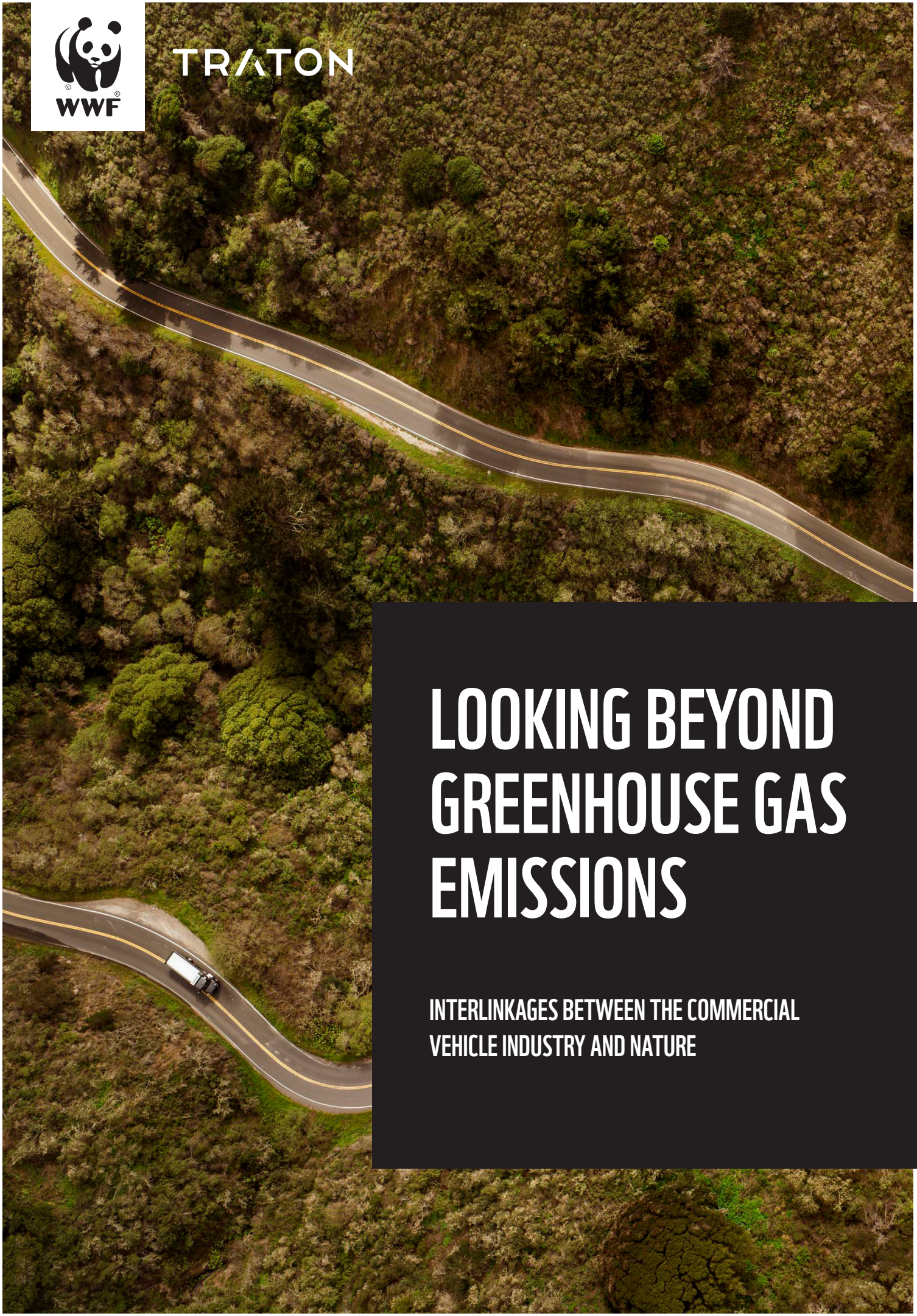

LOOKING BEYOND GREENHOUSE GAS EMISSIONS

INTERLINKAGES BETWEEN THE COMMERCIAL VEHICLE INDUSTRY AND NATURE

CONTENTS

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This report was authored and published by WWF Sweden. It is based on desktop and secondary research, uses existing tools and frameworks relevant to the topic. The TRATON GROUP provided sector-specific data for this report and has worked with experts from WWF Sweden in a joint working group. Any views and conclusions expressed in this report (with the exception of the TRATON foreword) are solely those of the author.

FOREWORD

Trucks play a crucial role in society. They are essential for transporting goods and materials, ensuring that everything from food and medicine to construction supplies and consumer products reaches its destination.

Transport is often referred to as the “bloodstream of society” as it allows economies and societies to develop. Meanwhile, our industry is transforming at an unprecedented pace, I am convinced that the future of transport is electric, powered by renewable electricity. However, the commercial vehicle sector also has a significant impact on nature, beyond greenhouse gas emissions. It is closely linked with nature throughout its value chain; from the extraction of raw materials to the production, use of vehicles and end-of-life. Every step has an impact.

I greatly value the collaborative work between WWF Sweden and TRATON, which is our first step in understanding the key areas of impact on nature across our sector’s operations and supply chains. Working with experts from WWF has allowed us to learn and broaden our perspective beyond what we could have achieved alone. With these valuable insights, we will strive to take informed decisions on strong nature-related actions for the TRATON GROUP.

We cannot do this alone. To take effective action, collaboration is essential, and companies like ours play a key role. We need to work hand in hand with politicians, suppliers, transport buyers, network providers and energy suppliers. We have a shared responsibility and a common interest in addressing nature-related impacts. Together, we can lead the way in fostering a sustainable future for our industry, the planet and society.

CHRISTIAN LEVIN,
CEO, TRATON GROUP

The risks posed by nature loss to the global economy are real, immediate and escalating. According to the latest World Economic Forum’s (WEF) Global Risk Report, five of the top ten long-term risks to the global economy are linked to nature. The WWF Living Planet Report further underscores this urgency, revealing a staggering decline in average wildlife populations sizes by 73 percent in just 50 years.

When our planet’s health is deteriorating, businesses can no longer afford to overlook nature as a fundamental pillar of economic stability. While a growing number of businesses have developed climate transition plans, recent research by McKinsey, shows that while companies increasingly commit to net-zero targets, few have set strategies to address nature-related risks.

This highlights an urgent need for businesses to recognize that nature is not just a passive backdrop to economic activity, it is a critical enabler of supply chains, market stability and long-term growth. Nature degradation can lead to disruptions in raw material supply, increased operational costs and reputational risks that can erode investor confidence. Forward-thinking businesses must move beyond compliance and proactively integrate nature into their risk management frameworks.

In 2024, WWF and TRATON joined hands to assess the commercial vehicle sector’s interlinkages with nature. This report presents key findings from that research, highlighting both risks and opportunities that nature presents to the industry. More than an assessment, it serves as a call to action for sector players to engage, innovate, and take decisive steps toward a nature-positive future.

Failing to address biodiversity loss will impose significant financial and operational burdens on businesses worldwide. However, we can act before it is too late. The climate transition has provided valuable insights—now, it is time to apply them to nature.

By integrating nature into corporate strategies today, we can safeguard our industries, economies, and communities for the future. Let this report be a starting point for meaningful action and lasting impact.

GUSTAF LIND,
CEO, WWF SWEDEN

EXECUTIVE SUMMARY

Nature is deteriorating at an alarming rate, as evidenced by the declining status of planetary health indicators, as well as the growing frequency of nature-related disasters. Nature provides the foundation for society and the economy, and failing to protect nature has negative consequences on both these systems. The Global Biodiversity Framework adopted in 2022 sets out an ambitious pathway for global action for the protection and restoration of nature.

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Businesses have both impacts and dependencies on nature, and face nature-related risks through their own operations and within their supply chains. Nature-related risks are often accompanied by financial and non-financial implications for companies such as through increased input costs, loss of brand value etc. At the same time, businesses can also grasp opportunities through addressing pressures on nature, such as improving their operational costs, and building resilience to nature-related shocks.

This report is based on a science-based study to understand the nature-related inter-dependencies of the commercial vehicles industry and how these are expected to change in the future. The commercial vehicles industry is set to undergo a transformation that is marked by a major shift towards battery electric vehicles (BEV), and increased use of biofuels in the coming years. The study examines this transformation and what it means for nature-related pressures. Furthermore, it explores the risks companies face due to nature-related interdependencies and the opportunities they can seize by addressing the pressures on nature.

The study performs mainly a qualitative analysis on the topic of nature-sector interlinkage. Pressures on nature are represented by the five major drivers of nature change — land, freshwater and sea use change, pollution, resource exploitation, invasive species and diseases and climate change, as recognized by the Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES). A process heatmap is presented, that maps key process types in the commercial vehicles' value chain and analyses them for their major impacts and dependencies on nature. Further, a deep dive into six selected topics covering commodities and value chain stages is performed to highlight key issues, risks and opportunities for the sector players.

To provide an example — a shift towards battery electric vehicles and the increasing automation in the commercial vehicles industry, will increase the demand for certain minerals like battery metals and Rare Earth Elements (REEs). These minerals are also critical to the clean energy sector that is growing. Increased mining and refining processes for these minerals and the component manufacturing processes that follow are expected to increase local pressures on nature. Moreover, some of these processes are carried out in regions and areas that are highly vulnerable to environmental changes, which in turn place stress on water and land resources and contribute to biodiversity loss. This can be a source of risk for companies in the commercial vehicles sector. Along with the operational and reputational risks associated with the supply chain, the geopolitical risks arising from this situation are also crucial to consider. An important solution to this risk is for companies to invest in battery recycling and reuse of battery metals and Rare Earth Elements. Companies can work in a plethora of ways, including investing in research and innovation, designing products for recycling, partnering with recycling companies to ensure that their products enter the secondary market and working with metal sustainability standards to ensure minimal nature-impact from their sourcing.

It is clear from the study that companies cannot work on their nature-related risks alone and must collaborate with their value chain actors and other stakeholders in order to address the most significant pressures on nature. Addressing climate change alone is insufficient, as it only tackles one of the drivers of nature loss. In addition to climate change, the sector also contributes significantly to other drivers of nature loss, including resource exploitation, pollution, and changes in land, freshwater and sea use.

This report serves as a starting point for sector players on their journey towards nature positive practices. It helps them understand which of their nature-related touchpoints may be significant at present and in the future and which require further investigation. It also helps to understand the key issues, risks and opportunities for their sector as linked with nature. As a follow up, companies must perform deeper analysis on key commodities and processes and integrate this understanding into developing their nature related strategies and action plans.

INTRODUCTION

Anthropocene – the period from 1950 to the present – is described as a distinct geological time during which humans have had the most powerful influence on the planet's climate and ecosystems. The so called "great acceleration" during this period has been marked by exponential population growth and resource consumption altering the Earth's biogeochemical processes. This has also led to a shift in global supply chains impacting the world's economies, businesses and consumers.

A study of the average price indexes of four commodity categories – food, agricultural raw materials, metals and energy – revealed that the year 2000 was marked by a sudden reversal in the overall declining trend of global commodity prices from the previous century and has since been followed by persistently high and volatile commodity prices. This reversal was explained by the long-term increase in marginal cost of production due to the declining state of nature and resource interlinkages (such as between energy, materials, water and land) which in turn had a ripple effect on the price economics[i].

A more recent update on the planet's health – the Planetary Boundaries framework[iii] finds that six of the nine planetary boundaries are now transgressed suggesting that the Earth is now well outside of the safe operating space for humanity. The planetary boundaries represent a set of processes that regulate the stability and resilience of the Earth system.

Overstepping these boundaries increases the risk of large-scale abrupt or irreversible environmental changes, increasing risks to people and ecosystems. For example, crossing the climate change boundary alone can impact rainfall, shift seasons and change soil conditions, limiting our ability to produce food. See figure 2.

Further, the Global Biodiversity Framework[iv] – often referred to as the 'Paris agreement for nature' – reinforced the message that more nature needs to be protected and restored, including in the world's production landscapes, in order to enable critical functions of the ecosystems.

As a key stakeholder, business has a shared responsibility when it comes to addressing the pressures on nature. Businesses not only hold the key to innovation and improved production, but also the ability to shift operating models and influence markets towards more nature-friendly alternatives.

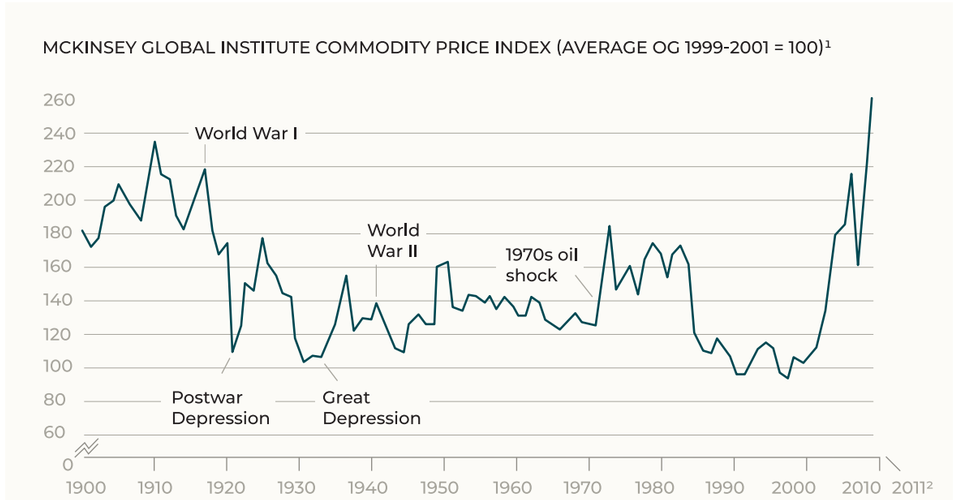


Figure 1: A shift in global commodity prices shown based on the average of 4 commodity indexes: food, agricultural raw materials, metals and energy. Source[ii]

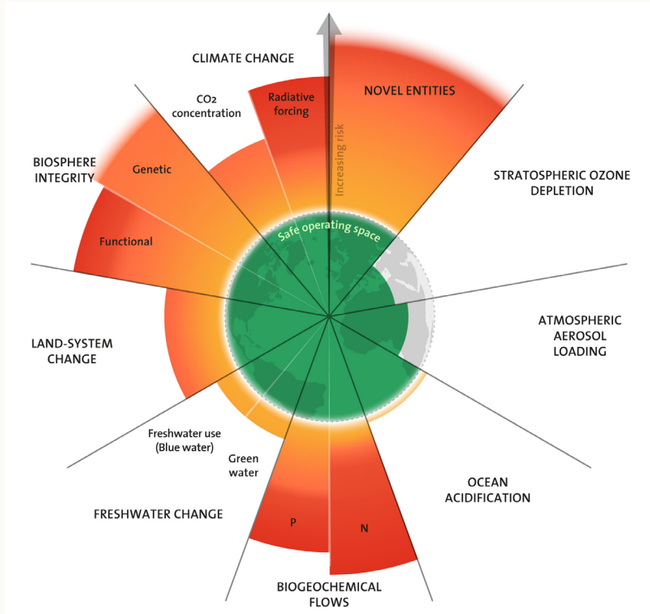


Figure 2: The Planetary Boundaries, 2025 update.[v]

Businesses connect with nature in two primary ways:

1. Nature provides essential products and services that businesses require, in order to function and thrive. In other words, all businesses have dependencies on nature even as the scale of these may differ for different businesses.
    - Manufacturing products require raw materials and energy sourced from nature.
    - Sectors like agriculture and tourism essentially require nature's services like pollination and recreation.
    - All businesses are dependent on ecosystem services that ensure climate regulation, air and water purification, control of floods and erosion, waste decomposition etcetera.
    - Nature provides food, water and materials to the people who work for businesses.
2. Business processes have impacts, that have positive or negative effects on nature.
    - Processes like mining, agriculture and fishing use land and water, creating demands on these resources and changing their natural state.
    - Air emissions, wastewater release and solid waste generation from industrial operations cause air, water and land pollution.
    - Greenhouse gas emissions from energy use contribute to climate change that has both direct and indirect effects on nature.
    - Business operations can lead to accidental introduction of plant species into new environments resulting in the spread of invasive alien species.

Such impacts and dependencies on nature create nature-related risks, or threats for companies that may affect their direct operations and value chains.

Four major types of nature related risks for companies are identified.

1. Nature-related physical risks resulting from degradation of nature and the consequential loss of ecosystem services on which a business may be dependent directly or indirectly on. Physical risks can be acute, such as a flood or forest fire leading to shutdown of business operations, or chronic, such as increased pollution in supply centers that leads to scarcity of manufacturing components.
2. Regulatory risks relate to nature-related laws, policies and regulations that affect operations of businesses. For example, fines or penalties imposed on a company due to an oil spill.
3. Reputational risks relate to a company's brand, image and relationship with customers, the general public and other stakeholders. For example, negative image resulting from business processes or actions known to cause extreme environmental damage at the location of its operations.
4. Market risks result from changing market dynamics, including changes in consumer preferences. For example, the value of a business production process is lowered by the emergence of new technologies that require relatively less water to operate.

Nature-related risks often have financial implications for companies and therefore create financial risk, such as through increased cost of capital and decrease of investment value.

Businesses, however, can also seek nature-related opportunities through actions that help mitigate the negative impacts, or create positive impacts on nature. These actions can relieve pressure on nature and its associated ecosystem services that the company and society are dependent on. As an example, circular economy measures that reduce a business unit's reliance on freshwater can reduce pressure on the local freshwater resources, thereby improving the unit's capacity to operate under erratic water supply situations or during droughts.

Following the adoption of the Global Biodiversity Framework in 2022, a series of regulatory and voluntary initiatives[1] are coming up at the global, regional and national levels, that require companies to understand their inter-relationships with nature, demonstrate action and make disclosures. Nature is rising on the global agenda, and businesses are facing increasing pressure to report on their actions to protect nature.

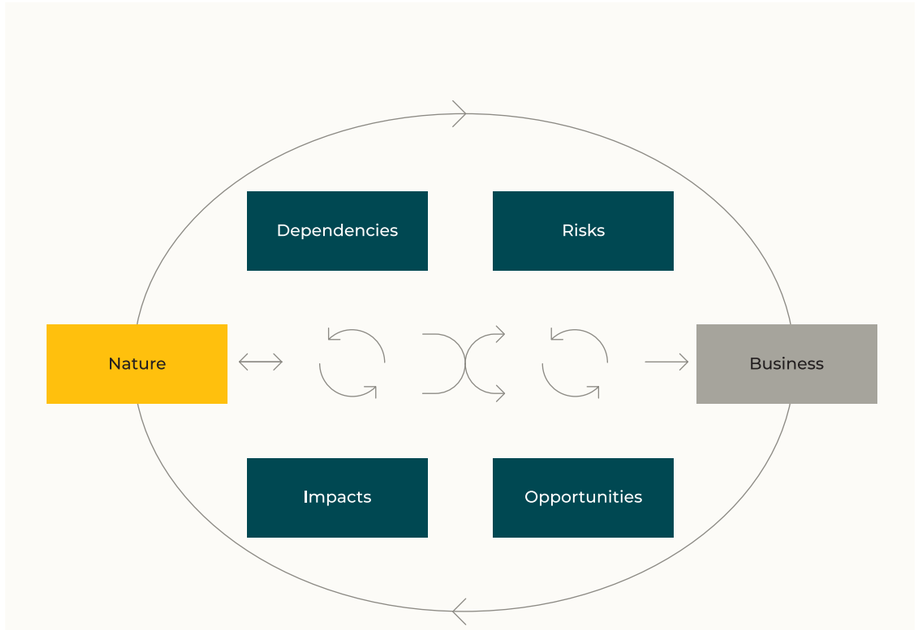


Figure 3: The interconnectedness of business and nature.[vi]

[1]Some such initiatives include the EU Corporate Sustainability Reporting Directive (CSRD), EU regulation on Deforestation-free Products, Science Based Targets for Nature, Taskforce on Nature related Financial Disclosures.

WHY THE STUDY

The commercial vehicles sector, that involves production, services and sales of buses, trucks and special application vehicles has a large and growing global market. In 2023, 3.13 million medium and heavy-duty trucks and 332 000 heavy buses were produced globally. By 2035, the demand of medium and heavy-duty trucks and buses is expected to grow to 3.64 million and 523 000 respectively[vii].

Like all manufacturing sectors, the commercial vehicles sector is closely linked with nature throughout its value chain. For instance,

- The mining of metals uses land and energy derived from natural sources and causes negative impacts like deforestation and pollution. It puts pressure on the finite mineral resources of the earth.
- Vehicle component manufacturing processes use materials like metals, rubber, chemicals and water, that are derived from nature and also create air, water and land pollution.
- Vehicle assembly requires energy and chemicals that use fuel derived from natural sources and generate emissions.
- During their use, vehicles emit greenhouse and non-greenhouse gases, particulate matter and create noise that negatively impacts biodiversity.
- Batteries used to power heavy electric vehicles contain chemicals, including heavy metals, which, if not managed properly, may reach land and water bodies polluting ground water and destroying aquatic life.

Even as the sector has some commonly known touchpoints with nature, there is no comprehensive study that examines the sector-nature interlinkage exhaustively across its value chain and what that means for business risk. Such a study is the critical first step for companies in the sector to inform the need and scope for action on nature.

A comprehensive approach to understanding nature-related interrelationships is also critical for derisking businesses through recalibrating priorities and reinforcing action.

Further, like the broader transport sector, the commercial vehicles industry is at the cusp of a transformation marked by a significant increase in the production and use of low emission technologies like Battery Electric Vehicles (BEVs) and biofuel-powered vehicles. By 2035 for instance, considering the Announced Pledges Scenario[2], the International Energy Agency (IEA) predicts that BEV buses and trucks will make a share of about 40% and 30% respectively in the global commercial vehicle sales. The current share of electric vehicles in these categories is about 3% and 1% respectively (see Figure 4)[viii].

This shift is significant for the sector since it not only changes the use-phase dynamics, but also key processes and controls involved in the upstream and downstream phases of the sector value chain. For example, a shift to BEVs comes with the construction of charging infrastructure and the linked electricity transmission. Increase in biofuel use comes with increased need for biomass production and logistics. Increased battery use comes with the need for appropriate handling, secondary use and safe disposal. Such a shift in processes and controls has effects on nature.

A study is needed to understand how the pressure points on nature would change with these shifts and what type of risks and opportunities it would present for companies.

[2] The Announced Pledges Scenario assumes that all announced ambitions and targets made by governments around the world are met in full and on time. With regards to electromobility, this includes all recent major announcements of electrification targets and longer term net zero emissions and other pledges regardless of whether these have been anchored in legislation or in updated Nationally Determined Contributions.

WHAT CAN TRANSFORMATION IN THE COMMERCIAL VEHICLES SECTOR LOOK LIKE?

Supportive policies, more stringent emission standards, improving infrastructure and cost structures are driving the shift to low emission commercial vehicles globally. The transition however looks different in different parts of the world.

The current share of electric vehicles in bus and truck sales is the highest in China (about 50% and 3% respectively) and is expected to reach over 70% and 40% respectively by 2035 considering the Announced Pledges Scenario. Europe follows China closely, rising from the current 14% and 1.5% share in sales. The penetration of electric vehicles in USA and other parts of the world is currently much lower (less than 1% share). The transition in USA in the coming years however appears quite significant with the country reaching close to 70% share of electric in sales of trucks and buses by 2035. Other major markets including India and Japan follow on the electrification trend. In general, medium and heavy-duty trucks prove more difficult to electrify than other vehicle segments (including buses) due to the size and weight of the batteries and charging requirements.

The uptake of biofuels in the transport sector is rising too and is set to increase by 30% during the period 2023-2028, relative to the last 5-year period. Ethanol and renewable diesel make the most of this demand. Most new biofuel demand however comes from the emerging economies, especially Brazil, Indonesia and India driven by robust biofuel policies and abundant feedstock potential. In advanced economies including European Union, United States, Canada and Japan, electric vehicle adoption takes a lead, while high biofuel costs and technical limitations constrain biofuel demand.

Hydrogen as a clean fuel (as hydrogen fuel cells, or direct substitute to diesel) is also being explored in the mobility sector. However, at present, around 95% of the world's hydrogen is produced from fossil fuels – natural gas and coal. Also, hydrogen fuel cells are expensive to produce and the infrastructure is lacking – however, the biggest hurdle remains the low efficiency and high cost of producing hydrogen. The demand of clean hydrogen in new applications may pick up post-2030. However, considering the current pace of developments in technology and charging infrastructure, electric vehicles in trucks and buses are expected to outcompete hydrogen-based applications in both the short and the long term.

References: EV[xi] Biofuels[xii] Hydrogen[xiii]

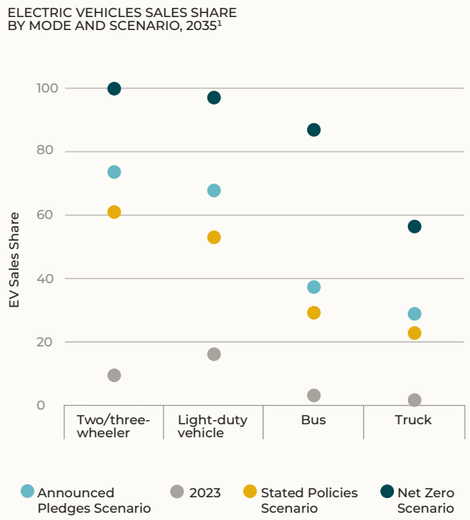


Figure 4: Electric vehicle sales share by mode and scenario[ix].

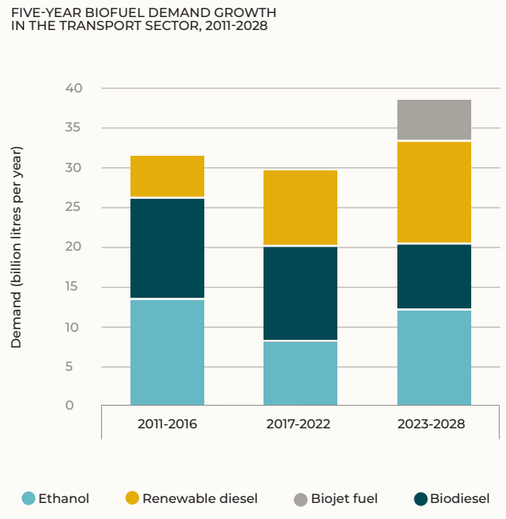


Figure 5: Five-year biofuel demand growth in the transport sector, 2011-2028[x].

SCOPE OF THE STUDY

The purpose of this study is to understand the interconnections of the commercial vehicles sector with nature, using a science-based approach and examine what types of risks and opportunities it presents for businesses in the present and future.

Specifically, it answers the following questions:

1. What are the nature-related impacts and dependencies of the sector?
2. How will the sector shift in the future?
3. What are the nature-related risks and opportunities for businesses in the sector currently and in the future?
4. What actions can the sector players take to address the nature-related risks and grasp the opportunities?

The study examines the entire commercial vehicles value chain for its interconnections with nature. It identifies the key value chain stages, as shown in Figure 6 and studies key processes existing across these stages for their interactions with nature.

Within the scope of commercial vehicles, the study focuses on haulage trucks (medium and heavy-duty) (referred to as trucks in this work) and buses only. It excludes vehicles meant for other applications such as construction vehicles, fire trucks etc. and light duty trucks[3].

The study is high level, serving as a starting point for companies in the sector on their nature-journey. It performs a qualitative analysis of the nature-related touchpoints of the sector as well as business risks and opportunities emerging from them. It will help companies prioritize key topics within the realm of business and nature for further investigation and action.

It is recognized that companies may be taking action on key aspects of nature-related risks already, such as through their work on decarbonization and circularity. But a comprehensive approach to understanding nature related linkages is key at this point as it helps fill any knowledge gaps in business understanding of nature-related risk, as well as reprioritize and recalibrate action. At a broader level, a comprehensive approach to nature is key to derisking the business in the light of current developments and future projections in the nature-business interlinkage.

The study is based on desktop research, uses existing tools and frameworks relevant to the topic and has been shaped closely by a joint working group, comprising experts from WWF and TRATON GROUP.

[3] Trucks are classified into light, medium and heavy duty based on their Gross Vehicle Weight Rating (GVWR) which includes the vehicle weight plus its maximum load. Different GVWR limits apply for vehicle categories in different geographies. The EU identifies trucks into N1/N2/N3 categories with GVWR of upto 3.5 tons/3.5-12 tons/12 tons and above respectively, while the following applies in the US: Light/Medium/Heavy-duty with GVWR upto 6.3 Tons/6.3-11.7 Tons/11.7 Tons and above respectively.

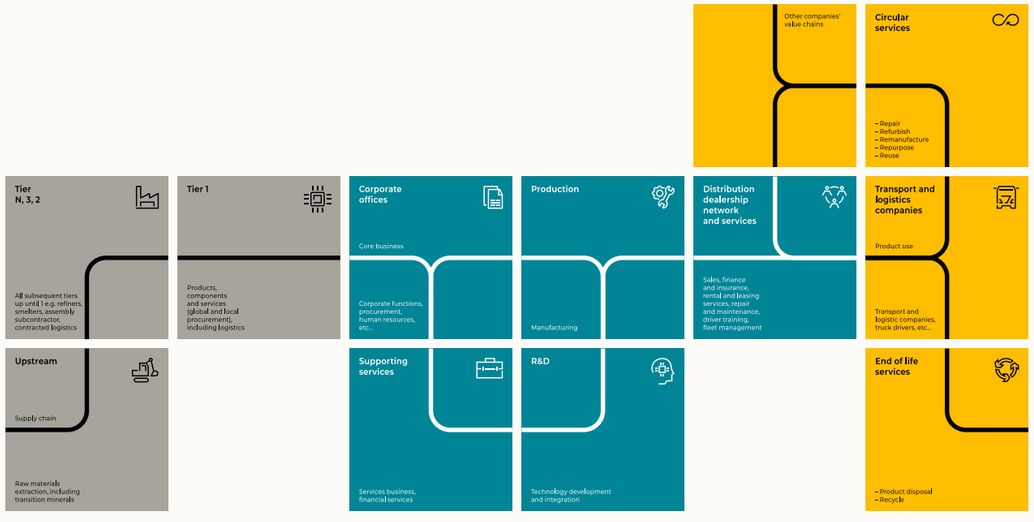


Figure 6: Illustrative high level commercial vehicles value chain

KEY CONCEPTS

Some definitions

Nature refers to the natural world, encompassing all living things and their interactions with the surrounding physical environments. It is made up of four physical realms – land, ocean, freshwater and atmosphere. Society, including people, corporations and financial institutions, is a part of nature

The nested systems concept provides that nature, society and economy are nested, interdependent systems where "Nature" provides the foundation for the other two systems. An intact biosphere is crucial for maintaining an intact society and economy. Conversely, a failing natural system has negative consequences on both society and economy.

Biodiversity refers to the variability among ecosystems and living organisms across the four realms. It is an essential and integral characteristic of nature that enables ecosystems to be productive, resilient and able to adapt.

The Intergovernmental Panel on Biodiversity & Ecosystem Services (IPBES) has identified five major/direct drivers of change of nature (also called pressures on nature), that unequivocally influence biodiversity and ecosystem processes (refer Figure 8).

Besides, there are indirect drivers of nature change that operate diffusely, by altering or influencing the direct drivers or other indirect drivers. Indirect drivers, also referred to as underlying causes include (1) Socio-economic and demographic trends (2) Technological innovations and (3) Culture and government[xv].

This study applies the understanding of major drivers of nature change as a representation for pressures on nature and analyses the commercial vehicle sector's impacts and dependencies against these pressures.

The sector's impacts and dependencies on nature are mapped against the major drivers of nature change (Table 1), and this mapping is used as a framework through different parts of the study.

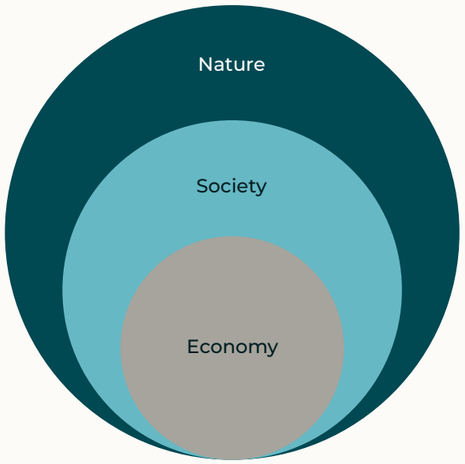


Figure 7: An illustration on the nested systems concept of sustainability[xiv].

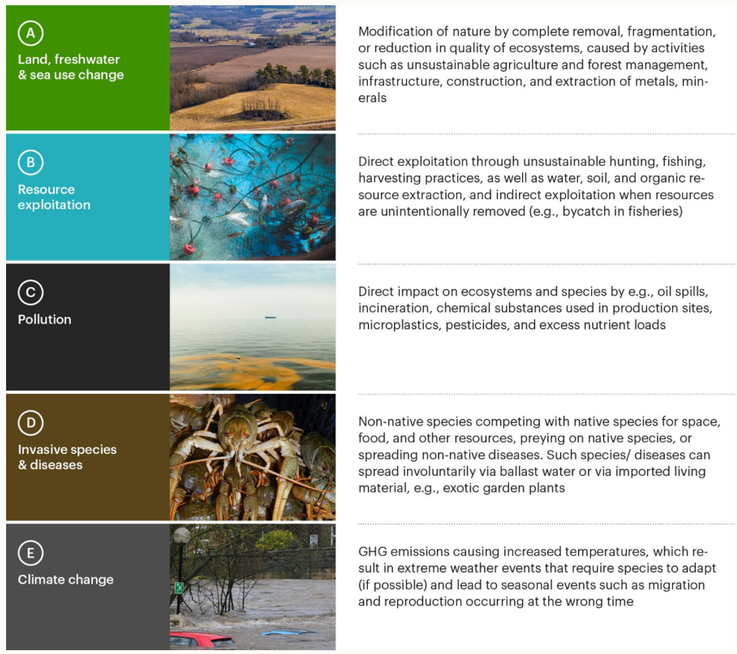


Figure 8: The five direct drivers of nature change[xvi].

DRIVERS OF NATURE CHANGE	NATURE-RELATED IMPACTS AND DEPENDENCIES
A. Land, freshwater and sea use change	Land use change Water pollution
B. Resource exploitation	Land/soil Water
C. Pollution	Water pollution Non GHG air-emissions Solid waste pollution Soil pollution Noise pollution
D. Invasive species and diseases	Invasive species and diseases
E. Climate change	GHG emissions

Table 1: Mapping of the major nature-related impacts and dependencies of the commercial vehicles sector with the major drivers of nature change. The impacts are marked in brown, and the dependencies are marked in blue.

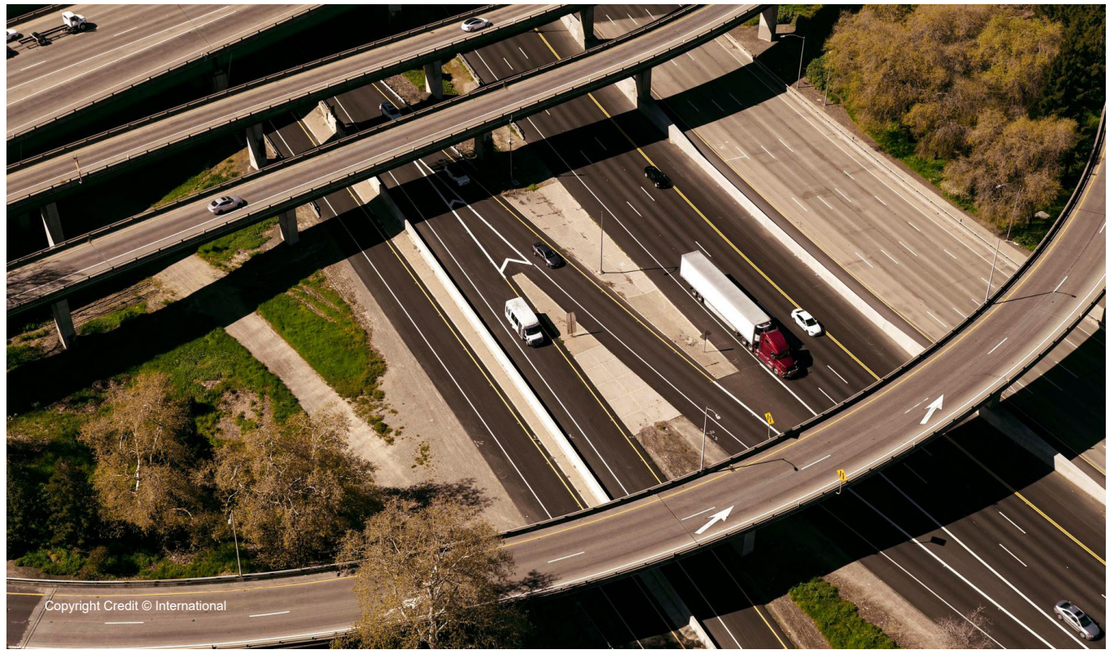
The underlying risk model

The study uses a simplified risk model that is based on the concept of risk determination for businesses. The concept finds its application in several existing nature or biodiversity-related tools and initiatives, the Natural Capital Protocol and WWF Risk Filter Suite.

Nature-related risk is based on the following factors:

1. The type of process carried out within the sector that determines its impacts and dependencies on nature. Risks arise from these impacts and dependencies.
2. The geographic location where the process is carried out. This determines the local state of nature and the risks to it at that specific location.
3. Business importance of the process or the location to the company.

The model is based on the assumption that no technological differences exist in the way a particular process is carried out. In practical terms, the level of impact or dependency on nature, and the corresponding risk differs with the technology used for performing a certain industrial process. As an example: steel manufacture in a blast furnace is a process that uses high amounts of energy and leads to high GHG emissions. Deployment of carbon capture and use technologies however may bring down the emissions from the process, thus reducing the risk to nature. For the purpose of simplification of analysis of impacts and dependencies and the corresponding pressures on nature, such technology-based differences are assumed to not exist. Since this is a sector study (and not that of a specific company in the sector), it has addressed the factors (1) and (2) of the risk model, that is the type of processes carried out within the sector, and the geographic locations where the processes are carried out. The third factor of the risk model is that the busi-ness importance of the process or location is specific to a company and is left for the company to consider in its analysis of business risk as the next step. As an example, mining of lithium – a battery metal (representing the type of process) – in Australia and Chile (representing two key geographic locations) creates nature-related risks for the commercial vehicles sector that are analyzed as part of this study. However, it is left to the company to understand how significant the Lithium ion-based batteries are to its business, and whether the company is reliant on supplies from Australia or Chile or both and to what extent. This consideration of business importance is the next step to this study and should be done by companies on their own or with assistance from experts.



Tools and frameworks used

The study uses the following tools and frameworks that are based on science and are available for nature-related risk assessments for businesses.

1. **Taskforce on Nature-related Financial Disclosure's (TNFDs) LEAP approach[xvii]:**
   LEAP stands for Locate, Evaluate, Assess and Prepare. LEAP is an integrated approach for assessment of nature-related issues developed by TNFD – a market-led, science-based and government-supported global initiative. LEAP is designed for use by organizations of all sizes and across all sectors and geographies (see figure 9).

   The LEAP approach was applied as a guiding framework for this sector study in order to understand the nature-related touchpoints, risks and opportunities in a systematic and step by step manner. Some datasets, tools and methods referenced in the LEAP approach were applied as part of this study.

2. **WWFs Risk Filter Suite (RFS)[xix]:**
   This is a screening and prioritization tool used to enable companies and investors to assess and act on nature-related risks across direct operations and supply chains. The RFS contains two complementary tools – the Water Risk Filter and the Biodiversity Risk Filter.

   The RFS tool has been used throughout this study to assess the various commodities and processes for their nature-related risks. The tool brings together data across the globe on the state of nature and risk to nature, represented by several indicators such as water availability, landslides, soil condition, pollution and Key Biodiversity Areas (KBAs)[4].

[4] Version 1 of the RFS that was live until October 2024 was used for this study.

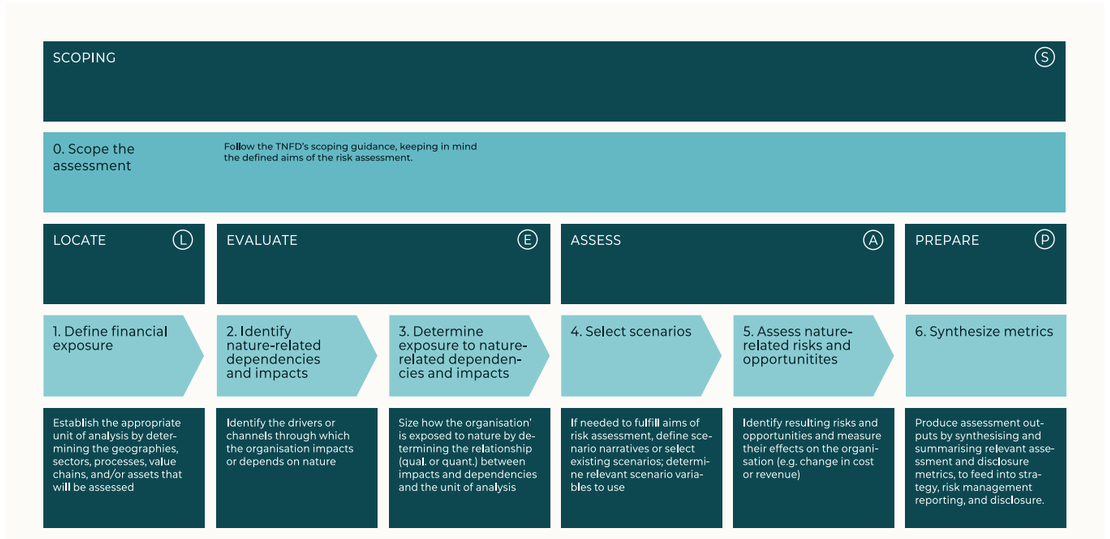


Figure 9: An infographic providing an overview of the TNFD LEAP approach[xviii]

UNDERSTANDING THE SECTOR'S TOUCHPOINTS WITH NATURE

A major output from this study is the process heatmap, that maps the major processes carried out across the value chain of the commercial vehicles sector against the major nature-related impacts and dependencies. The heatmap is based on addressing the factor #1 of the risk model described above, which states that the type of process deployed is one of the key determinants of nature-related risk. An illustrative version of the process heatmap is provided in Figure 10.[xx, xxi, xxii, xxiii, xxiv, xxv, xxvi, xxvii, xxviii, xxix, xxx, xxxi, xxxii, xxxiii, xxxiv, xxxv]

THE PROCESS HEATMAP

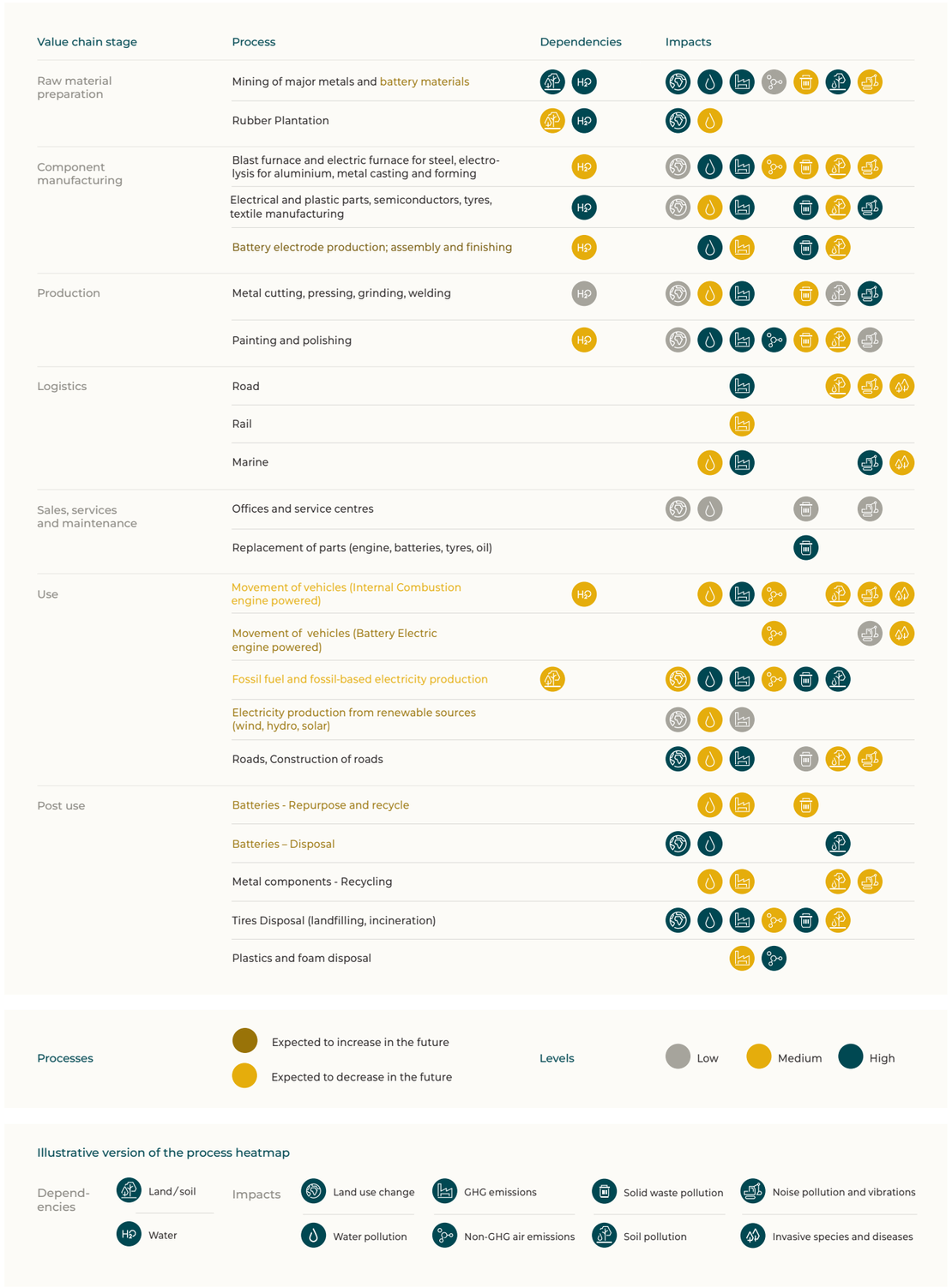


Figure 10: An illustrative version of the process heatmap. The rows list all major process types categorized by value chain stages of the commercial vehicles sector. The columns provide all major nature-related impacts and dependencies (represented by a symbol each) from the sector. The color codes of the symbols indicate the degree (high/medium/low) to which the process relates to the impact or dependency. Places where no symbols are provided indicate that the impact or dependency is either zero, or no references appear to exist for the impact and dependency of the process type on the corresponding nature-related indicator. The color codes of the text indicate processes that are expected to increase or decrease in the future as part of the sector-transformation.

The process heatmap captures high-level points where the commercial vehicles sector interacts with nature and which impacts and dependencies of the sector that may be significant. The purpose of the heatmap is to help companies in the sector understand which pressures on nature are relevant to their sector and which ones they should prioritize for further investigation and action.

The impacts and dependencies represented in the heatmap cover all the major touchpoints of the sector with nature and extend from the major drivers of nature change (refer Table 1). The level provided to each impact and dependency from the processes is based on secondary research and experience-based insights from the WWF and TRATON joint working group. The Delphi method[5] was used to engage the experts in the working group and arrive at a consensus. The levels are not measurement-based so they cannot be used to compare the different processes. However, they provide an indication of where these impacts and dependencies may be relatively significant and should be considered for further study. More information on some of these processes is provided in the subsequent sections of the report.

The heatmap also highlights the processes that are expected to be deployed more in the future and the ones that will be deployed less due to the transformation in the sector as mentioned before. The heatmap indicates that the pressure points on nature would in fact also change with this transformation.

HOW COMPANIES CAN USE THE HEATMAP

The first step that companies need to take in their nature journey is to answer some key questions such as:

- What are the company's nature related touchpoints i.e. impacts and dependencies of the company's own operations and value chains on nature?
- Are these touchpoints significant, or relatively significant in comparison to each other?
- Are these touchpoints important to the business, depending on factors such as the product mix, current and future business plans etc.?
- Can the company control or influence these touchpoints such as depending on how far in the value chain w.r.t own operations these exist?

The process heatmap can help companies answer some such questions in order to prioritise processes and commodities for further analysis.

As a next step, companies can allocate resources and effort to investigating the prioritised processes and commodities further. A lack of data on supply chains of components and commodities often presents a key challenge for companies. The above prioritisation exercise helps companies to channel their efforts for data collection towards commodities and processes that are most important to their business and are the most relevant from the nature perspective.

As part of the investigation, companies can map out their own suppliers for prioritised processes and sourcing locations for prioritised commodities using the Risk Filter Suite (riskfilter.org). This helps them bring information on the state of nature at particular locations and risks tonature at those locations in their analysis and get a holistic understanding of nature related risk for their business.

As they get more granular with their analysis, companies can take a measurement and modelling-based approach to quantify their impact or dependency at the specific location and also lead to key actions. For instance, if water quality is identified as a risk in a particular basin, then the company can measure the operational parameters of the site such waste-water quality, need for water treatment before intake etc. in order to determine whether it should target its intervention to improving the site's operational performance, or work with other stakeholders to target basin-level action or both.

[5]Delphi is a scientific method to organise and structure an expert discussion aiming to generate insights on a particular subject. The approach is based on a series of rounds where the experts share their opinion on a particular topic/question. The findings of each round are shared with the group anonymously and feed into the subsequent rounds where the experts get an opportunity to reposition their views as well as consider and feedback on the others' responses. Delphi method is often used to assess complex topics and those with limited information.

Key observations and takeaways

The process heatmap clearly demonstrates that several nature-related touchpoints (impacts and dependencies) exist throughout the commercial vehicles value chain and addressing nature-related risks requires companies to look beyond their own direct operations. For instance, for a company that operates mainly in the "Production" stage of trucks and buses (as indicated on the heatmap), a lot of impacts and dependencies lie outside of its own operations. This confirms that such companies need to work collaboratively with their suppliers in order to address the most significant impacts on nature.

One key issue that needs attention is the overall resource demand of the sector. Considering its growth and transformation, along with the demand from other competing sectors, like clean energy and electronics, the commercial vehicles sector will impose great resource demands on nature, for materials like metals and fuels besides enabling resources like land, soil and water. While resource extraction and processing are highly impacting on nature, there are also limits to how much resources are available in the future to support the growth. Resource quality, in particular for enabling resources like land, soil and water is also a key concern. This aspect is not explicitly visible on the heatmap but needs to be considered in the work of companies on nature going forward.

The transformation that the sector is set to undergo in the coming years focuses on reducing GHG emissions in the use phase of vehicles. It therefore addresses climate change as a key driver of nature loss. The process heatmap, however, indicates that there are several other pressure points on nature besides climate change that can be significant. It is therefore not sufficient to work on climate change alone.

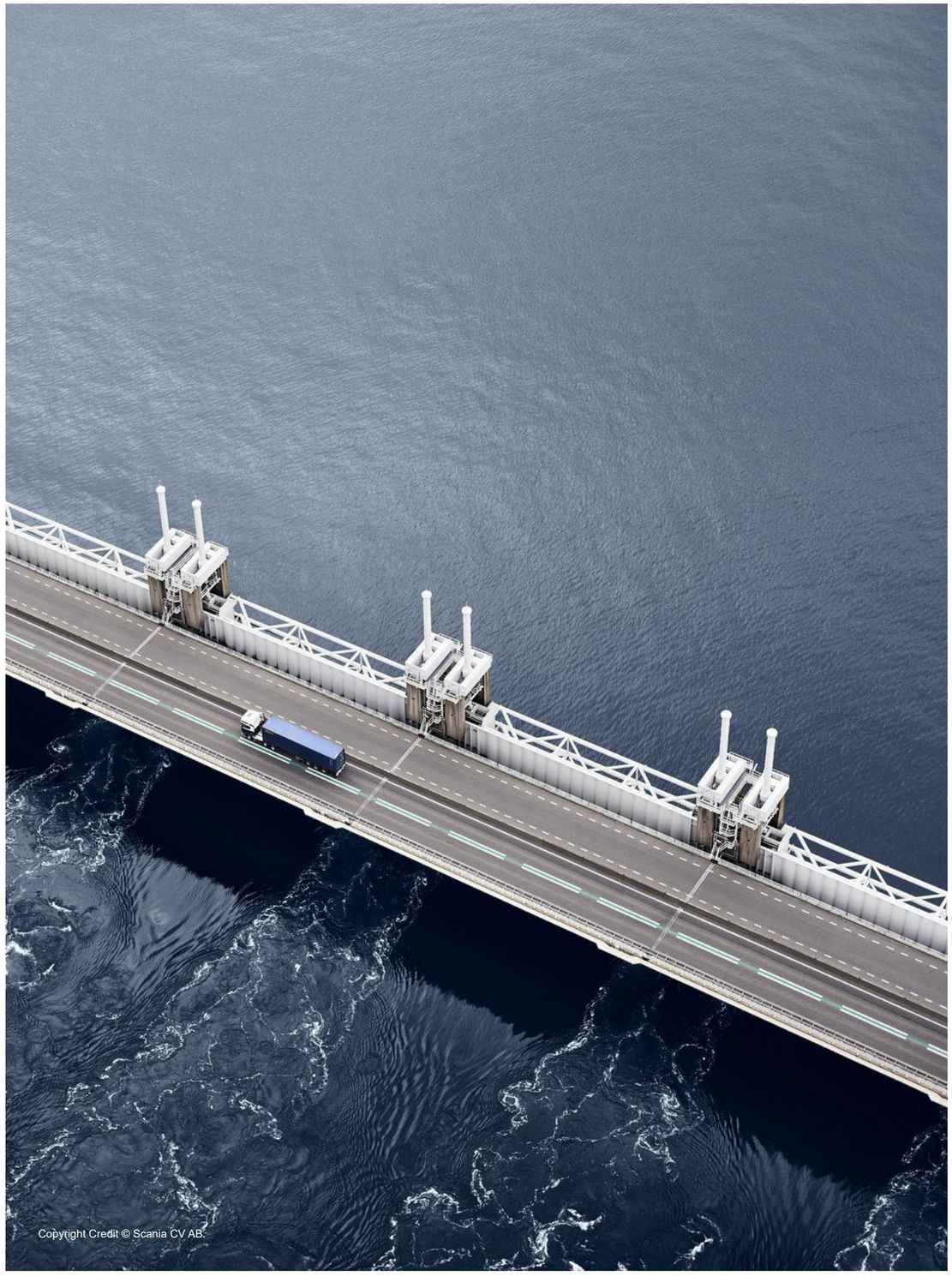
A comprehensive approach to nature would require companies to work on both climate change and other drivers of nature loss.

Nature represents an entire range of elements and their interconnections. The different realms of nature – air, freshwater, land, oceans and society – are interconnected, and so are the issues linked to them. This is what makes nature a complex topic. The idea is to highlight where there may be bigger impacts and dependencies, and to determine where companies need to act first. But as companies advance from this initial level prioritization exercise into local investigation and action, the interconnections between the nature-related elements and issues should be kept in view.

Finally, it is noted in the conceptual framework on nature that society is an integral part of nature. However, the tools and methods that are available for companies to address the topic of societal impact and human rights are different. While it is well recognized that issues of human rights such as Occupational Health and Safety (OHS), child labor etc. exist in different forms in the commercial vehicles sector value chain, companies should analyze and address these separately using appropriate tools and methods.

It should be noted that not all value chain stages are represented in this section of the report, but an attempt has been made to highlight all the relevant issues, risks and opportunities through the coverage of topics in this section. The production stage of the value chain has overlaps with the processes in the component manufacturing stage, and logistics (through road, rail and marine route) are covered as a sub-topic in the deep dive on the use phase of vehicles.

Mark Mahaney, International



Assumptions and limitations

A limitation of the process heatmap is that it does not take a quantitative or measurement-based approach to examine the impacts and dependencies from the commercial vehicles sector. The levels are assigned to the impacts and dependencies on a research- and experience-based yet qualitative approach, meant for the purpose of initial level prioritization of processes and issues.

In practical terms, a quantitative estimation of the magnitude of impacts and dependencies would involve consideration of additional factors, such as:

I. Duration over which the process is carried out. For example, movement of Internal Combustion Engine (ICE)-powered bus or truck has a significantly high impact from emissions since these emissions happen over the entire lifespan of the vehicle (over 12 years). In comparison, the process of production of steel for a single truck or bus will have low overall emissions since that process happens at a relatively much shorter duration of time.

II. Technology deployed for the process. Steel manufacture in a blast furnace for example has a high energy use and high associated emissions, but deployment of carbon capture and use technology can significantly lower the emissions from the same process.

III. The type of resource deployed in the process. Fossil-based energy use is associated with significantly higher emissions in comparison to non-fossil-based energy use.

It should be noted that some quantitative estimates (such as for GHG emissions through LCA studies) are available and referred to in the subsequent sections of the report since these are known to be more generally applicable. However, most impact and dependency indicators including those relating to air pollution, land and water require local quantification studies and cannot be summarized in a sector heatmap like the above.

Further, some of the processes and impacts have not been included in the heatmap for various reasons. These include:

1. **Biofuels or bio-based energy:**
The impacts of biofuel production for use in trucks and buses, and bio-based energy production are very specific to the project, meaning they are highly dependent on where and how the production is carried out. These are therefore not included in the heatmap but described in detail in the section on the use phase.

2. **Construction of production facilities:**
This process has impacts and dependencies on nature, in particular in the form of resource use, emissions and land-use change. However, since it has a relatively much lower frequency relative to other processes in the value chain, it is not considered in the scope of the heatmap.

3. **Linear infrastructure's impact on habitat fragmentation and animal injuries:**
This is a use-phase specific impact on biodiversity and is described in detail in the section on use-phase impacts.

LOCATING THE INTERFACE WITH NATURE

The study further performs an in-depth analysis of six different topics covering commodities and value chain stages to understand the pressures on nature in more detail.

To address the factor #2 of the risk model, i.e. the geographic location where the processes are carried out, desktop-based risk assessments were conducted using the risk filter tool (RFS). Further, each of these topics were studied in the light of the sector transformation and the risks and opportunities for businesses in the sector were identified.

Each of these deep-dive topics covered in this section provide examples of commodities and value chain stages that:

1. Have generally high nature-related impacts and dependencies as it follows from the process heatmap
2. Are critical for the future considering the sector transformation, and
3. Present issues that lead to risks and opportunities for businesses in the commercial vehicles sector

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I. ALUMINIUM MINING

Introduction

Aluminium is the world's most used non-ferrous metal. The transport sector consumes over a quarter of the aluminium produced in the world and represents the biggest end-use market for the metal. Aluminium is strong, recyclable and lightweight.

In a typical truck or a bus, aluminium is often the second-most used metal by weight only after ferrous metals. It is used in several vehicle parts including engines, wheels, brake components and vehicle chassis. Several battery components in a BEV including battery pack housings, cooling plates etc., have high aluminium content. In fact, electrification drives up the aluminium content in a typical commercial vehicle where the metal is deployed mainly to compensate for the weight of the EV battery[xxxvi].

WHY THE HIGH INTEREST IN ALUMINIUM?

Aluminium has unique properties that support cleaner and more sustainable transport. It is strong and lightweight, often used to replace steel or iron parts with similar requirements in order to make vehicles lightweight and save fuel. In trucks, aluminium allows truck payload increases due to reduced vehicle weight thus improving the freight-transport efficiency. Besides, aluminium offers unique recycling possibilities. It can be repeatedly recycled without quality loss and earns a high scrap value.

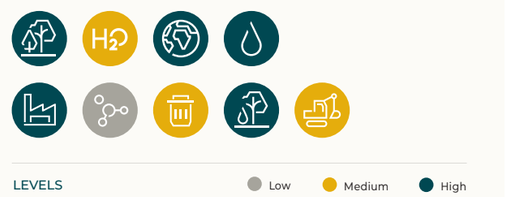
The process and nature-related issues

Bauxite – the most common ore of aluminium is often extracted by open-cast mining from geological or sedimentary layers (strata) found at a depth of 4-6 m under a shallow covering of topsoil and vegetation. The bauxite mined is transferred to a refinery where alumina is produced using the Bayer process[6]. Besides the bauxite tailings that are left behind in the mining process, the refining process generates a highly alkaline residue called red mud. Red mud is stored in open-air dams requiring large areas of land. The Bayer process is also an energy and water-intensive process. Around 5-7 tons of bauxite is used to produce a ton of alumina.

[6]The Bayer Process is an industrial method for refining bauxite into alumina (Al_2O_3) by dissolving it in sodium hydroxide, removing impurities, and precipitating aluminum hydroxide, which is then calcined to produce pure alumina.

Key nature-related issues:

- Land-use and land-use change due to removal of topsoil and vegetation
- High freshwater use for control of Particulate matter
- High GHG emissions due to high energy needs
- Pollution of soil and water leading to impacts on local biodiversity and ecosystems



ILLUSTRATIVE VERSION OF THE PROCESS HEATMAP

Location-based risk assessment

A location-based risk assessment for bauxite mining was done using the RFS. The major mining locations of the top six aluminium producing countries (making 90% of the world's bauxite production) were identified and mapped on the tool.

The outputs were then analyzed and the risk indicators that show high and very high risk values across the mining locations were identified to understand the global risk profile of the process.

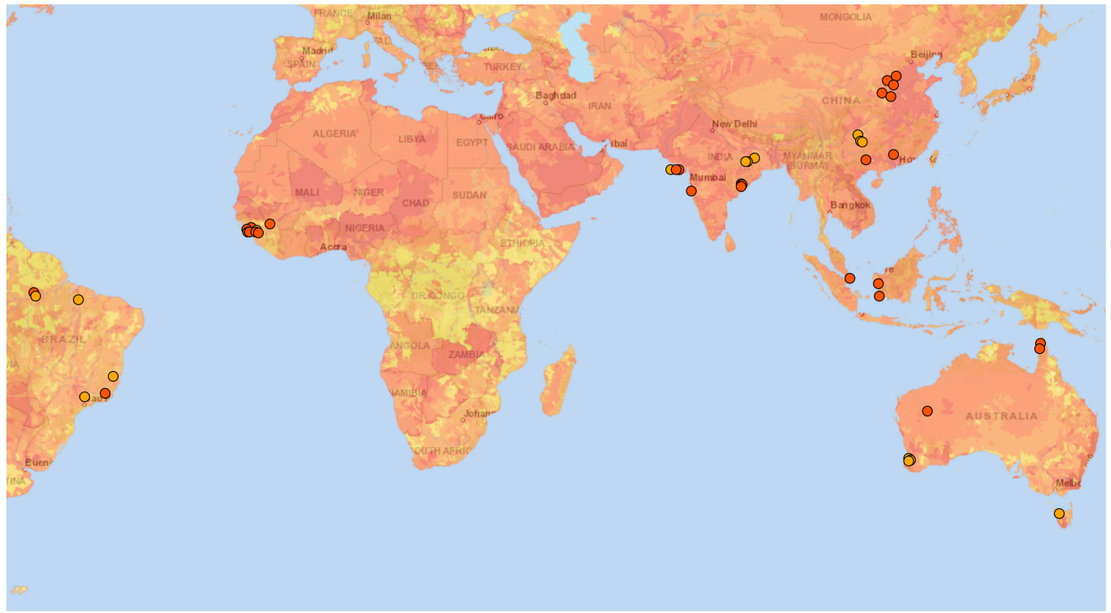


Figure 11: The map displays the scape physical risks output from the Risk Filter Suite's Biodiversity Risk Filter showing the locations of major bauxite mines in the world. The colour of the dots indicates the cumulative physical risk score obtained from combining the output of different physical risk indicators contained in the tool.

MAJOR ALUMINIUM PRODUCER COUNTRIES

1. Australia
2. China
3. Guinea
4. Brazil
5. Indonesia
6. India

KEY LOCATION-BASED NATURE RELATED ISSUES*

- Forest canopy loss
- Pollution
- Water scarcity
- Ecosystem condition
- Labour/Human Rights
- Media scrutiny

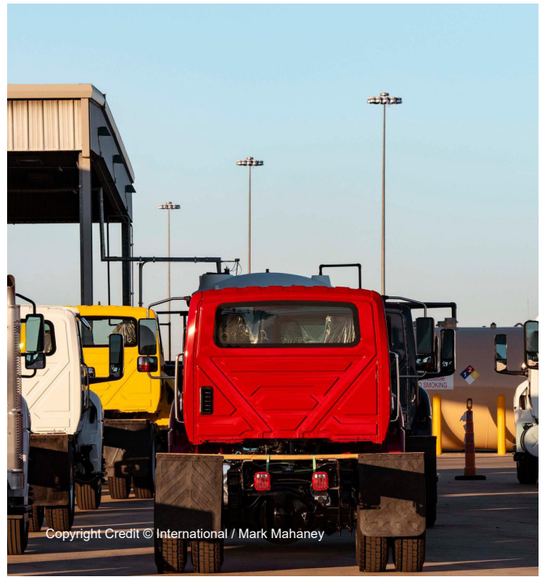
*Definitions and details of nature-related indicators from the Risk Filter Suite are provided in Appendix I.

Future trends, risks and opportunities for business

Aluminium's unique properties and recyclability allow for its use across key sectors, including transport, renewables and electricity transmission, building and construction, and packaging. It also plays a key role in the shift to green and efficient technologies, due to its critical use in renewable energy technologies, batteries and energy efficient buildings.

The global demand for aluminium is expected to rise by almost 40% by 2030 relative to the 2020 demand, and the biggest share of this increase is expected to come from the transport sector driven by the shift to electric vehicles. Electric vehicles contain on average 60-80 kg more aluminium per vehicle than those powered by internal combustion engines[xxxvii].

Even though the metal is highly recyclable, 70% of its demand is currently being met by virgin metal[xxxviii]. Virgin aluminium has both a high carbon footprint, as well as a range of other high impacts on nature as described above.



POTENTIAL RISKS TO BUSINESSES

1. High demand from competing sectors, and high nature-related dependencies and impacts may lead to affected supplies or price-rise thus creating risks to operations – Physical risk
2. Delay in climate-related transition plans affecting brand image – Reputational risk
3. Possible increased scrutiny and controls by regulator due to the high nature-impact linkage – Regulatory risk
4. Possible market risks such as due to price fluctuations – Market risk

OPPORTUNITIES FOR BUSINESSES

1. Responsible sourcing of the metal through subscribing for ASI Standards
2. Increase the use of recycled or secondary aluminium in production to reduce demand of virgin metal. Recycled aluminium is produced with 95% of the energy savings required to produce primary aluminium besides avoiding other nature-related impacts of primary aluminium production.
3. Design for recyclability, to increase the suitability of the product for the recycling market. Aluminium scrap can be re-casted to produce products used by other industries.
4. Partner with recyclers, and other metal user industries to bring circularity into action.

References: ASI Standards[xxxix], 95% energy savings of recycled Al[xl]

II. LITHIUM MINING

Introduction

The Lithium-ion battery is the predominant commercial form of rechargeable battery that is most widely used in electrified transportation today. Relative to other high-quality rechargeable technologies (like nickel-cadmium, nickel-metal hydride and lead-acid technologies) lithium-ion batteries offer high energy density, meaning high energy to weight ratio, long lifecycle, wide temperature range and low self-discharge rate.

A Lithium-ion battery of a typical heavy-duty truck may weigh between two to three tons and contain four to six battery packs. Each battery pack has several battery modules each of which contains six to twelve battery cells. Battery cells are rechargeable and make the most cost-intensive component of batteries.

Even though lithium is used in small quantities in a commercial vehicle relative to certain other metals, it is an indispensable constituent of the most commonly used, present-day battery technology.

The process and nature-related issues

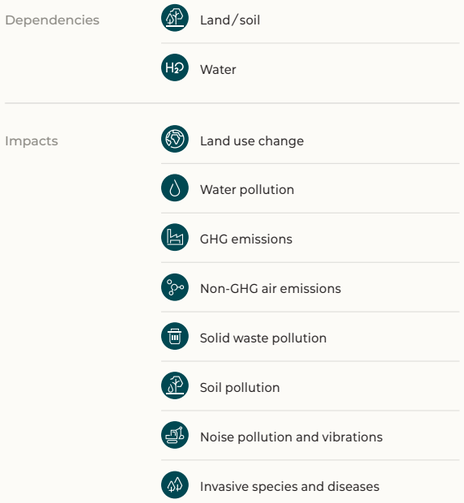
Lithium is a soft, silvery white metal found in two main types of ore deposits:

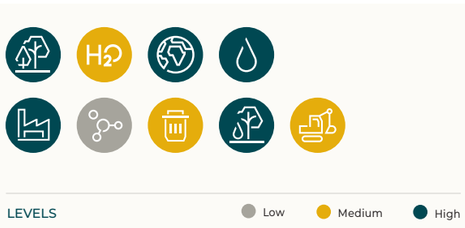
1. As mineral spodumene found in hard-rock formations. The ore is mined through open-cast mining from underground or near-surface deposits and processed to produce lithium compounds.

Key nature-related issues:

- Land-use and land-use change due to removal of topsoil and vegetation
- High freshwater use for control of Particulate matter
- High GHG emissions due to high energy needs
- Pollution of soil and water due to chemical rich mine tailings

ILLUSTRATIVE VERSION OF THE PROCESS HEATMAP





2. As brine found in salt lakes or underground aquifers. Brine is pumped to the surface and then evaporated using solar or mechanical methods to leave behind concentrated lithium brine. This is then processed to extract lithium using physical and chemical methods.

Key nature-related issues:

- High freshwater use for brine extractions. The process involves evaporation of significant quantities of water. 1 ton of lithium requires around 2 million tons of water to be evaporated[xlii].
- High water pollution (including underground reserves) mainly through salinization
- Land use for evaporation ponds
- High energy use for mechanical evaporation processes

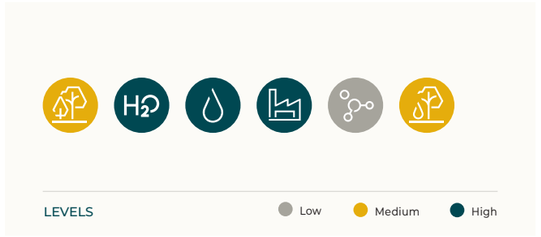
A third type of deposit called Lepidolite serves as a secondary source of lithium and is found in hard-rock formations with open-cast mining.

MORE ABOUT LITHIUM-ION BATTERIES

Lithium-ion batteries combine different proportions of other metals besides lithium. The anode of these batteries is made up of graphite while the cathode has a metal oxide containing lithium, oxygen and a combination of some other metals like nickel, cobalt, manganese etc.

A battery's chemistry is typically described using an acronym that denotes the proportion of the constituents – an NCM811 battery for example contains eight parts nickel, to one part cobalt and one part manganese. It is the battery's chemistry that determines its performance and residual value.

Reference: More about Lithium-ion batteries[xli]



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Location-based risk assessment

Major lithium mining locations for the top 8 lithium-producing countries (representing over 99% production by volume)[xliii] were identified and a location-based risk assessment was performed using the Risk Filter Suite. The following summary provides the risk profile for the key lithium mining locations.

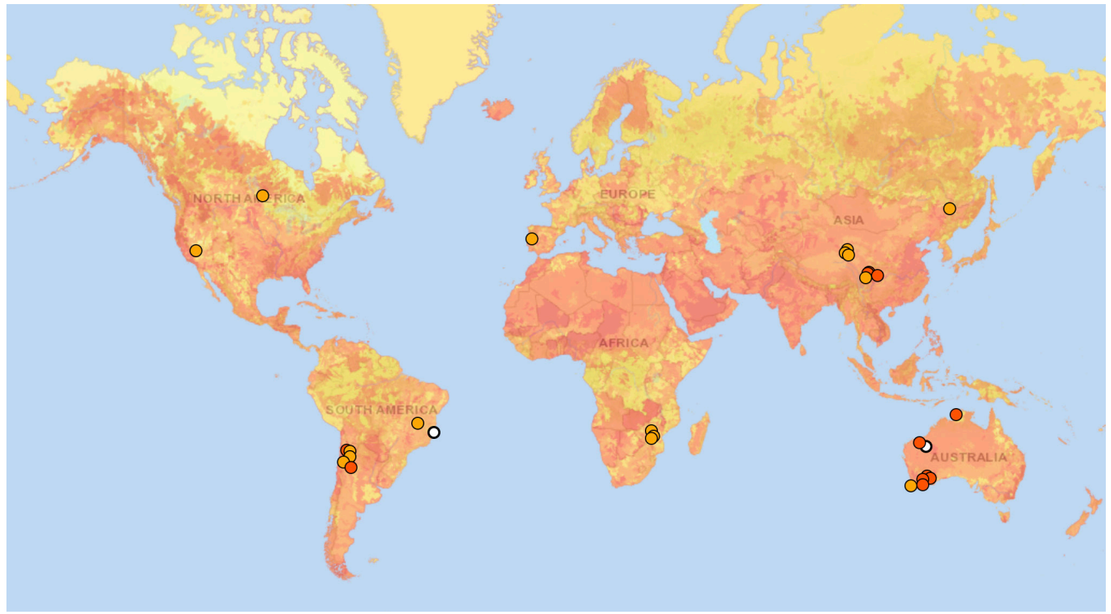


Figure 12: The map shows the Scape Physical Risks output map from the WWF Biodiversity Risk Filter showing the locations of key Lithium mines in the world. The colour of the dots indicates the cumulative physical risk score, obtained from combining the output of various physical indicators contained in the tool.

MAJOR LITHIUM PRODUCER COUNTRIES AND THEIR MAIN DEPOSIT-TYPE

1. Australia – hard rock
2. Chile – brine type
3. China – both hard rock and brine
4. Argentina – brine type
5. Canada – hard rock
6. Zimbabwe – hard rock
7. USA - both hard rock and brine
8. Brazil – hard rock

KEY LOCATION-BASED NATURE RELATED ISSUES*

- Pollution
- Forest productivity
- Ecosystem condition
- Water scarcity
- Proximity to biodiversity critical areas
- Sites of international interest

*Definitions and details of nature-related indicators from the Risk Filter Suite are provided in Appendix I.

Future trends, risks and opportunities for business

Driven by the clean energy transition, the annual global lithium-ion battery demand is growing rapidly. It is expected to surpass 1 Terawatt hour (1000 Gigawatt hours) in 2024 rising from the 70 GWh demand in 2015[xliv]. The electric vehicles market is the main sector driving this demand, while renewable energy production and electronics add to it.It isanticipated that under current projections, the supply of minerals critical to the clean energy transition including lithium will be insufficient to meet their rising demand. Under the International Energy Agency's Announced Pledges scenario, global lithium supplies are expected to show a demand-supply gap of 6% by 2030[xlv].

Australia is the largest producer of lithium at present, followed by Chile, China and Argentina. The downstream refining process for lithium is however largely controlled by China which currently refines 60% of the world's lithium. This situation however may change in the future as indicated by the status of global lithium reserves, and as other lithium mining countries build local refining facilities close to their mines[xlvii].

Figure 13: Anticipated demand-supply gap of critical minerals under the International Energy Agency's (IEA) Announced Pledges scenario. This scenario assumes that all long-term emissions and energy access targets, including net-zero commitments, will be met on time and in full, even where policies are not in place to deliver them[xlvi]. Illustration: World Economic Forum 2023

The largest reserves of lithium are contained in the so called “Lithium triangle” encompassed by the borders of Chile, Argentina and Bolivia in the form of brine type deposits. The increasing number of lithium mining projects coming up in these countries indicates their increasing dominance in the lithium production market globally. Several nature related pressures including water scarcity exist in this region, posing risks to local ecosystems and indigenous communities[xlviii].

Circular economy solutions such as reuse, repurpose and recycling of batteries are important solutions to reducing the demand of virgin battery metals including lithium. Several commercial vehicle sector companies are engaging in partnerships to support such efforts. Various technologies for recycling of Lithium-ion batteries and recovery of metals exist, with a high efficiency rate of over 90% in some cases[xlix]. However, as the production and use of electric vehicles ramps up in the coming years, the volume of spent batteries will significantly grow. To ensure that this used as an opportunity for sourcing sustainable battery metals, battery recycling capacity will need to be scaled up with stronger policy support[l].

If battery recycling is scaled up, it may eventually cover basically the entire need for new batteries – due to recycling rates inching ever closer to 100% while energy density of batteries are increasing with each generation, necessitating fewer minerals, ultimately more material may be recycled than is needed for the next generation of batteries.

Figure 14: A map showing locations of salt flats forming brine type lithium deposits in the Lithium triangle in South America. This region holds the largest reserve for lithium in the world[li].

POTENTIAL RISKS TO BUSINESSES

1. High demand from the transport and other sectors, and high nature-related dependencies and impacts may lead to affected supplies or price-rise thus creating risks to operations. High dependence for mineral suppliers on specific geographies creates geopolitical risks – Physical risk
2. Potential delay in climate-related transition plans affecting brand image – Reputational risk
3. High nature and people-impact linkage may affect brand image of companies – Reputational risk
4. Possible increased scrutiny and controls by regulator due to the criticality of the element and high nature-impact linkage – Regulatory risk
5. Possible market risks such as due to price fluctuations – Market risk

OPPORTUNITIES FOR BUSINESSES

1. Bring circularity into action by ensuring collection and recycling of used batteries and ensuring use of recycled lithium and other critical minerals in products. This reduces the demand of virgin metals and improves business resilience in the light of fluctuating mineral supplies.
2. Invest in innovation to support diversification of battery metals portfolio.
3. Diversify supplier portfolio for critical minerals.
4. Work with industry peers and policymakers to address geopolitical risks, improve awareness and contribute to policy.

III. NEODYMIUM MINING AND PROCESSING

Introduction

Neodymium is mainly used to produce magnets that find a wide range of applications in various sectors, including automotives and electronics, wind turbines, aeronautics, defence, and even space applications such as in satellite systems. A truck or bus uses neodymium magnets in components such as electric motor, braking system, steering, multimedia and electronic systems.

Neodymium is part of the Rare Earth Elements (REE) group of metals (17 in total). These are relatively common in occurrence in the earth’s crust but economically exploitable deposits of these metals are sparse.

WHY THE INTEREST IN NEODYMIUM

Neodymium magnets are called super magnets. They are among the strongest magnets in the world as they possess very high strength even at their smallest size. Typically, they are made of an alloy of Neodymium, Iron and Boron (NdFeB).

In automotives, as intelligent and autonomous vehicle applications such as safe driving assistant systems, collision prediction systems etc. develop, Neodymium magnets will find a much wider use and the demand of these magnets will rapidly rise.

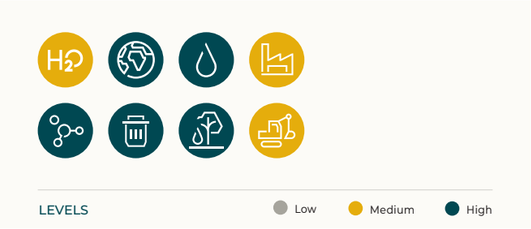
The process and nature-related issues

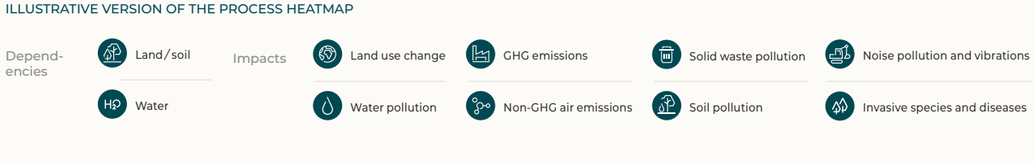
Neodymium is found in mineral groups together with other REEs that occur in 2 key mineral deposits: monazite and bastnäsite. REE mining is done by using conventional open-pit methods that involve blasting, crushing and concentration by physical methods. This is followed by chemical-based treatment called froth-floatation. The REE concentrate obtained from froth floatation is then refined and separated into individual REE metals.

The different REE metals are very similar in their characteristics which makes their refining extremely challenging. Refining REEs to obtain individual metals such as neodymium is a multi-step process involving the use of ion exchange technology and solvent extraction that requires large amounts of energy and chemicals.

Key nature-related issues:

- Land use and land-use change due to removal of topsoil and vegetation
- High freshwater use for control of particulate matter
- Pollution of land and water due to leaching of chemicals (which may be radioactive) during mining and discharge of chemicals through wastewater during refining
- GHG emissions from energy use during refining
- Emissions of particulate matter during mining
- Solid waste including radioactive chemicals





Location-based risk assessment

A small number of countries currently mine for REEs. The major mining locations of REE metals in these countries were identified[lii] and a location-based risk analysis was performed using the Risk Filter Suite. A summary of the major risks identified at these locations is provided below.

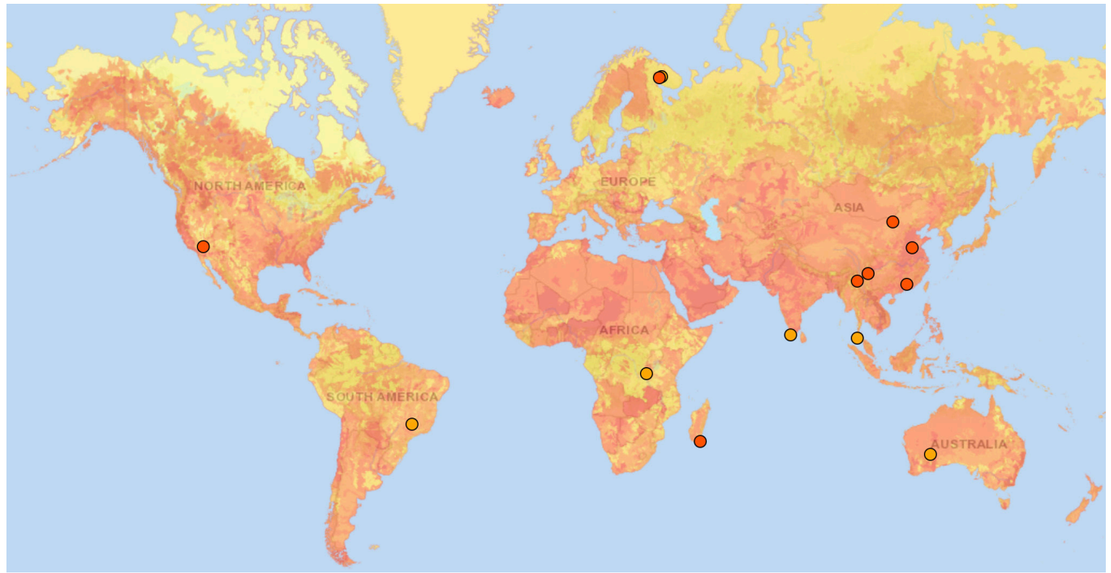


Figure 15: The map shows the Scape Physical Risks output map from the WWF Biodiversity Risk Filter showing the locations of key REE mines in the world. The colour of the dots indicates the cumulative physical risk score, obtained from combining the output of various physical indicators contained in the tool.

MAJOR REE (INCLUDING NEODYMIUM) MINING COUNTRIES

1. China
2. Australia
3. USA
4. Brazil
5. India
6. Russia

KEY LOCATION-BASED NATURE RELATED ISSUES*

- Proximity to biodiversity critical areas
- Pollution
- Land, freshwater and sea use change
- Labour/Human Rights
- Water scarcity

*Definitions and details of nature-related indicators from the Risk Filter Suite are provided in Appendix I.

Future trends, risks and opportunities for business

Magnets made with REEs including Neodymium are critical to the global clean energy transition considering their high use in electric vehicles, wind turbines etc. According to the International Energy Agency (IEA), the demand for magnet-REEs is expected to nearly double by 2050 (93 kiloton in 2023 to 181 kiloton by 2050 in the Announced Pledges Scenario)[liii] driven by the rising demand for electric vehicles and wind turbines. Neodymium magnets also find critical applications in other sectors, including defense, aerospace and electronics.

Further, the IEA identifies that among all key energy transition elements, the production of REEs is among the least geographically diversified. In mining, the share of top three producers of REEs stood at 85% in 2023 while looking at refining, China alone accounted for 92% of the refined global output. While other countries, including USA and India, are setting up integrated mining-refining-magnet production facilities, the geographical concentration at the global level is expected to show only small improvements in the future[lvi]. The European Union (EU) identifies REEs as critical raw materials considering their high importance to the EU economy and the high risk associated with their supply[lvii].

RESEARCH IN REE REFINING AND RECYCLING

Extensive research is happening in the area of REE refining considering their rising demand and involvement of high nature impact processes. Researchers at the Penn State have newly discovered a protein that naturally houses a binding site that can differentiate between the different REEs. It has the capacity to enrich Neodymium and Praseodymium over other similar REEs.

Another research from the Penn State has revealed a mussel/inspired nanocellulose coating (MINC) that has the ability to recover REEs from secondary sources like industrial wastewater using high amount of energy and chemicals.

Research also shows that Neodymium can be recycled and used to manufacture new Neodymium magnets. Recycling is however not developed currently. The techniques are very expensive and the infrastructure is not fully developed yet.

Reference: Bacterial protein[liv], MINC[lv]

POTENTIAL RISKS TO BUSINESSES

1. Rising demand of Neodymium magnets from the electric vehicles and other sectors, and high nature-related dependencies & impacts may lead to affected supplies or price-rise thus creating risks to operations. High dependence on specific geographies for mineral supplies creates geopolitical risks – Physical risk
2. Potential delay in climate-related transition plans affecting brand image – Reputational risk
3. High nature-impact linkage may affect brand image of companies – Reputational risk
4. Possible increased scrutiny & controls by regulator due to the criticality of the element and high nature-impact linkage – Regulatory risk
5. Possible market risks such as due to price fluctuations – Market risk

OPPORTUNITIES FOR BUSINESSES

1. Diversify supplier portfolio for REE/ Neodymium magnets to reduce supply risks
2. Support research and innovation to help diversify mineral portfolio for magnet production
3. Support development of recycling capabilities of REE/Neodymium magnets.
4. Work with industry peers and policymakers to address geopolitical risks, contribute towards development of sustainable refining options for REEs.

IV. NATURAL RUBBER PLANTATIONS

Introduction

70% of the natural rubber produced in the world goes towards the production of tires. Natural rubber is mainly produced in the tropical belt of the world, rich in forest cover and biodiversity, and 90% of it is produced by small-holder farmers. The European Union has identified natural rubber as a critical raw material that reflects the combi-nation of its high importance to the economy and the high risk associated with its supply.

NATURAL RUBBER IN TIRES

A tire has a complex structure and rubber goes into its different parts. Both natural and synthetic rubber have unique properties and are both necessary for a tire. The various components of a tire including rubber must be precisely processed and assembled in order to achieve the safety, durability and performance needed for different vehicle types.

Different vehicle types contain a different share of natural rubber in their tires. Truck tires contain about 30% (equivalent to 20-25 kg) of natural rubber while passenger car-tires contain about 15% natural rubber.

Reference: %Natural rubber[lviii]

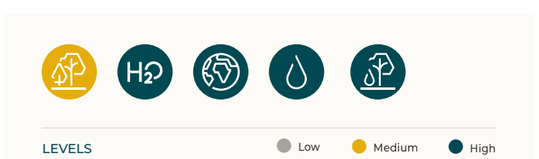
The process and nature-related issues

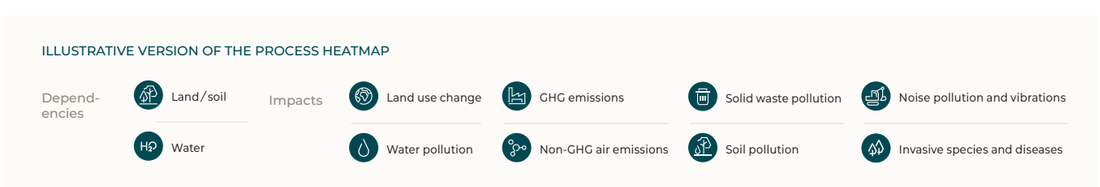
Most of the commercially produced natural rubber is produced from the bark of the tree Hevea brasiliensis. The trees are tapped for their latex, which is collected and coagulated by adding formic acid. The mixture is then passed through rollers to remove excess water. Once rolling is complete, the layers of rubber are hung over racks in smokehouses or left out to air dry. Once dry, the rubber is sent for processing which is a chem-ical and heat-enabled process.

Natural rubber production is a major economic activity for several developing countries, particularly in Southeast Asia and contributes significantly to their national in-comes. Over the years, however, expanding agricultural plantations for rubber production have raised concerns regarding effects on nature.

Key nature-related issues:

- Land use change in the form of agriculture-led deforest-ation and conversion of agricultural lands meant for food production. Over 5 million hectares of land were converted to rubber plantations between 2003 and 2017 in mainland Southeast Asia and sub-Saharan Africa[lix].
- High water use. Rubber plants are known to consume more water than the forests and croplands they replace[lx].
- Soil and water pollution due to increased chemical use. Rubber trees are highly vulnerable to pests and diseases and so require more herbicides and pesticides as part of pest management activities. Chemicals persist in soil, and leach into water bodies causing pollution of these media and harming other species.
- Social issues: exposure to harmful chemicals among far workers, low smallholder incomes, land grabbing and inequality[lxi].





Location-based risk assessment

The top six rubber producing countries together produce 85% of the natural rubber produced globally. The high rubbergrowing provinces of these top six producer countries wereidentified and a location-based risk assessment was performed using the Risk Filter Suite. The outputs were studied toidentify the high and very high- risk nature re-lated indicators. The following summarizes the risk port-folio of natural rubber in these regions.

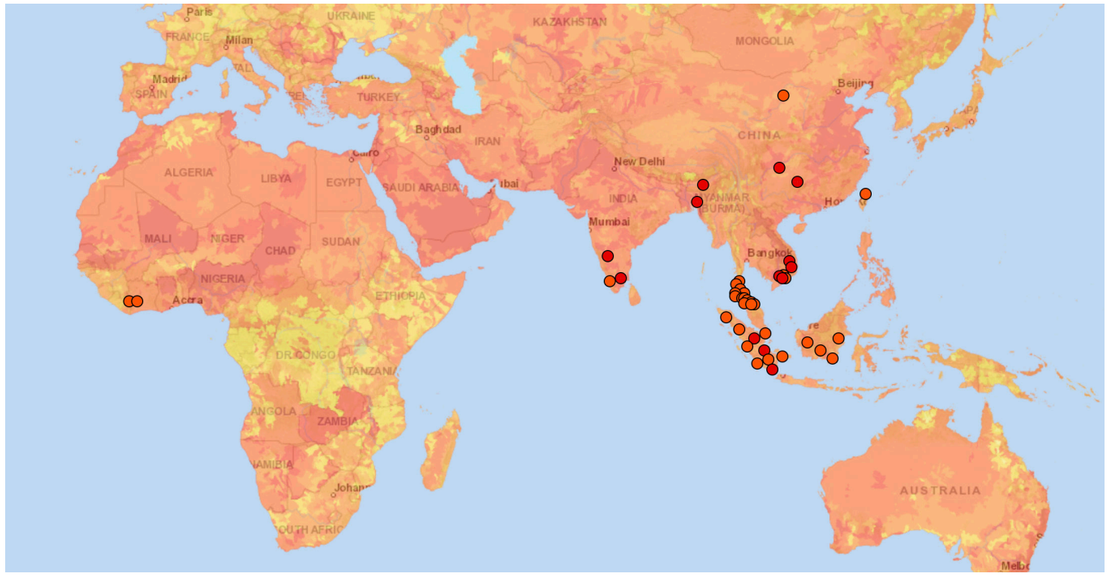


Figure 16: The image shows the Scape Physical Risks output map from the WWF Biodiversity Risk Filter, highlighting the locations of the high rubber producing provinces in the six main producer countries. The colour of the dots indicates the cumulative physical risk score, obtained from combining the output of various physical indicators contained in the tool.

MAJOR NATURAL RUBBER PRODUCER COUNTRIES

1. Thailand
2. Indonesia
3. Vietnam
4. India
5. Côte d'Ivoire
6. China

KEY LOCATION-BASED NATURE RELATED ISSUES*

- Forest canopy loss
- Limited wild flora & fauna availability
- Plant/forest/aquatic pests & diseases
- Landslides & tropical cyclones
- Labour & Human Rights
- Media scrutiny

*Definitions and details of nature-related indicators from the Risk Filter Suite are provided in Appendix I.

Future trends, risks and opportunities for business

Rubber production has been growing rapidly since the beginning of the century. According to the Food and Agriculture Organization (FAO), global production of natural rubber increased by 109% and its harvested area by 72% between 2000 to 2020. Forecasts indicate that the demand of natural rubber will further rise by 33% by 2030, compared to the 2020 levels. A major share of this demand comes from the tire industry, which holds the key to bringing sustainability in the natural rubber production and supply chain.

As the transport sector switches from the use of ICE to BE vehicles, the demand for natural rubber in tire production is expected to rise. BE vehicles require heavier tires due to their extra weight and show faster acceleration that leads to more tire wear. As global demand for natural rubber increases, newer areas in the world's tropical belt are expected to come under production, further increasing the nature-related pressures from the commodity.

POTENTIAL RISKS TO BUSINESSES

1. High nature-related dependencies and impacts may lead to affected supply chains (affected supplies or price rise) creating operational risks for companies– Physical risk
2. Increased reporting burden and risk of penalties or fines due to tighter regulatory controls – Regulatory risk
3. High nature-impact linkage may affect brand image of companies – Reputational risk
4. Possible market risks such as due to price fluctuations – Market risk

OPPORTUNITIES FOR BUSINESSES

1. Work with suppliers to improve traceability and source sustainably.
2. Recycled rubber can go into lower grade applications thus reducing the demand for virgin rubber.
3. Invest in research and innovation to reduce the use of natural rubber in tires and explore alternatives.
4. Work with other stakeholders (rubber producers, processors, suppliers) in a landscape-based approach to protect nature and produce sustainably.

V. COMPONENT MANUFACTURING

Introduction

A commercial vehicle is complex, in that it contains several thousand parts or components and various systems in function. There are larger components like chassis, engines, brakes; smaller components like nuts, bolts and calipers; and systems like suspension system, electrical and multimedia system.

Production of components involves a range of industrial processes, for example, forging of metals, injection moulding to make plastic parts, extrusion of electric wires, milling of rubber to build tires etc. An Original Equipment Manufacturer (OEM) of commercial vehicles typically has a series of suppliers in its supply chain, which ensures that automotive systems or components with the right specifications are produced and supplied for assembly.

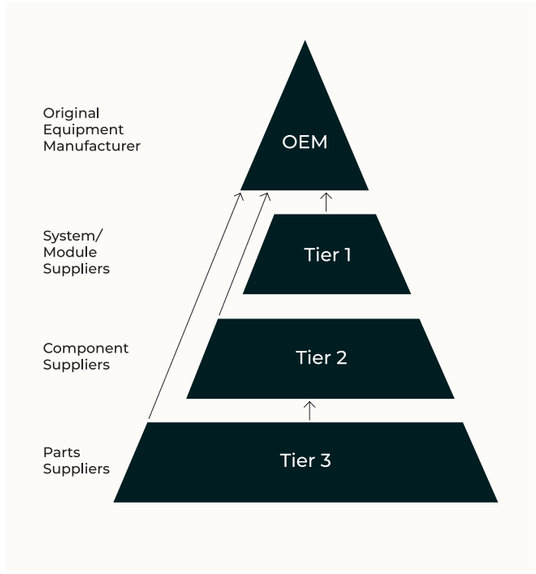


Figure 17: An illustration of the supplier pyramid of an OEM of commercial vehicles

The process and nature-related issues

The following key nature-related issues are expected to be the most common.

Key nature-related issues:

- GHG and non-GHG emissions like NOx, SOx and Particulate Matter from the use of energy. Most industrial energy consumption is still dominated by fossil fuels, in particular coal associated with high emissions. Processes like steel and aluminium production, production of plastics and semi-conductor chip manufacture are examples of energy intensive processes for component manufacturing.
- Non-GHG emissions like Particulate matter and gases from physical processes like painting, metal cutting and grinding.
- High freshwater use in processes associated with metal refining, battery manufacture, semiconductor chip production etcetera. Battery cell manufacture for example, requires the use of ultrapure water for which a high degree of purification of incoming water is carried out through a complex series of steps.
- Water pollution is associated with high chemical use in processes like tire manufacture, metal refining, painting and polishing and battery cell manufacture.
- Solid waste generation can be significant, including generation of hazardous waste from processes such as battery electrode production and tire production.

Location-based risk assessment

Data for production sites of major suppliers of truck and bus manufacturing companies was compiled[lxii], and a location-based risk assessment was carried out using the Risk Filter Suite. Over 1600 manufacturing sites of automotive components belonging to 326 supplier companies (identified as major suppliers) that supply 21 large commercial vehicle OEMs were mapped in this exercise. The production sites are found to be highly clustered, representing major hubs for automotive components. The results were studied for key nature-related risks and the risk profile below was prepared by identifying risk indicators in the high and very-high risk categories.

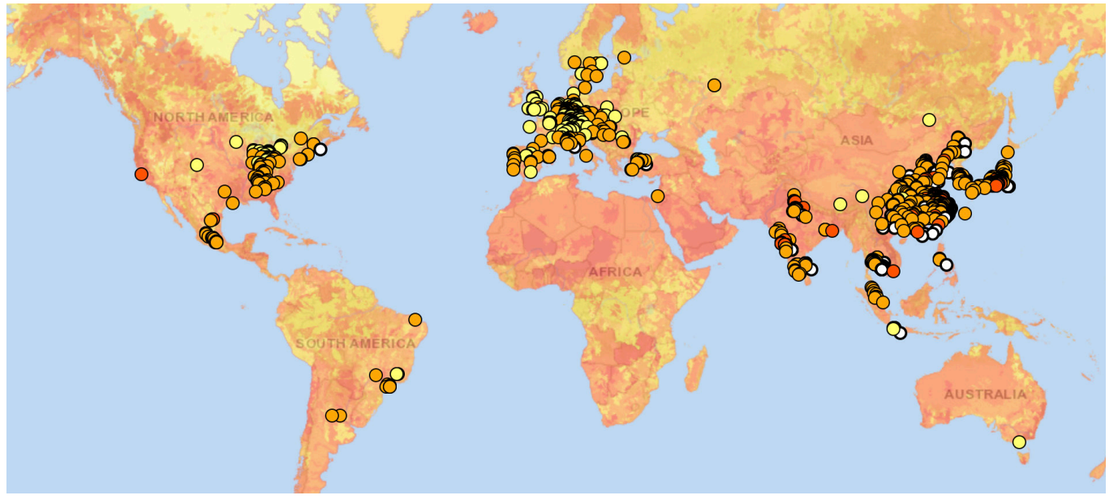


Figure 18: The image shows the Basin Physical Risks output map from the WWF Water Risk Filter, highlighting the locations of the manufacturing sites of major suppliers to commercial vehicle OEMs. The colour of the dots indicates the cumulative risk score obtained by averaging the risk values of all water related physical risk indicators contained in the tool.

MAJOR COMPONENT SUPPLIER COUNTRIES

1. China
2. Japan
3. India
4. Thailand/Malaysia
5. Western Europe
6. East/Central USA
7. Mexico

KEY LOCATION-BASED NATURE RELATED ISSUES*

- Pollution
- Water availability
- Flooding
- Landslides and tropical cyclones
- Labour / Human Rights
- Ecosystem services status (for water)

*Definitions and details of nature-related indicators from the Risk Filter Suite are provided in Appendix I.

Future trends, risks and opportunities for business

The global commercial vehicles market is growing rapidly and is expected to correspondingly increase the demand for components. Component manufacturing happens mainly in production clusters or manufacturing hubs that have high nature-related impacts, due to high energy and resource use, and pollution. The industrial clusters cater to different brands in the commercial vehicles industry as well as other industry sectors and can be a source of risk for the entities involved. A disruption in supplier operations due to nature-related issues can lead to a scarcity of components and potentially put a commercial vehicles brand in competition with other brands, and even with other industry sectors if the disruption concerns lower tiers of the supply chain. The semiconductor crisis that lasted for about three years (2020 – 2023) was a lesson on how supply chain vulnerabilities can take global proportions and create significant operational risks for companiesl[xiii].

As electrification of commercial vehicles scales up, the mix of processes contributing to the production of automotive components will likely change. While technological advancements in the sector may improve resource efficiency or deploy renewable energy thereby reducing process-level impact, these trends need to be studied in more detail to understand their level of adoption in relation to the increase in demand and manufacturing.

Overall, there is a strong case for businesses to understand their supplier impacts further and address the risks associated with them.

POTENTIAL RISKS TO BUSINESSES

1. High nature-related dependencies and impacts may lead to affected supply chains (affected supplies or price rise) creating operational risks for companies – Physical risk
2. Increased reporting burden and risk of penalties or fines due to tighter regulatory controls – Regulatory risk
3. High nature-impact linkage may affect brand image of companies – Reputational risk
4. Possible market risks such as due to price fluctuations – Market risk

OPPORTUNITIES FOR BUSINESSES

1. Improve supplier awareness through trainings etc on nature issues to inspire action
2. Supplier sustainability: work with and support suppliers such as through target setting and making finance available for meeting better operational standards
3. Work with other stakeholders including other companies in manufacturing hubs to address nature issues through sustainable production

VI. USE PHASE OF COMMERCIAL VEHICLES

Introduction

A truck or bus has a fairly long lifespan of ten years or more, over which it runs over fairly long distances such as over 1,000,000 km. Several vehicle parts, such as tires, oils and oil filters batteries, undergo replacement after which the trucks are often also sold in the market for a second life. The nature-related impacts caused by heavy vehicles in the use phase are therefore realized over a long period of time and can be significant.

The process and nature-related issues

The impacts from the use phase can be identified as coming from:

1. The actual movement of vehicles
2. Roads and their construction
3. Production and conveyance of fuel/electricity that powers the vehicles

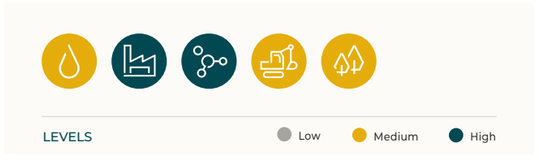
Each of the above phases/processes is examined below for their major nature related impacts.

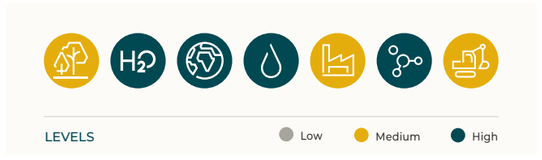
I. Movement of vehicles – Key nature-related issues:

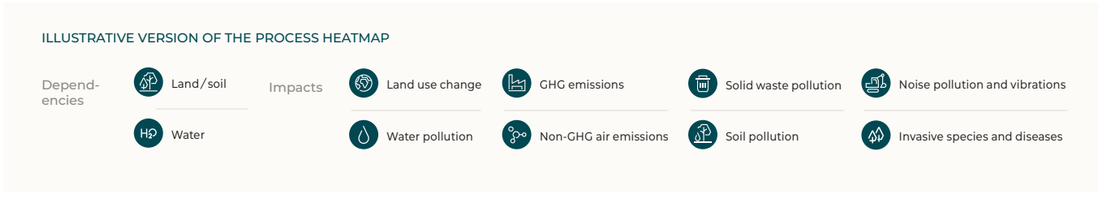
- GHG emissions from the use of fuel. In ICE vehicles, the use of fuel (as diesel, gasoline, Liquefied Natural Gas, or Compressed Natural Gas) contributes the most to GHG emissions across the entire vehicle lifecycle, and switch to BE vehicles brings down the emissions significantly. See figure 19.
- Non-GHG emissions in the form of particulate matter, and gases like carbon-monoxide, nitrogen oxides and aldehydes. These emissions cause health hazards to humans and other life forms, as well as contribute to soil and water pollution, through combining with airborne chemicals. See figure 20.
- Tire emissions such as tire-wear particles, chemicals, microplastics and heavy metals. These cause health hazards as well as contribute to air and water pollution. Recent research reveals that tire emissions can be more significant in terms of their impacts than known earlier[lxiv].
- Animal kills and injuries, especially significant in biodiversity critical areas, such as Key Biodiversity Areas (KBAs). For more on biodiversity critical areas, refer Appendix I.
- Noise, especially significant in remote wilderness sites. In terrestrial environments, increased noise coming from various sources can have adverse effects on the hearing and behaviour of animals[lxv].

II. Roads and their construction – Key nature-related issues:

- GHG and non-GHG emissions during road construction, and from material extraction and conveyance. These processes use energy and release particulate matter that can be significant depending on the scale of activity involved.
- Water use for soil compaction and control of Particulate matter etc. Water use in road construction is particularly key to consider in countries or regions with major infrastructure development plans and high water scarcity/stress issues[lxvii].
- Land use and land use change in the area of construction
- Barriers for habitats and animal movement

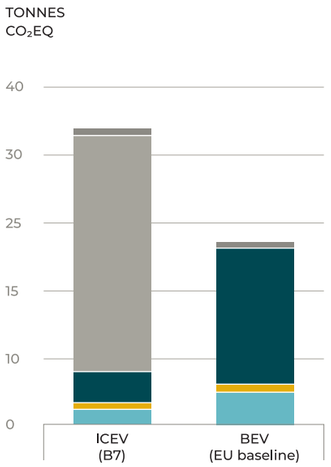






HOW THE SWITCH TO BEV ADDRESSES IMPACTS FROM VEHICLE MOVEMENT

A study of GHG emissions over the lifecycle of a distribution vehicle reveals that over 90% of the lifecycle GHG emissions come from the tailpipe. A switch to BEVs brings this down to null. Through addressing tail-pipe emissions, this also brings down the impacts related to non-GHG emissions, such as fine particulate formation, acidification and ozone creation significantly. BEVs may however lead to higher tire emissions but no research-based evidence on this is available yet.



Vehicle	Production	Maintenance	Use WtT	Use TtW	Recovery
ICEV (B7)	27,5	2,4	44,9	354,3	2,1
BEV (EU baseline)	53,6	2,4	209,5	0,0	2,1

Figure 19: Total lifecycle carbon-dioxide emissions presented per lifecycle phase. The use phase is divided into WtT (Well to Tank) and TtW (Tank to Wheel)

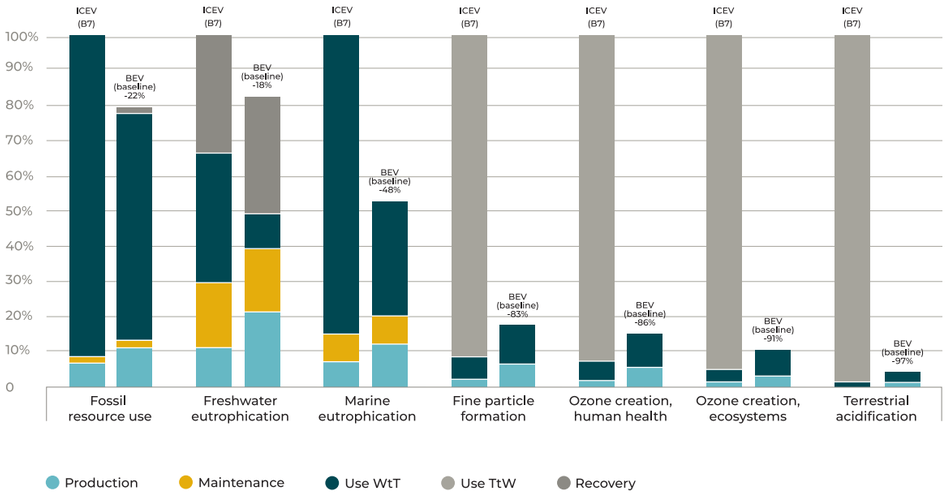


Figure 20: Reduction potential for battery electric vehicles presented for impact categories other than carbon emissions. The reduction values are presented over the lifecycle of a distribution vehicle and in relation to ICE vehicles.

Reference: GHG emissions[lxvi]

ANIMAL ACCIDENTS AND BARRIER EFFECT OF ROADS

Habitat loss and fragmentation have been identified as major threats to animal biodiversity. Animal mortality through animal-heavy vehicle collisions, and the barrier effect of roads contribute to these factors.

The effect of animal-vehicle collisions is particularly relevant for areas rich in animal biodiversity that have overlaps with areas of high economic activity. An example is the Highway of Death – Brazilian highway BR-262 that cuts across Brazil's fauna-rich Cerrado (savannahs), and Pantanal (wetlands) and connects with major mining sites. A study reveals that over 3000 animals die on the highway every year due to truck movement impacting 88 different animal species, including those that are vulnerable to extinction.

The barrier effect of roads impacts vertebrate and invertebrate populations in many ways. Animal species are often cut-off from seasonal migration routes, invertebrates are killed on roads or their behavioural patterns are impacted. For example, snakes known to follow trails of pheromones for mating that are disrupted by roads making it difficult for them to find mates.

Construction of roads through forests creates a edge habitat that faces increased predation rates of bird nests in the absence of the protection that forest canopy offers. Animals that rely on light for their biological activity can also get impacted by lights on roads. Road lights can alter the routes that bats fly, impacts frogs by delaying metamorphosis and hatchling sea turtles, by disrupting their movement to oceans which is dependent on following light.

Modern technology however offers hope to addressing some of these impacts. The use of Artificial Intelligence (AI) presents an opportunity for vehicle companies to develop warning systems, based on tracking real-time recognition of animals, or hotspots where animals cross roads. Training truck workers, recording animal sightings using mobile applications, and working with logistics companies to reduce night-time driving are some possible solutions. Infrastructure investments such as constructed corridors for wildlife crossing are known to be highly effective too.

References: Brazilian Highway of Death[lxviii]. Barrier effect of roads[lxix]

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III. Production and conveyance of fuel and electricity: Nature related impacts

A. Fossil fuel and fossil-based electricity

S. NO.	PROCESS	IMPACT
1.	Production of fuel – diesel, gasoline, natural gas, LPG	• Land use change • Pollution (air, water, soil) • GHG and Non-GHG emissions from process-related energy use
2.	Logistics, through rail, roads or shipping. The role of logistics is central to the sector considering global value chains and concentration of many processes in regional centres. Transport of components, vehicles and fuel is considered in scope.	• GHG Non-GHG emissions • Additional impacts linked to shipping – accidents or fatalties among marine animals, noise impacting animal behaviour, ballast water release causing release of invasive alien species, and possibility of oil spills
3.	Fossil (coal, oil, natural gas) based electricity production	• GHG and Non-GHG emissions • Soil and water pollution (including thermal pollution) • Water use • Solid waste pollution
4.	Power transmission	• Transmission lines can injure animals and birds through electrocution

B. Renewable-source and nuclear-based electricity production

S. NO.	ENERGY SOURCE	POTENTIAL IMPACTS
1.	Nuclear power	• Energy use and GHG emissions from preparatory steps like Uranium mining, enrichment and transport • Land-use and land use change for safe containment of nuclear waste • Water use, considered significant[lxxi] • Risk of accidents (due to operational failure or natural hazards) impacting humans and other life forms • Resource footprint, land use change and pollution during the construction of nuclear plants
2.	Hydro power	• Impact on water flow for ecological needs that impacts fish migration and genetic exchange • Impact on native plants and animals due to change in water chemistry • Resource footprint due to use of construction materials • Possible land use impact on natural or agricultural lands
3.	Wind power	• Impact on bird and bat populations due to collision, disturbance or habitat damage

C. Biofuels and biomass-based electricity production

Biofuels represent a nature-based alternative to conventional fuels, in being produced from plants or from agricultural, domestic or industrial bio-waste. The production and use of biofuels, such as bioethanol and biodiesel, is increasing in the commercial vehicles sector. In particular, its uptake has been high in regions where feedstock availability for biofuels is high and electrification is picking up slow due to factors like slow charging infrastructure development. Biofuels are used by other sectors as well, such as industrial and residential sectors, and factors like availability and cost determine to a large extent the level of use by these different sectors.

Nature-related impacts of biofuels can be analyzed by understanding each of the different processes involved in biofuel production. Agricultural and industrial processes, as well as logistics, are involved in the biofuels lifecycle and each of these can be a potential source of nature-related impacts. The impacts of biofuel projects are very specific to the project and depend on various factors such as type of biomass, its production practices, type of energy source used during biomass processing and logistics and the distance between biomass production and processing facility.

Biofuels must be sustainably produced through each of the processes along their lifecycle, in order for them to have a net positive effect on nature. Biofuels produced from waste – agricultural, domestic or industrial origin – are a more sustainable alternative to those produced from purpose-grown biomass. However, the limited availability of waste limits the potential of this alternative in meeting the rising biofuel demand.

Conflicting viewpoints are often brought up on the topic of biofuels in road transport with regards to their impacts on nature. Several studies analyze issues, such as the use of biofuels across different sectors of application and the opportunity cost of land used for biofuel production, making recommendations in favor of or against the use of biofuels. In general, considering that sustainably produced biofuels have a limited potential for meeting the global demand for clean fuel from the transport sector, they should be viewed as one of the options, and not the only option to decarbonize the sector sustainably.

NATURE-RELATED IMPACTS OF BIOFUELS

Biofuel projects may be associated with potential negative impacts such as due to

1. Deforestation or conversion of natural lands. When considering alternatives, does biomass production provide the best opportunity value of land?
2. Unsustainable water use during biomass production
3. Unsustainable energy use during processing
4. Excessive emissions during processing and conveyance
5. Competition of agricultural product for higher value uses like food or feed


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Use phase case examples

A thematic deep-dive on two country-specific case examples (Sweden and Brazil) for the use phase of commercial vehicles was performed as part of this study. These case examples help understand the state of nature and pressures as well as the situation of mobility and fuel use currently and in the future.

The two examples were chosen to represent two different economy types which is likely to have an effect on the situation of mobility and the corresponding pressures on nature.

Case example: Sweden

A. STATE OF NATURE

Sweden has a varied landscape with over 50,000 known plant and animal species. Forests make up the largest biome (58% land area) The country contains the largest area of old-growth boreal forests in Western Europe. Agricultural landscapes and grasslands are the other terrestrial biome types. Sweden is rich in wetlands and marine habitats.

References: State of Nature and pressures on nature[lxxii], Road area[lxxiii], GSMI[lxxiv]

B. PRESSURES ON NATURE

The UN Convention on Biological Diversity has identified the following key pressures on nature in Sweden. Some of these clearly relate with the commercial vehicles sector.

- Extensive logging of high value areas
- Agriculture intensification
- Climate change
- Road and off-road driving
- Marine – oil transport

References: Biofuels[lxxv]

C. POPULATION, MOBILITY AND GROWTH

Sweden has a low population density (25.5 inhabitants sq. km) and low growth in population (0.58%). Roads make 1% of the total land area of the country, and buses and trucks make a small proportion of all vehicles (4%). No major increase in the number of vehicles, or development of new roads is planned in the next decade. Sweden ranks #1 on the Global Sustainable Mobility Index (GSMI) based on the assessment of Universal access to mobility, safety, efficiency and Green mobility.

D. FUEL USE IN TRANSPORT: CURRENT AND FUTURE

Sweden's energy statistics indicate that a major share (70%) of the fuel used by the transport sector is fossil-based. About two-third of the transport sector energy use comes from road transport. Among EU countries, Sweden has one of the highest use of biofuels (26.4% in 2022) in the transport sector. The share of electrification is currently small (4.8%) but is likely to go up significantly in the coming years as the country is working towards the milestone of 50% of new vehicle registrations as electric by 2030. By 2045, Sweden's target is a 100% fossil free vehicle fleet.

Biodiesel derived from hydrotreated vegetable oils is the major biofuel type in road transport. Domestic production of biofuels is from waste but biofuel imports are large.

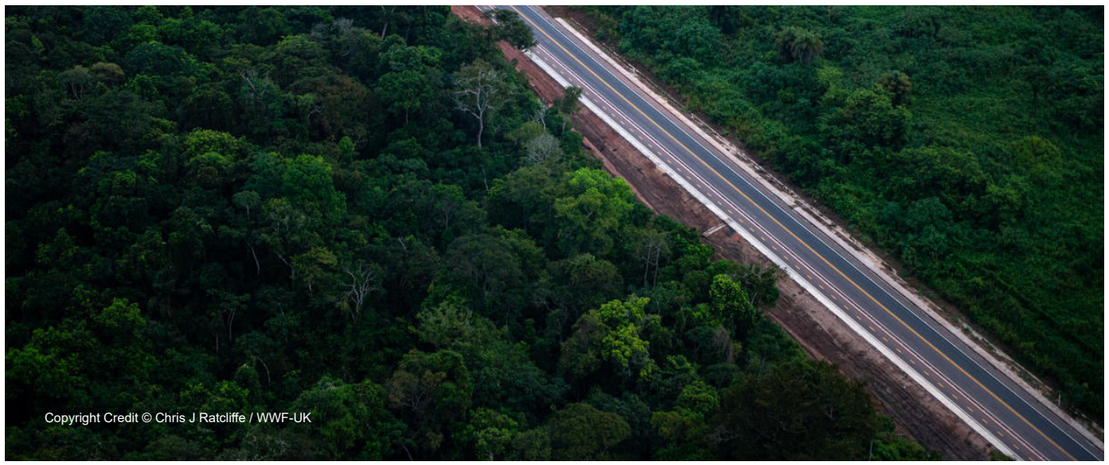
Clean energy sources (nuclear, hydropower, wind power) supply a major share of electricity. By 2040, the country aims to switch to 100% renewable energy so the share of nuclear power and fossil fuel is likely to come down significantly.

FUEL CATEGORY	% SHARE (2022 ACTUALS)	FORECAST (2027 AND BEYOND)
Fossil (gasoline, diesel, natural gas)	68.8	↓
Biofuels	26.4	↓
Electricity.	4.8	↑

Table 2: Fuel use in the transport sector in Sweden[lxxvi, lxxvii]

SOURCE	% SHARE
Hydro	41
Nuclear	29
Wind	19
Thermal (fossil + heat from industrial processes)	19
Solar	1

Table 3: Sources of electricity production in Sweden[lxxviii]



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Case example: Brazil

A. STATE OF NATURE

According to the Convention on Biological Diversity, Brazil is the most biologically diverse country in the world. It houses 15-20% of the world's biodiversity (about 147,000 species in all). Brazil has six terrestrial biomes and three marine biomes. It is home to Amazon – the world's largest rainforest and Pantanal – the world's largest tropical wetland.

Reference: State and pressures on nature

B. PRESSURES ON NATURE

The following are identified as the key pressures on nature in Brazil, some of which relate to the commercial vehicles sector:

- Fragmentation and loss of habitat
- Introduction of invasive alien species
- Over-exploitation of plants and animals
- Pollution and climate change

Reference: State and pressures on nature[lxxix]

C. POPULATION, MOBILITY AND GROWTH

Brazil is the fifth largest country in the world and has the seventh largest population. There is high concentration of population along the coastal regions and most people (over 85%) live in the urban areas. The road network is unevenly distributed and has highly variable quality. Only 12.4% of the roads are paved and about 20% are considered to be in bad or very bad condition. Brazil has a high dependence on trucks for road transport. The country has some of the largest and heaviest trucks in the world, which are known to contribute to the poor road quality (due to absence of required maintenance investments).

References: Infrastructure quality & trucks[lxxx]

D. FUEL USE IN TRANSPORT: CURRENT AND FUTURE

Brazil's energy statistics in the transport sector indicate a major reliance on fossil-fuels (75%). The remainder of the energy use comes from biofuels (25%). There is almost no existence of battery electric vehicles in road transport as of today.

There is a significant push to biofuels in the future through supportive policies on the use side, as well as supply side (through credit lines for sugarcane production and processing for examples). There is a significant support to R&D as well for biofuel production.

As a result, as Brazil works towards its net zero GHG emissions target by 2050, the share of biofuels in transport is expected to increase. Even as battery electric might come up in the future, it is expected to make a small share.

The main biofuel types for commercial vehicles are: (1) Biodiesel for trucks and buses derived from vegetable oils (70% share from soy, and the remaining from peanuts, castor, palm oil etc.) and bovine fat. (2) Bioethanol used in buses derived from sugarcane (1st generation ethanol) or sugarcane residues (2nd generation ethanol).

References: Fuel use in transport[lxxxi]

Summary, risks and opportunities for business

The case studies examined above make it clear that at the national level, the transformation of the transport sector is evident in the form of switch to electrification and increased use of biofuels. Different countries may, however, take a different pathway to transformation depending on the type of policies, as well as the availability and cost of fuel and infrastructure.

Each of the processes involved in the use phase, and the type of fuels deployed by commercial vehicles, has its impacts and dependencies on nature. These impacts and dependencies should be considered by businesses as they play a role in the transformation.

There are also significant opportunities to addressing the impacts on nature such as through ramping up recycling capacities for battery metals to ensure a 'closed loop' system is created.

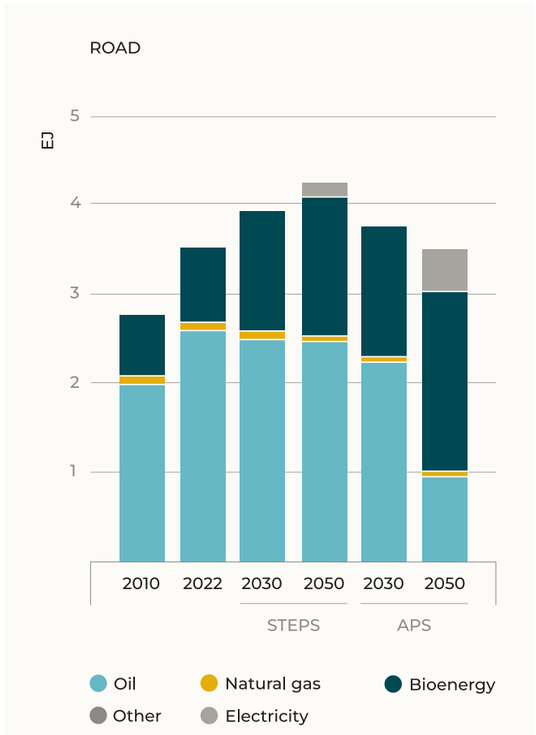


Figure 21: Fuel consumption in transport by type and scenario in Brazil. STEPS refers to Stated Policies Scenario, reflecting today's policy settings and APS refers to Announced Pledges Scenario, which assumes all pledges and targets are achieved in full and on time, including climate goals established by Nationally Determined contributions[lxxxii]

The role of businesses lies in:

1. Understanding the impacts and dependencies on nature and tailoring their products and processes to offer low impact solutions.
2. Work with consumers and policymakers to help transition towards more sustainable alternatives.

Businesses that fail to respond to the above may face risks such as:

1. Market risks from a reduced demand of products
2. Reputational risks from a high nature-impact linkage of their products
3. Regulatory risks such as fines and penalties.

CONCLUSIONS & KEY TAKEAWAYS

The study clearly demonstrates that several nature-related touchpoints (impacts and dependencies) exist throughout the commercial vehicles value chain. These impacts and dependencies create risks and opportunities for businesses in the sector which are key to examine as businesses take the first step on their nature stewardship journey.

The transformation of the commercial vehicles sector is driven by the decarbonization ambition, mainly through switch to low emission technologies such as BEVs. The transformation is expected to change the impacts of the sector on nature. A shift to BEVs for example will likely reduce the nature-related impacts from the use phase and logistics, in particular the impacts due to climate change. However, certain impacts, such as from resource-use and pollution, caused due to the increased need for mining minerals and the disposal of batteries may increase in the future (refer Figure 22). There are also significant opportunities to addressing the impacts on nature such as through ramping up recycling capacities for battery metals to ensure a 'closed loop' system is created.

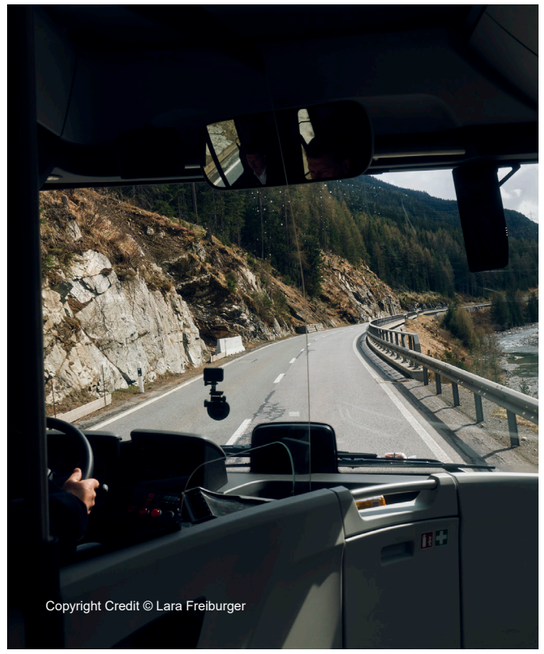
Further, it is noted that there are significant overlaps of the commercial vehicles sector's nature related needs with those of certain other sectors, such as equipment manufacture and clean energy. As there is growth in these sectors over time, the pressures on nature will increase. There will be a significant increase in the demand for battery metals and Rare Earth Elements (REEs) that are needed to power the clean energy transition across the world. This will pose heavy demands on nature.

Figure 22: An illustration to show how the pressures on nature would change as the world shifts from a major reliance on ICE powered vehicles to BEVs. The decrease of pressure is on account of the replacement of fossil fuels with electricity, and the reduced need for logistics. The increase is mainly attributed to increased mining and processing of metals, and the need for battery disposal. The arrows are indicative only (and not quantitative) of the changing pressures on nature.

Business risks are intertwined with risks to nature. Companies face physical, regulatory, reputational and market risks from the deteriorating state of nature, and can seize relevant opportunities such as tailoring their products, or working with suppliers to improve the state of nature. Specifically, three ways in which companies can act are:

1. By investigating their inter-relationships with nature, risks and opportunities. Based on such investigation, companies can develop nature-related strategies and action plans for working towards nature positive. Improved data and traceability can help companies perform such investigations at a more localized level. Some key areas that emerge from the study where company-specific investigation could be useful as the next step are:
    A. Supplier risk assessment, including those engaging in high impact processes such as battery manufacture and tire manufacture.
    B. Commodity risk assessments, such as for major metals (like aluminium, steel), battery metals and rubber.
    C. Assessing impacts on biodiversity from movement of vehicles, and linear infrastructure such as roads.
    D. Understanding the material flows after end-of-life of vehicles
2. Through internal action: by improving their policies, products and processes to reduce their impacts on nature. Improving internal awareness is a means to inspire cross-functional internal response.
3. Through external action: by working with other stakeholders, including suppliers, governments, consumers, industry peers and communities to protect and restore nature.

As companies take the next step in performing company-specific risk assessments and analyses, they can integrate measurement-based approaches to inform their actions.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WAY FORWARD

The above study lays the foundation for commercial vehicles sector players to act on and for nature. It recognizes that while the transformation of the commercial vehicles sector is underway, there is much work to be done in order to make it sustainable on all fronts. The study also clarifies where the focus of the sector must lie, in order to make the transformation sustainable.

Even as it manifests locally, nature is a global issue. It requires action at scale. The magnitude of the challenge means that the sector players must act urgently and use their collaborative power to bring scale to their action. This is also a unique opportunity to apply the lessons learnt from past developments, such as from globalizing the decarbonization movement and to learn from the other sectors.

As sector players explore their pathway to nature action, there are key areas where collaborative approaches can help companies move forward faster. For example,

- Availability of high quality and open access data such as on supply chains
- Identifying standards for operational practices in own operations and supply chains
- Learning and sharing of best practices and experiences
- Sector benchmarks and commitments
- Influencing the rapidly evolving regulatory landscape

WWF and TRATON call for the alignment of efforts across sector players and organizations so more informed and effective action on nature can be taken. Clearly, the time for nature is now, and collaborating is the best way forward.

APPENDIX I

Definitions and details of Risk Filter Suite (RFS) indicators.

1. **Ecosystem condition**
Ecosystem condition indicates whether the natural environment is intact and connected. Poor ecosystem condition can result in businesses having restricted access in the long-term to the quantity and quality of resources and enablers needed for their activities as well as other ecosystem services they rely on. The ecosystem condition indicator has been calculated separately for terrestrial, freshwater and marine areas. Terrestrial: Biodiversity Intactness Index and Functional Connectivity of the Worlds Protected Areas were used. Freshwater: Fragmentation Status of Rivers has been used, and Marine areas: Ocean Health Index' habitat condition data for six marine ecosystems was considered. Areas of very high risk are estimated to have low levels of ecosystem intactness (below 70% or 82% for terrestrial and marine areas, respectively) and low levels of connectivity (high fragmentation of rivers and low mammal movement probability).

2. **Ecosystem services status (for water)**
Ecosystems provide business, people and communities with a wide range of goods and services such as climate and streamflow regulation, water purification, species habitats maintenance, balance of soil biodiversity, pests and diseases, among many others. Therefore, the degradation of ecosystems can result in businesses having restricted access in the long-term to the quantity and quality of water needed for their activities as well as other ecosystem services they rely on. The Water Risk Filter risk category ecosystem services status is informed by indicators of fragmentation status of rivers (i.e. Connectivity Status Index – CSI); catchment degradation (i.e. forest loss, as forests play an essential role in terms of water regulation, supply and pollution control); wetland degradation, freshwater invasive species and river extent change.

3. **Forest canopy loss**
This indicator measures forest canopy loss. Land- and sea-use change is the major human influence on habitats. Habitat loss is one of the biggest threats to biodiversity and is the number one reason species go extinct. For this indicator, only forest canopy loss since 2020 was taken into account. A very high risk score indicates an average forest canopy loss of over 8%.

4. **Forest productivity**
This indicator refers to aspects of productivity and commercial access to timber – more specifically the total potential sustainable supply of timber as well as aspects of accessibility for commercial timber harvesting and availability of infrastructure for the subsequent transport to markets. This indicator was calculated on the basis of relative realised timber services indices (RRTS) – a function of potential commercial timber (calculated from dry matter productivity, above-ground carbon stock and fractional tree cover) within 6 hours travel time of a population centre of >50K people and on slope gradients <31.5 degrees (70%) considered to be workable for logging. Areas of very high risk are estimated to have no realizable timber provisions due to unavailability and/or inaccessibility of the resource.

5. **Flooding**
Flooding is when there is an overflowing of water onto land that is normally dry. Floods can happen due to overflowing rivers, lakes, or oceans, and are often caused by heavy rainfall, rapid snowmelt, when dams or levees break, or a storm surge from a tropical cyclone or tsunami in coastal areas. The Water Risk Filter risk category flooding considers historical patterns based on empirical evidence of large flood events since 1985 to present, derived from a wide variety of news, governmental, instrumental, and remote sensing sources. And flood depth within a 100-year-flood-prone extent.

6. **Labour/Human Rights**
Labor and human rights are the basis of just working conditions for employees. This indicator aims to give a first insight into regional discrepancies in labour and human rights situations. The indicator is based on the V-Dem civil liberties index, which provides an estimate of the extent to which people are free from government torture, political killings, and forced labour, they have property rights, and enjoy the freedoms of movement, religion, expression, and association. Areas of very high risk are those where its inhabitants are most deprived of human rights.

7. **Land, freshwater and sea use change**
This indicator measures cropland expansion, river fragmentation and pressures on marine environments through shipping and direct human impact. Land- and sea-use change is the major human influence on habitats. Habitat loss is one of the biggest threats to biodiversity. This indicator includes data from terrestrial, freshwater and marine environments. Areas of very high risk experienced high percentages of cropland expansion (>12%) and a high fragmentation of rivers; or high pressure from shipping and direct human impact.

8. **Landslides and tropical cyclones**
This is a derived indicator, that is based on the occurrence of high risk of either or both of the two RFS indicators – Landslides, and Tropical cyclones. The landslides indicator assesses the potential threat of rainfall- and earthquake-triggered landslides. Landslides have become more prevalent because of anthropogenic disturbances, such as land-cover changes, land degradation and expansion of infrastructure. These are further exacerbated by more extreme precipitation due to climate change, which is predicted to trigger more landslides and threaten sustainable development in vulnerable regions. Areas of very high risk have a high landslide susceptibility according to rainfall patterns, terrain slope, geology, soil, land cover and (potentially) earthquakes that make localized landslides a frequent phenomenon.

   The tropical cyclone indicator assesses the predicted maximum wind speed (mph) on a 50-year return period. This indicator is based on GFDRR's tropical cyclonic strong wind and storm surge model, using information from 2,594 historical tropical cyclones, topography, terrain roughness and bathymetry. Areas of very high risk are predicted to experience very high maximum wind speeds (>120mph) on a 50-year return period.

9. **Limited wild flora and fauna availability**
This indicator refers to the unavailability of commercially harvested species. Wild species are used in many applications, including for medicinal, cosmetic, aromatic and genetic purposes. They are used globally as feed, fibre (e.g., for clothing, building materials, etc.), fuel, medicines and food ingredients. Overexploitation is one of the main threats to nature, but the intensity of this threat varies geographically. Areas of very high risk are estimated to experience high intensity of unsustainable commercial harvesting.

10. **Media scrutiny**
Media scrutiny indicates whether there has been documented negative news (e.g., incidents, criticism and controversies) related to environmental and social issues that can affect a company's reputational risk. For this indicator, RepRisk's country weighted score of negative news for all ecological and social tags was used. Areas of very high risk have many incidents with high severity ratings related to environmental or social issues.

11. **Plant/forest/aquatic pests and diseases**
This indicator assesses the potential threat from transboundary animal and plant pests and diseases. As genetic and species diversity is lost and ecosystems are degraded, the complexity of the overall system can be compromised, making it more vulnerable and potentially creating new opportunities for disease emergence. Emerging diseases include transboundary animal and plant pests and diseases, including forest/timber pests and aquatic animal diseases. Areas of very high risk have a very high number (>42) of forecasted transboundary animal and plant pests and diseases.

12. **Pollution**
This indicator is based on nutrient, pesticide, plastic and air pollution. Areas of very high risk have high levels of nitrogen and pesticides per hectare of cropland (>77kg/ha; >5.9kg/ha, respectively); high total N concentrations in freshwater (>2.6mg/L); high amounts of mismanaged plastic waste (> 2000 kg/year/km2); a very high nutrient and chemical pollution impact score in marine areas (>0.156); elevated emissions of plastics from rivers to oceans and high floating plastic concentrations in ocean waters (>1000 tons/year and >150 grams/km2, respectively); experience more than 50 mg/m2 of PM 2.5.

13. **Proximity to biodiversity critical areas**
This is a derived indicator that is used to indicate a high risk with respect to one or more of the three indicators contained in the RFS: (1) proximity to Protected/Conserved areas. UNEP-WCMC's World Database of Protected Areas (WDPA) was used in this case (2) Proximity to Key Biodiversity Areas. The dataset on Key Biodiversity Areas contained in the IBAT was used in this case (3) proximity to other important delineated areas. This is based on WWF Global 200, Intact Forest Landscapes, Ecologically or Biologically Significant Marine Areas (EBSA) and Vulnerable marine ecosystems (VMEs) database.

14. **Sites of international interest**
This indicator is based on overlap with Natural World Heritage Sites and Ramsar sites. World Heritage sites are a collection of unique and diverse places that encourage nature conservation and the preservation of cultural properties. Ramsar sites highlight important wetlands and encourage their wise use. Assessment units of very high risk overlap with both Natural World Heritage Sites and Ramsar sites.

15. **Water scarcity**
Water scarcity refers to the physical abundance or lack of freshwater resources, which can significantly impact a company through production or supply chain disruption, higher operating costs and growth constraints. Water scarcity is human-driven and can be aggravated by natural conditions (e.g., aridity, drought). It is generally calculated as a function of the volume of water used relative to the volume of water available in a given area. The indicator of the RFS integrates seven datasets and modelling approaches: aridity index, water depletion, baseline water stress, blue water scarcity, available water remaining, drought frequency probability and projected change in drought occurrence.

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ABOUT WWF AND TRATON GROUP

WWF is an independent conservation organization, with over 40 million followers and a global network active through local leadership in over 100 countries. Our mission is to stop the degradation of the planet's natural environment and to build a future in which people live in harmony with nature, by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption. Find out more at panda.org.

As part of its effort to achieve this mission, WWF works in partnership with companies based on a common understanding of issues, shared ambitions or activities, and a willingness to speak out in public.

With its brands Scania, MAN, International, and Volkswagen Truck & Bus, TRATON SE is the parent and holding company of the TRATON GROUP and one of the world's leading commercial vehicle manufacturers. The Group's product portfolio comprises trucks, buses, and light-duty commercial vehicles. "Transforming Transportation Together. For a sustainable world.": this intention underlines the Company's ambition to have a lasting and sustainable impact on the commercial vehicle business and on the Group's commercial growth.

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For further information about the report, please reach out to business@wwf.se and media@traton.com.

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