government not only fines the operator but applies further regulatory pressure on the company. The company must invest in technical and enterprise risk management measures to ensure a continuation of operations.



MIDDLE ZONE

PHARMACEUTICAL

Although demand for medicines is growing more rapidly in emerging economies than in the industrialized economies, the overall growth of the pharmaceutical sector has slowed over the last few years. However, due to recent advances in technological innovation, the market is expected to grow in the future.

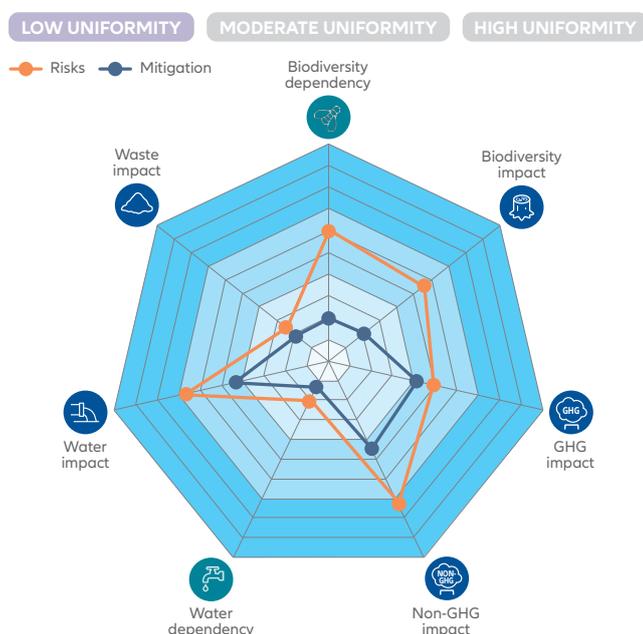
The sector is characterized by both impact and dependencies on natural capital risk factors at the same time. All types of risks are relatively high, although mitigation is present throughout all aspects. Yet, despite the relatively high dependency on biodiversity, for example, there is limited mitigation in the sector.

While the pharmaceutical sector is relatively exposed compared with other sectors when it comes to natural capital risk, awareness and preparedness to mitigate issues is moderate. Given its reliance on biodiversity, higher mitigation might be expected.

“Importantly, only 28% of rated companies disclose programs aimed at working with suppliers to reduce toxic emissions. 72% of companies lack disclosure or have only limited oversight of suppliers.”

MSCI ESG Research Industry Report: Pharmaceuticals (November 2016)

Pharmaceutical sector natural capital risk analysis



Key gaps identified

- Biodiversity dependency
- Biodiversity impact
- Non-GHG impact
- Water impact

Risk scenario example for a pharmaceutical company



The harvesting of natural ingredients for pharmaceutical products puts stress on a local resource due to overuse. After the resource declines, supply chain interruptions occur. As the main buyer of this product, the company must find a short-term substitute. As well as incurring additional cost, the company also experiences a serious business interruption due to the limited supply of the ingredient.



SAFE HAVEN

TELECOMMUNICATIONS

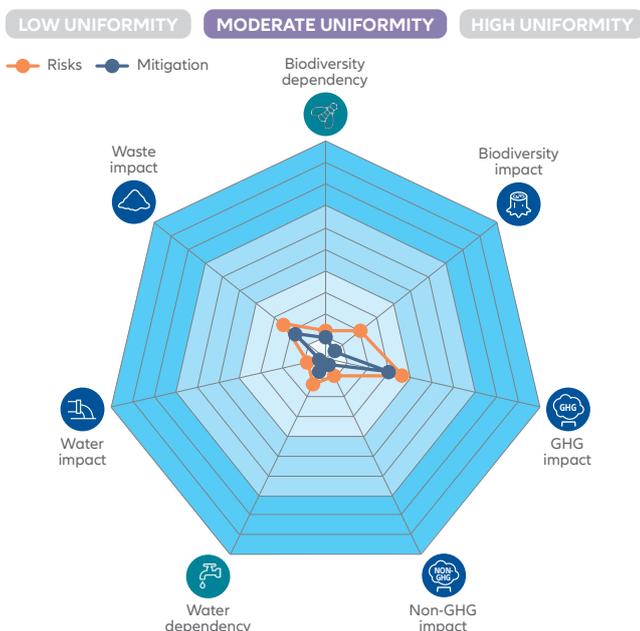
The telecommunications sector continues to be a key enabler of growth and innovation across multiple industries. The sector is relatively active in collaborating on natural capital risks, even though it has a low exposure to these risks.

Businesses are increasingly including natural capital risk considerations into decision-making and telecommunications is often seen as part of a solution. There are tremendous opportunities for telecommunications companies to develop solutions to limit natural capital exposure in other sectors. Digital communication and management solutions can help enable more efficient resource use.

“Vodafone is a key enabler of growth and innovation across multiple industries when it comes to climate-friendly solutions. The telecommunications sector can support business to manage their risks, as we provide data and communication management solutions. There are tremendous opportunities for the telecommunications sector to further develop competitive solutions in the emerging field of natural capital risks.”

Martin de Jong, Director Societal Value, VodafoneZiggo

Telecommunications sector natural capital risk analysis



Key gaps identified

Biodiversity impact

Risk scenario example for a telecommunications company



A telecommunications company, operating an energy-intensive server center in a given location, is faced with a planned price increase for carbon dioxide (CO₂) creating additional costs going forward. A refined internal enterprise risk management framework deals with the risk, attempting to mitigate the adverse financial impact as much as possible.



DANGER ZONE

TRANSPORTATION

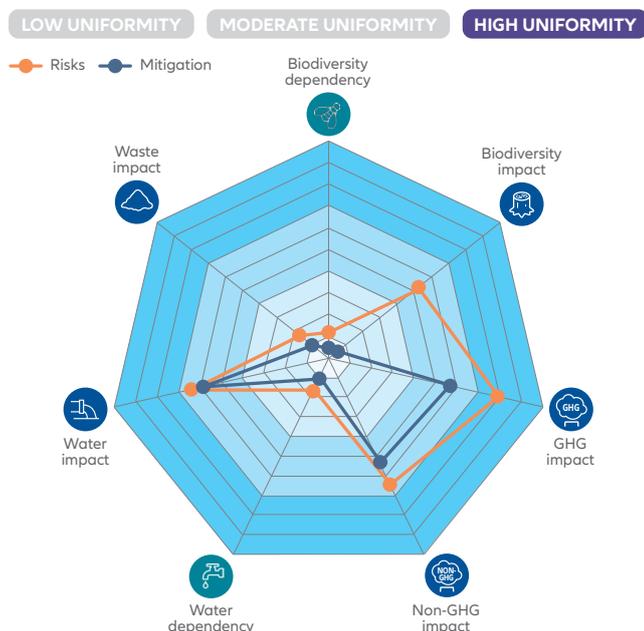
Fueled by economic growth and globalization, the transportation sector is enjoying unprecedented demand. Yet, factors like energy-efficiency are becoming more and more critical in transportation choices.

The transportation sector has a relatively high impact on biodiversity, and on GHG and non-GHG emissions, as well as on water. While less exposed compared with other sectors when it comes to natural capital risks, the awareness and preparedness to mitigate the issues is relatively low.

“Transportation-related carbon emissions have increased by 250% since 1970 and account for 23% of total global emissions. The majority of the transport sector’s emissions are generated through road transport and largely through the combustion of petroleum-based products such as gasoline, diesel or heavy fuel. Road and rail and marine companies that rely on the combustion of fossil fuels face growing regulatory pressure to lower their carbon footprint.”

MSCI ESG Research Industry Report: Road and Rail Transport (May 2017)

Transportation sector natural capital risk analysis



Key gaps identified

- Biodiversity impact
- GHG impact
- Non-GHG impact

Risk scenario example for a transportation company



A marine transportation company is confronted with stricter regulation regarding toxic non-GHG emissions and must write-off parts of its fleet sooner than expected. Technical measures can help certain vessels to remain in operation; however, additional costs are required to keep the fleet in operation and avoid business interruptions.



MIDDLE ZONE

UTILITIES

The utilities sector encompasses gas and electric companies involved in the production, distribution and trading of energy for households and businesses. The sector is currently caught up with a trio of challenges concerning goals relating to affordability, reliability and decarbonization. The overall sector underwent a remarkable shift toward renewable power generation in the last few years and expectations are that renewables will grow by another 30% in the next five years.¹¹

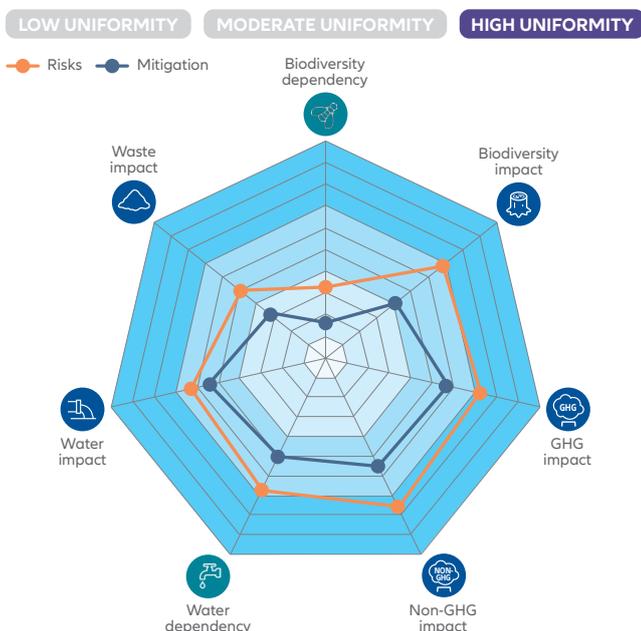
Like mining, the utilities sector is heavily impacted by regulatory, political and social pressures when it comes to natural capital risk. Impacts are as important as dependencies and extend to companies' own operations and the supply chain. At a given location, the impact on air quality can play a role in business interruptions as significant as insufficient levels of cooling water on the dependency side. Technical mitigation and corporate risk management need to be complemented with strong stakeholder engagement and risk transfer.

“The European Union, and now even China, through its regional carbon markets, have instituted emission trading schemes (ETS). Power plants in these regions are faced with increasing compliance cost under those schemes following the auctioning of allowances.”

MSCI ESG Research Industry Report: Utilities (March 2017)

¹¹ International Energy Agency, [Renewables 2017](#), October 2017

Utilities sector natural capital risk analysis



Key gaps identified

- Biodiversity impact
- Non-GHG impact
- Biodiversity dependency
- Water dependency
- Waste impact
- GHG impact

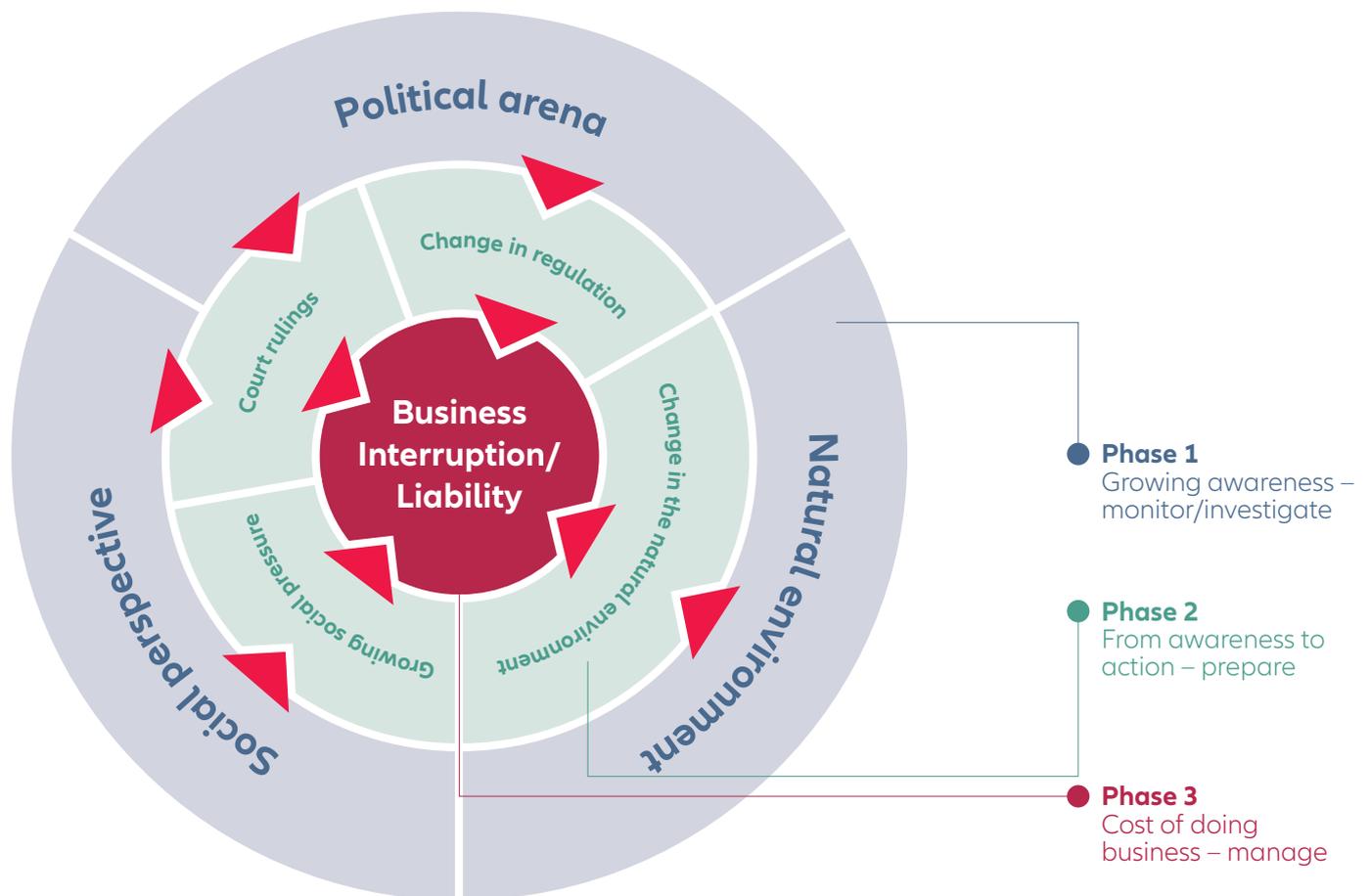
Risk scenario example for a utilities company



Due to increasing political and regulatory pressures concerning carbon dioxide (CO₂)-intensive electricity generation, a utilities company takes the decision to split off CO₂-intensive power generation from the core company. This strategic decision enables the company to avoid a stricter regulatory regime when it is introduced a few years later. Apart from escaping the resulting social and political pressures and reputational damage, the company also avoids the potential additional costs relating to CO₂ (CO₂ price), business interruption (CO₂ cap) or even loss of business (power plant write-off).

HOW DO NATURAL CAPITAL RISKS MATERIALIZE?

Natural capital risks are today's reality. Sectors and businesses will directly or indirectly be confronted with the implications in the future. AGCS analyzes how natural capital risks typically emerge to ultimately affect the bottom line of an individual business and offers thoughts on the practical implications of its research as it relates to the enterprise level. AGCS believes companies need to improve their understanding of natural capital risk and use existing insurance and risk management systems to adapt to and mitigate the threats.



Natural capital risks rarely come without warning, but emerge gradually and materialize over time in three subsequent phases. Each phase typically increases the intensity of the impact upon a company, as well as the costs.

1 Phase 1 Growing awareness – monitor/investigate

Our research shows that natural capital risks rarely come without warning but emerge gradually and build up over time in three subsequent phases. In the first phase, a growing awareness can be observed, generally triggered by one or a combination of the following factors:

- Changes in the physical natural environment become increasingly evident and affect local communities. For example, a given watershed is impacted by drought and local overuse, resulting in less stable patterns of water availability.
- Changes in the social perspective and public opinion as society or a local community become increasingly aware and concerned about the natural environment, such as on the loss of biodiversity, climate change or the impact of water pollution.
- Changes in the political arena: governments feel pressured to act, for example, by curbing CO₂ and other emissions or protecting (local) water resources.

As a matter of good practice, companies need to proactively investigate potential risks stemming from these changes and assess the extent to which it could affect the operations or even the business model. If necessary, proactive steps for risk management can be implemented.

2 Phase 2 From awareness to action – prepare

At some point, natural capital risk will start to affect individual companies in their supply chain, their own operations or at site level, either through:

- Regulatory change: for example, government(s) decide to introduce a regulatory regime to limit and/or put a price on CO₂ emissions (through a price/cap).
- Growing social pressure: for example, a company is criticized by local stakeholders for its negative impact on biodiversity because of its toxic releases.
- Changes through court rulings: initiated by the government or activists, a company is held liable for its alleged impact on the local watershed.
- Changes through scarcity in the natural environment: a water source used by a site becomes scarcer and less reliable through climate change and local overuse.

For a company, a risk in this phase requires mitigation through reactive steps in risk management. At this stage, it is often costlier to try to divert the damage from the company – and far less likely to succeed.

AGCS research indicates that sectors and businesses that take precautionary measures will benefit. These are companies that act against a risk that has a reasonable chance of materializing through a relatively small expenditure today to avoid larger losses in the future.

3 Phase 3 Cost of doing business – manage

If the risk cannot be mitigated, it materializes in this last phase and ultimately leads to a financial cost, either by becoming a liability or by triggering a business interruption. In this phase, the efforts to handle the risk should be directed to minimizing the impact through crisis management. Such efforts are generally costly and unlikely to entirely divert damage from the company.

This triggers the question on how risks can be mitigated, especially in phases one and two. Generally, natural capital risks can be mitigated by several types of risk management measures ranging from technical measures to enterprise risk management (ERM) measures and up to strategic steering.

For example, in the case of local water scarcity, a technical mitigation measure would be rainwater harvesting within the plant's premises, while an ERM measure would be to come up with a water management plan that could also entail technical measures. Strategic steering would go beyond ERM in the on-site day-to-day management, for example, by deciding not to expand the existing plant due to the water shortage risks, but rather open a new location.

“In order to manage operational risk effectively, organizations need to introduce some form of measurement. This requires a full understanding of the risks insurance companies face in running their business and of the impacts of these risks on the company’s capital needs. Therefore, quantifying operational risk is important as it sets a metric which is easily understood by business managers, allows for comparison with other risks and makes its impact on business clearly defined.”

WHAT IS NEXT?

AGCS research shows that the understanding of natural capital in the corporate world has improved, that companies are increasing their expertise in this area and expect to continue to do so further in the future. Yet despite this recognition and progress, the associated business risks remain underexplored. Sectors and companies need to gain an increased awareness of the specific natural capital risks that confront them, which demands further investment in understanding and mitigating risks.

Most companies have effective insurance and management systems in place that can be used to address natural capital risks. Rather than reinventing the wheel, companies can broaden the scope of these systems beyond financial and operational risk management. Widely accepted external control frameworks, such as the Committee of Sponsoring Organizations of the Treadway Commission (COSO), and internal systems, seem fit for purpose.

One of the challenges faced in this context is balancing traditional risk management focused on the present with the management of emerging risks arising in the mid- and long-term. Future and non-financial risks are often overlooked as companies are expected to deliver short-term performance targets and it is challenging to quantify those risks for shareholders.

This is why Allianz, for example, is involved in projects like the Embankment Project (see page 10). The initiative aims to develop a new framework that will help companies to measure and articulate the long-term value they create for stakeholders.

While this review has primarily focused on the business risks of natural capital, it also acknowledges the opportunities that companies can grasp. Companies that respond best to natural capital risks are also likely to be those that can most readily grasp the opportunities. An example is the telecommunications sector, which has the potential to develop solutions to limit the natural capital exposure in other sectors. It is likely that similar opportunities exist in other sectors.

At the same time, AGCS expects that companies increasingly must account for natural capital risks and disclose them to the governmental agencies, investors and other stakeholders. Allianz and, within the Allianz Group, AGCS, is investigating the concept of natural and social capital for its own operations (see page 10). This may prove to be a challenge as generally accepted reporting and disclosures requirements are yet to be developed.

In summary, AGCS believes that companies that are willing to invest in natural capital risk management will be best-equipped to keep damages under control and seize opportunities in an increasingly resource-constrained world.

“Businesses face increasing risk from natural capital costs priced by markets, either directly by regulators, or indirectly by trends such as customer preference and reputational damage. Factoring natural capital costs into business decision-making helps companies get ahead of these risks and identify transformative business models in the transition to a more sustainable economy.”

Steven Bullock, Global Head of Research, Trucost, part of S&P Dow Jones Indices

Research Methodology

AGCS conducted quantitative and qualitative research on 2,500 companies in 12 industry sectors, complemented by sector research. The methodology is as follows:

Quantitative research: AGCS quantitative research encompasses qualitative data analysis of 2,500 companies worldwide in cooperation with data provider MSCI ESG Research, its partner on ESG data and analysis. As there is no explicit and specific rating data available on the risks and mitigation measures related to natural capital, data proxies were selected for the analysis and weighted and corrected where relevant and possible.

Qualitative research: The quantitative research was amended by qualitative research in the form of desk research on dozens of companies, plus selected in-depth company interviews and qualitative sector information. This research section took explicit and specific data on risk and mitigation related to natural capital into account.

Terms and Definitions

- **Water consumption:** water intake from public water systems and other extraction from local water tables
- **Water pollution:** discharge of nitrogen, phosphate, heavy metals, organic and inorganic compounds, eutrophication, eco-toxicity, acidification, etc. into water
- **Land use:** occupation of converted land; new conversion of natural ecosystems; restoration of converted land for business activities
- **Soil pollution:** soil contamination through discharges with petroleum hydrocarbons, polynuclear aromatic hydrocarbons (such as naphthalene and benzo(a)pyrene), solvents, pesticides, lead and other heavy metals
- **Biodiversity:** volume of diversity of flora and fauna in a given geography
- **Greenhouse gas emissions:** emission of CO₂, CH₄, N₂O, HFCs, PCFs and SF₆ into the atmosphere
- **Non-greenhouse gas emissions:** emissions of SO₂, PM2.5, PM10, NH₃, NO_x, VOCs into the atmosphere
- **Process waste:** hazardous and non-hazardous waste to landfill, incineration, open dump sites, etc.

Bibliography

- Ashby, Michael F., Materials and the Environment, Second Edition: Eco-informed Material Choice, 2012
- Automotive World, Water, water, everywhere in vehicle manufacturing, October 2014
www.automotiveworld.com/analysis/water-water-everywhere-vehicle-manufacturing
- Bloomberg, Water Risk Valuation Tool: Integrating Natural Capital limits into financial analysis of mining, 2015
- California Cleaner Freight Coalition,
cactcleanfreight.wordpress.com
- Canadian Mining Journal, Preserving the ecosystem means preserving capital, naturally, August 2016
www.canadianminingjournal.com/features/preserving-the-ecosystem-means-preserving-capital-naturally
- Clelland, Iain J, Dean Thomas J, Douglas, Thomas J, Towards Sustainable Business: An Evaluation of Waste Minimization Practices in US Manufacturing, 2000
- Environmental Protection Agency (EPA), US, Resource Conservation and Recovery Act (RCRA), October 21, 1976 www.epa.gov/rcra
- EPA, US, Superfund Amendments and Reauthorization Act (SARA), October 17, 1986
www.epa.gov/superfund/superfund-amendments-and-reauthorization-act-sara
- EPA, US, Toxics Release Inventory (TRI) Program
www.epa.gov/toxics-release-inventory-tri-program
- German Association of the Automotive Industry (VDA), Environmental protection in production
www.vda.de/en/topics/environment-and-climate/environmental-protection-in-production/car-production-and-sustainability.html
- Government of Canada, Automotive Innovation Fund – program summary, July 2017
www.ic.gc.ca/eic/site/auto-auto.nsf/eng/am02257.html
- International Energy Agency (IEA), Energy Technology Perspectives, May 2014
- IEA, Renewables 2017, October 2017
- International Monetary Fund (IMF), Countries are signing up for sizeable carbon prices, April 2016
<https://blogs.imf.org/2016/04/21/countries-are-signing-up-for-sizeable-carbon-prices/>
- KPMG, Top 10 risks for mining companies, March 2017
- MIT Technology Review, How Much Will It Cost to Solve Climate Change? May 15, 2014
<https://www.technologyreview.com/s/527196/how-much-will-it-cost-to-solve-climate-change/>
- Muthu, Subramanian Senthilkannan, Handbook of Life Cycle Assessment (LCA) of Textiles and Clothing, July 2015
- National Academy of Engineering and National Research Council, Industrial Environmental Performance Metrics: Challenges and Opportunities, 1999
<https://www.nap.edu/catalog/9458/industrial-environmental-performance-metrics-challenges-and-opportunities>
- Natural Capital Coalition (NCC), Natural Capital Protocol, 2016
<https://naturalcapitalcoalition.org/protocol/>
- NCC, Natural Capital Protocol – Apparel Sector Guide, 2016
<https://naturalcapitalcoalition.org/protocol/sector-guides/apparel/>
- NCC, Natural Capital Protocol – Food & Beverage, 2016
<https://naturalcapitalcoalition.org/protocol/sector-guides/food-and-beverage/>
- Natural Capital Declaration (NCD), The NCD Roadmap: Implementing the four commitments of the Natural Capital Declaration, May 2013
www.naturalcapitaldeclaration.org
- PricewaterhouseCoopers, Chemicals Trends, 2017
- Reuters, Big investors press major companies to step up climate action, December 12, 2017
www.reuters.com/article/us-climatechange-investors/big-investors-press-major-companies-to-step-up-climate-action-idUSKBN1E60PU
- Society of Motor Manufacturers and Traders (SMMT), UK, Automotive Sustainability Report, 2014 www.smmt.co.uk/industry-topics/sustainability
- Stern Review, The Economics of Climate Change, 2006 http://mudancasclimaticas.cptec.inpe.br/~rmclima/pdfs/destaques/sternreview_report_complete.pdf
- Sustainable Fashion Academy (SFA), Natural Capital Accounting In The Apparel Sector, 2014
https://glaasaaward.org/wp-content/uploads/2014/01/Natural_Capital_Accounting_White_Paper_Draft_version_2.pdf
- The Economics of Ecosystems and Biodiversity (TEEB), TEEB – An Interim Report, 2008
www.teebweb.org/media/2008/05/TEEB-Interim-Report_English.pdf
- TEEB, Natural Capital At Risk: The Top 100 Externalities Of Business, April 2013
- Trucost, Putting a price on global environmental damage, October 5, 2010
www.trucost.com/trucost-news/putting-price-global-environmental-damage/
- United Nations Development Program, Chemicals and waste management
www.undp.org/content/undp/en/home/sustainable-development/environment-and-natural-capital/chemicals-and-waste-management.html
- United Nations Global Compact, The CEO Water Mandate <https://ceowatermandate.org>
- World Economic Forum (WEF), How car manufacturers can reduce waste, October 2016
www.weforum.org/agenda/2016/10/how-car-manufacturers-can-reduce-waste

Allianz Global Corporate & Specialty business scope

Allianz Global Corporate & Specialty (AGCS) is the Allianz Group's dedicated carrier for corporate and specialty insurance business. AGCS provides insurance and risk consultancy across the whole spectrum of specialty, alternative risk transfer and corporate business. Insurance product lines covered include:

- Alternative Risk Transfer
- Aviation (including space)
- Energy
- Engineering
- Entertainment
- Financial Lines (including directors' and officers' [D&O])
- Liability
- Marine
- Mid-Corporate
- Property

Our role as the leading corporate insurance company demands in-depth understanding of the emerging sustainability related trends that impact our clients and ourselves and foster the awareness and understanding thereof.

AGCS has a dedicated team of experts for sustainability risks from an industrial insurance perspective available. AGCS supports its clients in identifying and assessing material risks along their value chain as well as assigning and designing risk management solutions in a collaborative manner.

AGCS believes that a proactive approach and better understanding of natural capital risks improves the risk profile of our clients and steers companies towards greater and more sustainable long-term profitability. We would welcome any feedback and comments on this report from companies that are interested in or are already working with the natural capital risks described in this report. We can support business with practical examples, in-depths case studies and workshops. We are dedicated to deliver the best possible solutions to the management, control and reduction of natural capital risks.

Credits

Content: Chris Bonnet (christopher.bonnet@allianz.com), Alina Morozova (alina.morozova@allianz.com)

Contributing Advisor: Barend van Bergen

Editor: Greg Dobie (greg.dobie@allianz.com)

Publications/Content Specialist: Joel Whitehead (joel.whitehead@agcs.allianz.com)

Contributing Editor: Greg Langley

Data provider: MSCI ESG Research

Design: Kapusniak Design

Photos: Adobe Stock

CONTACT US

For more information contact your local Allianz Global Corporate & Specialty Communications team.

London

Michael Burns
michael.burns@allianz.com
+44 203 451 3549

New York

Sabrina Glavan
sabrina.glavan@agcs.allianz.com
+1 646 472 1510

Singapore

Wendy Koh
wendy.koh@allianz.com
+65 6395 3796

Munich

Daniel Aschoff
daniel.aschoff@allianz.com
+49 89 3800 18900

Paris

Florence Claret
florence.claret@allianz.com
+33 158 858863

South Africa

Lesiba Sethoga
lesiba.sethoga@allianz.com
+27 11 214 7948

Global

Hugo Kidston
hugo.kidston@allianz.com
+44 203 451 3891

Heidi Polke-Markmann
heidi.polke@allianz.com
+49 89 3800 14303

Follow Allianz Global Corporate & Specialty on



Twitter [@AGCS_Insurance](#) [#ARB2018](#) and



LinkedIn

www.agcs.allianz.com

Disclaimer & Copyright

Copyright © 2018 Allianz Global Corporate & Specialty SE. All rights reserved.

The material contained in this publication is designed to provide general information only. Whilst every effort has been made to ensure that the information provided is accurate, this information is provided without any representation or warranty of any kind about its accuracy and Allianz Global Corporate & Specialty SE cannot be held responsible for any mistakes or omissions.

Allianz Global Corporate & Specialty SE
Fritz-Schaeffer-Strasse 9, 81737 Munich, Germany
Commercial Register: Munch HRB 208312

June 2018