SDG 13 – The impact of the German automotive industry on decarbonizing the sector

A Qualitative Assessment based on German Companies

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Abstract

In the context of climate change and increasing demand for sustainability, the Sustainable Devolvement Goals are more important for businesses than ever. The targets set by the United Nation are a complex system of interlinked goals, which require great commitment and understand to serve their purpose. As greenhouse gas emissions play a crucial role and the automotive sector is among largest contributors, this thesis thrives to analyze the impact of the sector on the achievement of the sub-targets of SDG 13. As current research is mainly focusing on the general contribution of businesses to SDG 13, this dissertation focuses on individual methods and critical challenges of the German automotive industry, as the leading country in the sector. To validate relevant theory in the automotive sector, data has been collected through a comprehensive review of Literature on the role of businesses and the automotive sector to reduce GHG emissions and contributing to SDGs. The literature is complemented by interviews with industry experts – from different sectors engaging with the automotive branch. Analyzing the outcomes highlights the importance of the Germany in the transformation process as well as the need for close engagement with stakeholders. Nevertheless it also reveals the dependency on other sectors such as the energy and raw material industries.

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Abstrato

No contexto das alterações climáticas e da crescente preocupação com os temas da sustentabilidade, os Objectivos de Desenvolvimento Sustentável são mais importantes do que nunca para as empresas. Os objectivos estabelecidos pelas Nações Unidas são um sistema complexo de objectivos interligados, que requerem grande empenho e compreensão para servir o seu propósito. Como as emissões de gases com efeito de estufa desempenham um papel crucial e o sector automóvel está entre os maiores contribuintes, esta tese procura analisar o impacto do sector no cumprimento dos objetivos do SDG 13. Enquanto a investigação existente se centra principalmente na contribuição geral das empresas para o SDG 13, esta dissertação centra-se em métodos individuais e desafios críticos da indústria automóvel alemã, como país líder no sector. Foram recolhidos dados através de uma revisão abrangente da literatura sobre o papel das empresas e do sector automóvel na redução das emissões de GEE e na contribuição para os ODS. A literatura é complementada por entrevistas com peritos da indústria - de diferentes sectores envolvidos no ramo automóvel. A análise dos resultados salienta a importância da Alemanha no processo de transformação automovel, bem como a necessidade de um estreito envolvimento com as partes interessadas. A analise realizada revela ainda a dependência de outros sectores, tais como as indústrias da energia e das matérias-primas.

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Palavras-chave: Empresa Responsável, Objectivos de Desenvolvimento Sustentável, Sector Automóvel Alemão, Estratégia, Adaptação, Teoria das Partes Interessadas, Cadeia de Abastecimento

Table of Contents

1. Introduction

Since Industrialisation, humankind has been conducting actions that significantly impact our world and the environment we are living in. We live in an "uncertain world" – as the US Military College describes, the environment is changing due to increased Volatility, Complexity, Ambiguity, Uncertainty created by political, technological and economic processes implemented by our society (van Tulder, 2018).

Businesses have hard times adapting to those challenges and properly assessing risk due to rapid changes. Planning on a long-term horizon is becoming more and more crucial to sustain our planet as we know. There is an urgent need for humanity to change how we treat our world, our home drastically. If businesses do not adapt to change and continue to do business as usual, the situation will become worse. To conquer climate change, we as individuals and companies that form our way of consuming things and services need to adapt. A great effort in innovating and recreating business models as they existed and to align efforts in developing and enhancing education, business models, infrastructure and ways of transportation is needed.

As we speak of transportation – several ways of transportation make up the major amount of total global CO2 and Greenhouse Gas Emissions. The Automotive industry makes up the central part. Therefore, it is of great need for the automotive sector to adapt to change and drastically reduce emissions within their powertrain and more critical, along the whole value chain.

The European Union itself is the third-largest emitter of Greenhouse Gases globally. In 2018, international and national transportation accounted for 32% of Emissions with the automotive (light and heavy vehicles), of which passenger cars accounted for 15% being the largest emitter of greenhouse gases in the European Union ("European Commission", 2022). With Germany being known for its innovativeness and prestige of their automotive industry and producers belonging to the top 15 carmakers worldwide, Germany's automotive industry could lead the European Union in cutting Greenhouse Gases within the sector. However, they need to keep track of new entrants due to the changing business environment (Krpata, 2021).

On 25th September 2015, the United Nations introduced the 17 Sustainable Development Goals (SDG) as the predecessor of the Millennium Goals from 2000. Those targets should be used as a guideline for individuals and other social actors such as businesses to achieve the

targets set by the UN collectively. As Ban Ki-Moon, the United Nations Secretary, states: *"Business is a vital partner in achieving the Sustainable Development Goals, Companies can contribute through their core activities and we ask companies everywhere to assess their impact set ambitious goals and communicate transparently about the results."* ("The SDG Compass | UN Global Compact", 2021).

The targets create new opportunities but also challenges that need to be used and overcome by businesses. Nevertheless, there is a lack of success in achieving the SDGs. Scientists urge that rapid and fundamental actions are needed to transform and change our society. Otherwise, the Sustainable Development Goals cannot be achieved (Sinkovics, Sinkovics & Archie-Acheampong, 2020). The greatest challenges remain; decreasing emissions and sustainable consumption of our planet's resources are of great need.

Following, this thesis thrives to research the Automotive Sector in Germany, a key sector in producing emissions, and its impact on the SDGs, more precisely the contribution on SDG 13 – "Climate Action", which calls for the reduction of Greenhouse Gases.

2. Context

2.1 Climate change and the UN Paris Agreement

By the end of 2015, during the 21st Conference of Parties, member parties (195 nations) drafted a holistic agreement that emphasized the urgency to combat climate change. The purpose of the agreement is to "address the significant gap between the aggregate effect of Parties' mitigation pledges in terms of global annual emissions of greenhouse gases by 2020 and aggregate emission pathways consistent with holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels" (United Nations & Framework Convention on Climate Change, 2015). The agreement further emphasizes the reduction of GHG emissions by increasing efforts in research and development, capacity building and further increased financial efforts by developed countries. Additionally, access to sustainable energy should be guaranteed by the member countries. In 2016, the UN Secretary General, Mr. Ban Ki-moon, signed the Paris Agreement and the largest amount of members ever signed an agreement in one day (Gonzalez-Perez, 2016). The agreement included:

1. Limiting the temperature increase by 2°C above pre-industrial levels by 2030
2. The limitation of global emissions as soon as possible
3. And assume a fast reduction, according to the best available science

Setting those targets should act as a guideline for governments to adjust their policy and companies to help them develop a more sustainable strategy for their operation and motivate both to approach climate-neutrality in the future. Moreover, keeping the climate in a certain range of our pre-industrial levels is one necessary goal, which is a precondition for achieving Agenda 2030, which is outlined in the following paragraphs.

2.2 Agenda 2030: The Sustainable Development Goals

As humankind faces multiple global challenges that impact society's well-being, economic prosperity, and environmental protection, the European Union introduced the Sustainable development goals to set the 2030 agenda and guide society, corporations, and governments to achieve a better world by 2030 collectively. As a result, the 2030 agenda for a sustainable future has been accepted in 2015 by all UN – Member states and provides a blueprint on how to conquer current issues related to the planet and society to ensure a peaceful and sustainable present and future. At the heart of the "2030-Agenda" are the 17 interlinked sustainable development goals formed by the UN, countries and especially the "UN Department of Economic and Social Affairs". The 17 goals presented by the United Nations are an urgent call for action for everyone to ensure the future for our planet.

The SDGs consist of 17 individual goals, each contributing to an individual issue society is facing:

Source: https://www.ifad.org/de-DE/web/guest/ifad-and-the-sdgs

The goal of the SDGs is to create a common understanding of global sustainability challenges and to underline that this challenges are all depending on each other. The SDGs are addressing everyone and every stakeholder – states, society, businesses and scientists – to

collectively achieve goals and targets set within the SDGs (Mio, Panfilo and Blundo, 2020). Companies started integrating sustainability into their operation far before the introduction of the SDGs. Ever since, businesses have developed innovative new solutions to approach environmental and social issues, as their stakeholders demand it. As climate change is getting more urgent, stakeholders' demand shifts towards more sustainable and social companies, which enables new and existing corporations to exploit new market opportunities and in fact, to gain a competitive advantage by successfully aligning with the SDGs.

2.2.1 Sustainable Development Goal 13 – Climate Action

From the above listed 17 SDGs, this paper will focus on "SDG 13 – Climate Action" and how companies can adapt to meet those targets and contribute to a more sustainable world. The Sustainable Development Goal 13 is among the most relevant ones for the conservation of our planet and avoiding irreversible consequences to our climate system.

To address "Climate Action", the goal is defined as follows:

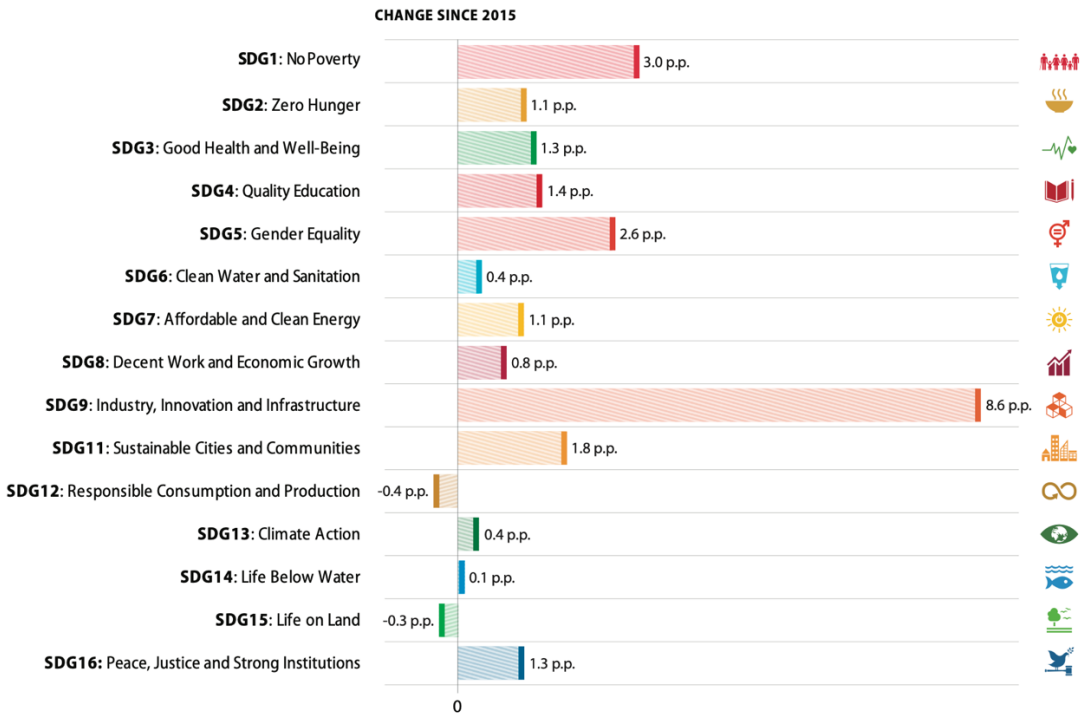
"*Take urgent action to combat climate change and its impacts."*

The general reference of SDG 13 is used as an umbrella term for several sub-goals which aim to guide stakeholders to contribute to the goal successfully. The sub-goals are formulated as follows ("Goal 13: Climate action - The Global Goals", 2022):

- ***Target 13.1:*** *Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries*
- ***Target 13.2:*** *Integrate climate change measures into national policies, strategies and planning*
- ***Target 13.3:*** *Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning*
- ***Target 13.4a:*** *Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly $100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible*
- ***Target 13.4b:*** *Promote mechanisms for raising capacity for effective climate change-related planning and management in the least developed countries and small island*

developing States, including focusing on women, youth and local and marginalized communities

But how are businesses able to contribute to the SDG? To work towards the goal to stop climate change, businesses can contribute to the following SDG by decarbonizing their value chains and operations by reducing Greenhouse gas emissions and increasing energy efficiency. Additionally, it is the role of businesses to provide customers with products, where effort is made to reduce the carbon footprint of their products or services. The SDG Compass addresses four different themes for businesses which are addressed by SDG 13: Businesses should increase their energy efficiency throughout all processes, increase their investments in environmental related topics, reduce their GHG emissions not only for the business but also for the users/customers and ultimately assess risks and opportunities which are related to climate change ("The SDG Compass | UN Global Compact", 2021). So far, the economy could not align its operation with the reduction targets. The Sustainable Development Report form 2021 indicates that SDG 13 is among the worst-performing SDGs in percentage terms since 2015:



Source: Sustainable Development Report 2021, Cambridge University

As the average global temperature remains 1.2°C above the pre-industrial baseline, measured in 2020, SDG 13 remains among the most crucial goals stated by the European Union (Januta,

2021). To stay at or below a 1.5°C temperature increase, as called by the Paris Agreement, SDG 13 calls for carbon neutrality and an increased effort in climate finance.
The econsense members also highlight the importance of SDG 13, within their ranking "Top 5 SDGs for Business Case" (Econsense.de, 2017):

Source: Econsense.de, 2017

Environmental sustainability reduces greenhouse gases and other emissions which pollute the environment. It also requires a sustainable use of resources (energy, water, raw materials), reducing waste and increasing recycling efforts of waste and products at the end of their life cycle. Keeping track of all these aspects does contribute to the 17 SDGs. Still, for the research at hand, there is a special focus on avoiding greenhouse gas emissions, especially CO2, which corresponds with SDG 13 – Taking immediate Climate Action.
Therefore, the industry separates the following three scopes of emissions (Umweltschutz in der Produktion, 2021).

3. Literature Review

The following chapter will provide a comprehensive literature review on the importance of the sustainable development goals and the role of businesses in their achievements. It will describe management theories that can help industries understand and adapt to their role as contributors. The review will be based on the pillars of acting as a responsible business. On

this basis, we will discuss the managerial and theoretical implications of the following research.

3.1.1 Responsible Business

To align the goals of the SDGs with corporate strategy, businesses need to change the way they do business. They have to stop doing business as usual and commit to the change and adapt their business to serve changing needs of several stakeholders involved in their business. Engaging with the stakeholder environment will ensure future business feasibility (Hammann, Habisch & Pechlaner, 2009). The "Responsible Business" theory describes how businesses can have a real impact while taking responsibility for their actions.

The research center at Católica Lisbon School of Business and Economic responsible for the field of Responsible Business and Leadership frames a responsible business as follows: "Companies that have sustainability at the core of their business strategies, always embracing an integrated view of the relevant stakeholders' interests, sharing the same broader purpose, to advance society's well-being". Following the research of the "Responsible Business and Leadership Center", integrating sustainability at the core, creating shared value, engaging stakeholders and being purpose-driven are the main drivers of acting as a responsible business (Center for Responsible Business And Leadership, 2020). Following the paper, the strategy needs to be at the core of business operations to have an impact: "*There are no sustainability strategies, sustainability is the strategy* ."The concept of shared value was developed by Porter & Kramer in 2011 and is defined as the ability to improve competitiveness while contributing to societal and economic aspects. This leads directly to the engagement of stakeholders and other societal actors, which M. Freeman already describes as a necessary condition for long-term success under his stakeholder theory (Appendix 2). All stakeholders need to be respected within the decision-making process of businesses, while financial performance should never come at the cost of ignoring stakeholder demands (Hollensbe et al., 2014). And finally, a responsible business should be purpose-driven, which means generating profits while using the proceeds for the greater good and balancing economic performance and societal contribution.

The following chapter will outline the role of sustainability as a strategy for corporations.

3.1.2 Corporate Sustainability

Corporate sustainability is defined as respecting and dealing with the demand of direct and indirect stakeholders without harming those of future stakeholders. To achieve this goal, firms have to preserve their environmental, social and economic capital, while growing their contribution to a sustainable environment.

From this definition, we can derive the "triple bottom line" theory, which implies respecting economic, ecologic and social factors when setting business targets. Integrating the three elements into business strategy and operations. The theory implies that a sole focus on economic sustainability might positively impact in the short-run but will not succeed in the future. To be successful, all three elements have to be incorporated into operations as they are strongly dependent on each other and therefore need to be addressed simultaneously (Dyllick & Hockerts, 2002).

The business environment has gradually changed: Companies focused on short-term capital gains on stock markets that are not in line with sustainability. The Concept of Sustainability has a long-term focus and accounts for the costs of social degradation (Dyllick & Hockerts, 2002). Companies should disregard the focus on short-term profits and focus on the long-term value they can create for themselves and the industry to ensure future survival.

3.2 Stakeholder Theory

In 1984, E. Freeman developed a theory that focuses on the importance and the engagement of different stakeholder groups. The Stakeholder Theory is based on organizational management and business ethics, which has to account for entities they are impacting and vice versa. They have to consider employees, suppliers, governments and financial institutions as their future ability to conduct business is based on the perception of those stakeholders. As E. Freeman states, a firm needs to account for all those groups (Appendix 2), that can affect or are affected by organization's actions. Therefore, each stakeholder group plays a role in the success of business operations. Managers have to understand each group and develop a strategy for each of them and integrate those insights at the core of the corporation's overall strategy (Freeman, 1984).

The following paragraphs will highlight the aspects of responsible business and stakeholder theory to connect the importance of businesses for the SDGs.

3.3 The Role of Businesses in Achieving the SDGs

As businesses impact society in nearly every situation, they are seen as social actors. As a social actor, it is crucial to guide society and act responsibly. Introducing the SDGs is far more than a guideline for social actors, and it is an urgent call for a "paradigm shift" of businesses. The SDGs are not only creating challenges and opportunities; the aim is to involve businesses and guide them to successfully contribute to achieving the Sustainable Development Goals (van Tulder, 2018).

As per nature, the Sustainable Development Goals are approaching complex interconnected problems, and are called 'wicked problems'. To conquer those problems and turn them into opportunities, it is important that social actors such as governments, civil society organizations and the private sector take advantage of complementary capabilities across sectors, with each player taking responsibility (van Tulder, 2018). To achieve those targets, each actor: State, the Civil Society and the Market must take responsibility and avoid harming the environment. Taking collective actions is of greatest need for a successful implementation. So strong cross-sector partnerships are needed to exploit those opportunities and are essential for sustainable development. Businesses need to spot those opportunities and engage in necessary partnerships to avoid harm and do good – not only businesses but also each sector has to engage in opportunity spotting and proper risk management.

Active participation of businesses is perceived as crucial for reaching the SDGs. But how can they contribute to the SDGs?

As stated by van Tulder (2018), Corporations are essential to tackle so-called wicked problems due to the below-listed reasons:

- *Businesses can leverage on their capability to extend their activities across sectors, borders and products*
- *Innovation is driven by their willingness to take risk*
- *After governments, corporations invest the most in technology*
- *They can introduce new business practices on their own or in cooperation with others*
- *The tackle rudimentary needs of people and deal with individual challenges by deploying their entrepreneurial mindset – while taking responsibility for costs and rewards*
- *Businesses create jobs, products and services.*

- *Since corporation play a central role in networks, technology and sectors, they can be a great hurdle for change if they are not involved in the process*
- *They are able to deploy scalable and immediate financial resources through open stock markets and other financial tools*
- *Through competition they create efficiency on the market which is a driver for cheaper and better solutions of existing products and services*
- *They are aimed at investments rather than subsidies*

These factors potentially enable corporations to contribute to the SDGs and provide added value to society. But several factors impact the positive effect of any measures taken, such as *the wickedness of a problem, the regulatory environment, competitive environment, technology and consumers' willingness to pay.*

Therefore to effectively contribute to SDGs, businesses must move from narrow business models to broader business models to incorporate sustainability at the core of their strategy, such as a circular or inclusive economy model (Appendix 1).

At the end of the life cycle, goods are turned into resources for other things, closing cycles in the economic world while minimizing waste. This concept changes the economic production process into sufficiency. A study shows, that implementation of a circular economy into the European Union would reduce greenhouse gas emissions by up to 70% and has the potential to increase the workforce by 4% (Stahel, 2016)

To approach the correct implementation, businesses are facing complex decision problems. Van Tudler (2018) defines a framework on how companies can better contribute to the SDGs. He highlights four crucial factors for a successful implementation:

Reversing Materiality

He states that the potential of the SDGs can only materialize if they are embedded in the strategy in a forward-looking manner. The materiality of a business's defines how important challenges and issues are for operations. The biggest challenge here is translating theory into practice and stopping using SDGs to greenwash the business without linking to the core business (van Tudler, 2018). To contribute to the Sustainable Development Goals, the private sector has to move from a reactive position towards a more proactive one by approaching corporate social obligation (Scheyvens, Banks & Hughes, 2016; van Tudler, 2018). Companies must adapt their materiality analysis using the SDGs to move from present

problems towards future opportunities. Nevertheless, the overall commitment is low. Businesses tend to use the SDGs as a communication tool but do not incorporate them into strategy and operations (van Tudler, 2018).

Partnering Challenge

Partnering is crucial for radical and disruptive innovation. Partnering with incumbents from the same sector or others who have similar priorities creates an environment that supports innovation. Those partnerships can speed up sustainable innovation across all sectors by changing the rules of the game (van Tudler, 2018). Combining complementary skills, resources and technologies will create new market solutions. Partnerships among several industry leaders have the potential to raise standards across the whole industry and to overcome shared challenges. Additionally, it gives them more bargaining power across their common value/supply chain. Integrating non-market partners such as governments allow businesses to overcome complex problems, such as 'wicked problems' ("The SDG Compass | UN Global Compact", 2021).

Creating strategic fit and license to operate

Businesses need to start with partnership portfolio management to monitor the internal and external alignment of partnerships actively. This is important to overcome the challenge of matching the company's strategic fit of the partnership's portfolio and the challenges they have to overcome. The challenge related to the strategic fit of partnerships with four decision making dimensions: *(1) what to produce; (2) with whom to produce; (3) where to produce; (4) what next to produce.*

The license to operate is defined by the products and activities a company is producing and that there are no controversial or unethical products. Moreover, their positioning toward their stakeholders is responsible for earning a license to operate.

Sequencing: SDG alignment

The Sustainable Development Goals create an opportunity for companies to engage proactively with their stakeholders. It implies that companies move from an inside-out approach to an outside-in approach, taking societal needs as materiality. Businesses should prioritize their challenges as a risk-management strategy and consider future possibilities/ opportunities as part of an opportunity-seeking strategy.

Reversing materiality is needed to engage with the SDGs – there are seven principles that guide companies to implement reversed materiality as a condition for engaging with the SDGs.

1. *Depart from societal needs and ambitions as defined by the SDGs*
2. *Make a gap analysis*
3. *Asses present materiality*
4. *Define present and potential spill-over effects*
5. *Assess your stakeholder portfolio*
6. *Define a future agenda*
7. *Connected leadership challenge*

But as businesses need to gain from investing in SDGs, the following paragraph highlights how businesses can take advantage of participating in the contribution of the SDGs.

3.4 Why do SDGs matter for businesses?

SDGs help businesses connect their operations with critical factors demanded by society. Companies can use the SDGs as a framework or guidebook to adapt their strategies to changing externalities and thereby capitalize on future opportunities given through the SDGs.
Companies can gain from strong integration of the SDGs by identifying future businesses opportunities. SDGs might open new markets through the redirection of public and private investments, which lead to innovation and transformative change for industries.
Second, they can increase the value of corporate sustainability as the SDGs do increase the economic feasibility of sustainable use of resources. Additionally, they can strengthen their stakeholder relationships and keep up with policy development by integrating the SDGs. As stakeholders and policymakers demand more sustainable business models over time, those who do not adapt to those changes will face legal and reputational pressure.
Moreover, as the environment changes and global concerns destabilize markets, investing in SDGs and adopting strategy and operation will strengthen societies and markets. A stable economic environment is a precondition for businesses to be successful.
Lastly, SDGs provide a common framework for all societal actors and help businesses engage with their stakeholders and potential partners to conquer global societal challenges ("The SDG Compass | UN Global Compact", 2021).

3.5 Relevance of the Automotive Sector to the SDGs

In 2020, the author Lisowski et al.(2020), states that the progress in 2020, after five years of SDGs, is insufficient with severe performance gaps in climate change and biodiversity. As implemented during the introduction, the automotive sector is among the largest contributors to global warming/ climate change and greenhouse gas emissions. But it is caused not only by the power train of sold cars, but also by production and especially materials sourced by OEMs to manufacture cars and car components. Being one of the most relevant industries for the private sector, the automobile industry can have a significant influence on the SDGs. The automobile sector has a huge international impact as multinational corporations and global presence. It can offer a variety of benefits and actions to contribute to the SDGs substantially: *modern mobility options, driving economic growth, social security for employees, influence on global supply chain, and production facilities, sustainability awareness and actions (electrification and decarbonization)* (Lisowski et al., 2020). Synchronously, the automotive sector belongs to the largest contributors to global CO_2 emissions. In 2018 road transport accounted for 18% of global CO_2 Emissions. And in 2017, road transport in the European Union accounted for 19% of greenhouse gases and 28% of NO_X, another gas polluting the air. Additionally, focusing on electrification to cut fuel and reduce vehicles' emissions is causing social and environmental problems in the supply chain, especially during the mining of raw materials (Lisowski et al., 2020). This is one of the most relevant examples for the successful contribution towards one SDG without harming others.

3.6 Circular Economy in the Automotive Industry

As highlighted above, adopting a circular economy model is one-way businesses can incorporate compliance with the SDG into their business. Especially in the light of electrification of the powertrain, circular economy plays a significant role for the automotive sector. The Circular economy is technology-driven and economically profitable and aims to create a sustainable future. It aims to address environmental and socio-economic issues in the future by transforming waste into resources and closing life cycles of products. Resources are becoming scarcer and therefore a sustainable usage of them is of great importance. For the automotive industry raw material supply is one of the biggest challenges they have to overcome.

The automotive sector produces 85 million new cars every year, with $7 trillion worth of them being unused. And here, we can apply a circular economy model to use this waste a recycle resources to create a new car. Additionally, resources used by the automotive sector are high in emissions – they have to rethink their choice of structural materials to uncover the potential of a circular economy fully.

Electric Vehicles account for 7% of sales of passenger cars worldwide, according to McKinsey & Company, which is about to increase heavily due to growing demand and regulation. The use of lithium and other resources is creating new challenges in waste and resource management. It is essential to recapture and reuse lithium and other raw materials used for technological innovation, close the life cycle of automotive vehicles, and reduce emissions and waste to manage resource scarcity (Buruzs and Torma, 2017).

3.7 Strategic and Operational Change

Porter's Framework of the Five Forces can be used to evaluate changing businesses environment and to define potential challenges. To adapt to those changes, corporations need to adjust their strategies, operations, and ways of thinking to survive in the competitive environment successfully and, moreover, to continue adding value to society. Strategic change is a concept developed to describe the process of businesses adjusting their strategy to changes in the external environment (Hofer & Schendel, 1978; Rajagopalan & Spreitzer, 1997). Thus the ability to adapt to changes is a major driver of firms' overall performance and forces them to align strategy with the external environment. Therefore, the strategy's impact and appropriateness are defined by externalities and, moreover, the abilities of a corporation to adapt. A lack of adaptation will thus lead to significant performance declines and, therefore, might be the most crucial of the strategic management of a corporation.

But different businesses do react differently to changes within their environment and deploy different strategic changes to adapt to the new conditions. There are different reasons that explain companies' ability to adapt to those changes: Dynamic Capabilities are one of them and show the ability to deal with a changing environment. Following dynamic capabilities are a crucial source of competitiveness of businesses and enable companies to change the strategy according to externalities and appropriately adopt businesses models to it (Teece, Pisano, & Shuen, 1997).

Dynamic capabilities are the managerial and organizational ability to adjust the resource base of a corporation by recombining or exchanging resources to develop new value-creating

strategies for a new external environment (Eisenhardt & Martin, 2000). Eisenhardt and Martin (2000) define Dynamic Capabilities as follows: "*The firm's processes that use resources—specifically the processes to integrate, reconfigure, gainand release resources—to match and even create market change. Dynamic capabilities thus are the organizational and strategic routines by which firms achieve new resource configurations as markets emerge, collide, split, evolve, and die*."

Thus, Dynamic Capabilities describe the ability of a corporation to adjust their businesses strategy, operation and resources to environmental changes to exploit opportunities and gain a competitive advantage. The theory of competitive advantage was developed by Porter in 1985. Competition is the source of profits, innovation and product differentiation. To remain profitable or gain market share, incumbents have to continuously readjust their strategy to create superior products or services than those of competitors. A company is thereby able to define the attractiveness and competitive position within the market, which makes a choice over the competitive strategy difficult. Porter defines the source of competitive advantage as the ability to create value for customers, which is higher than the costs of creating it. The superior value is created by offering cheaper options for equivalent services/products or by creating unique benefits, which offset higher prices. Thus there are two main sources of competitive advantage: cost leadership or differentiation (Porter, 1985).

Given the complexity of the SDGs, the social and environmental constraints do require financial resources and the capability to incorporate and deal with them (Sinkovics et al., 2016).

4. Problem Statement & Research Questions

Since the Sustainable Development Goals has been introduced in 2015, the world is only slowly approaching the achievement of the targets. As climate levels continue to rise compared to the pre-industrial levels staidly, societal governmental and especially business practices have to change to more rapidly and become more effective to achieve the targets set by the United Nations to stop climate change. The Sustainable Development Goals require the efforts of all market participants to effectively conquer rising temperature levels ("The SDG Compass | UN Global Compact", 2021). Nevertheless, as we discussed earlier, progress towards achieving SDGs is slow. There are many dependencies of each player to reduce negative impact effectively. Therefore, climate change and energy security concerns are the main drivers for the automotive industry to decrease emissions (PWC, 2007).

The biggest challenge for the automotive industry for the upcoming years will be to reduce GHG emissions to a minimum or even eliminate them, which requires actions by suppliers and strategic partners. Trends such as a zero-carbon car or carbon-neutral manufacturing (offsetting emissions with sustainable projects) display the urgency of the problem arising from regulations and increasing the environmental awareness of society (PWC, 2022).
With the automotive industry being essential to achieving net-zero global emissions and therefore SDG 13, original equipment manufacturers (OEMs) have to change their strategy to meet set decarbonization targets. As approximately 65-80% of emissions are tailpipe emissions, electrifying powertrains is the first measure to limit global warming to 1.5°C compared to the time before industrialization. But as a net-zero carbon industry, OEMs now need to weigh their focus on material emissions, as otherwise, they will become the larger share of lifecycle emissions.

The following Research Questions are aimed to discuss the difficulties in contributing to SDG 13 and the above-mentioned problems:

RQ1: “How do German Automotive contribute to SDG 13 – reducing greenhouse gases throughout the value chain?

RQ2: “What are the most crucial aspects for the German Automotive industry to decarbonize the Supply Chain?”

This dissertation aims to identify actions to effectively reduce CO2 Emissions without harming other environmental and social aspects. Therefore, a new era has started, which states that companies need to stop "Doing business as usual" and try to adapt to the changing business environment and stakeholder demands further.

5. Pitfalls and Challenges contributing to SDG 13

Implementing sustainable measures to fight the climate crisis and contribute to the 17 SDGs is, especially by big corporations, greatly respected as a contribution to society and the environment. Overall the important role of businesses in the 2030 Agenda is not neglectable – as economic growth, sustainable Industrialisation, and innovation are at the core of the agenda, businesses need to adapt. Therefore, it is crucial for businesses to effectively participate and contribute to the agenda's pillars to exploit new business opportunities and remain competitive with new sustainable key players within the market. But as SDGs are

interconnected, they create dependencies and so-called wicked problems. Generally, there are several challenges for achieving the Sustainable Development Goals.

To contribute to SDG 13, businesses and, in the case at hand, OEMs have to decrease their emissions without harming other targets set by the United Nations. To achieve SDG 13, enormous investments in R&D are necessary, and moreover, recourses aligned with the requirements of SDG 13 are more expensive than conventional non-sustainable resources. As decarbonization has not approached far enough, economies of scale prevent zero-carbon cars from being sold at comparable market prices. So far, consumers are not willing to pay a premium for a sustainable car. To decarbonize the automotive sector, a holistic and systematic approach to understanding all resource-flows, climate mitigation, and "life-cycle-thinking" in strategy and operations is crucial (Gebler et al., 2020). As Dr. Sebastian Jursch (PWC, 2022) states:

"Car manufacturers and suppliers must therefore re-evaluate the sustainability of their products and value chains. Their greatest challenge here is to comply with legislative requirements while at the same time ensuring cost-effective manufacture and meeting the demands of consumers."

This quote highlights the crucial factor of sufficient capital and the willingness to pay by costumers to successfully apply action to reduce emissions and contribute to SDG 13.

6. Methodology

This chapter of the dissertation will outline the methodology under which the research was conducted. First of all, the research method will be described, followed by the selection of the sample, the key individuals who participated in the study and how the data was collected. The last paragraph of the chapter will talk about the evaluation method and tools used to retrieve important information from the interviews. This will also be the introduction to our interview results and analysis, which will be discussed in the next chapter.

6.1 Research Method

The contribution of the German automotive sector to SDG 13 – especially with focus on the decarbonization of the industry is a highly complex topic. As there are many challenges to overcome and a high degree of cross-industry interaction is required, qualitative research on the topic of decarbonizing and transforming the industry will provide a deeper understanding

of the hurdles the sector has to overcome. The selected interviewees will complement the literature review, which provides the necessary information on the topic and will be used to proof theory and its implications (Patton, 2015). By using information from the literature review and interviews, this thesis will provide real-life insights into the ability to transform and the future of the automotive industry, validated by theory and real-life experience. As already stated above, interviews have been chosen as the data collection method to acquire knowledge from industry experts (Patton, 2015).

The interview approach was based on the two research questions implemented above and followed a semi-structured way, which allows guiding the interview with the pre-set interview questions while leaving the opportunity to ask additional questions (Kvale, 1996).

The interviews were all transcribed by the same tool, using the same approach.

6.2 Sample – Participant & Insights

The interviews were conducted with diverse players and experts in the German automotive sector. The interview partners were selected based on the company they work for or the department within a company they are responsible. The companies are mainly OEM, Original Equipment Manufacturers (60%), while the remaining 40% are based on other stakeholders and experts of the automotive industry. To get a diverse view from different companies, one bank was selected to provide a future outlook of the automotive industry and additionally one expert from the oil and gas industry as he might also provide a future external outlook on the industry itself.

Only individuals working for a company with at least 500 employees were considered to ensure their need to transform and the necessity to compete with new entrants. Additionally, those companies might have the ability to make impactful changes within the industry during the approach of decarbonizing. The following table will introduce the involved companies:

Company	Industry	Interview Purpose
Volkswagen	Automotive	As an OEM in the selected industry and by being on the top of the supply chain, insights from the strategy
Schaeffler AG	Automotive	Also acting as an OEM, but also as a supplier of large car manufacturing companies, Schaeffler AG is among the largest of its kind.

VDA	Automotive Association	VDA is the Association of the German Automotive Industry and consists of manufacturers and suppliers. Therefore they have valuable insights into the future and the potential collaboration of suppliers and manufacturers.
IKB	Financial Services	“IKB-Deutsche Industriebank" is a bank mainly focusing on SME & MNEs by providing capital (debt). The unit industrial groups have different focuses, while one is "Industrial and Automotive", which allows for deep insights into the industry.
BP	Oil and Gas	BP as a supplier for combustion engines, will also have insights into the decarbonization process, as this also directly impacts their business.

As described throughout the literature review, achieving a competitive advantage and actually contributing to the achievement of SDG 13 and successfully decarbonizing the industry, a high level of collaboration within the industry players (vertically along the supply chain) and across industries is necessary. Top Managers have been selected as they can briefly describe the future strategy of the industry, and moreover, the banks will be responsible for the future evaluation when lending money to SMEs/MNEs within the German automotive sector. This valuation will reflect the future business ability. Additionally, the partner from IKB is responsible for industrials and automotive, so he brings the cross-industry connection between the automotive industry and resources suppliers (such as the steel industry). The interview partners need to be close to top-level strategic decision making, at least for their department to give reasonable insights about the feasibility and the ability to implement strategic decisions and plans. The second table lists the respective interview partners:

Company	Interview Partner/Position
Volkswagen	Adelia Felicio – *Integrity, Risk and Compliance Manager*
Schaeffler AG	Robin J. Stalker – *Board Member & Chairman Board of Trustees: Accounting for Sustainability Initiative*
Schaeffler AG	Head of Environment – *Anonym*
VDA	Loic Geipel - *Climate, Environment and Sustainability Officer*
IKB	Heinz-Jürgen Büchner – *Managing Director Industrials&Automotive*
BP	Pedro Oliviera – *CEO BP Portugal*

6.3 Interview protocol/ transcript

As stated in the introduction to this chapter, the interviews were conducted based on a semi-structured approach as it ensures that necessary insights to answer the developed research questions are collected while allowing for flexibility and discussion along with the interview (Kvale,1996). A software, based on artificial intelligence was selected to record and transcribe the interviews. The interview catalog consisted of 6 questions, which aimed to reflect the two research questions this dissertation is researching. The semi-structured approach allows to collect missing or needed information if the interview partner did not answer the first question sufficiently.

6.4 Interview Procedure and Set-Up

Selecting appropriate interview partners was based on research via company websites and associations. Additionally, scanning my personal network allowed me to acquire further contacts who were willing to contribute to the study. To contact individuals, a short informational E-Mail on the dissertation topic was sent to potential partners. After contacting 23 individuals, six responded and were willing to help. One interviewee asked for the participation of another expert to jump in if he himself is not able to answer some questions.
The partners received a Microsoft Teams invitation, including a calendar and video conference link. Around 50% of the interview partners requested the interview catalog upfront to prepare for the questions. Due to the recent pandemic, all interviews were conducted remotely during a time frame of 45-60 minutes.
Before starting with the interview, each participant received a short briefing and was taught about the usage of the data. Additionally, they were asked for permission to record their answers and actually transcribed them. To ensure the validity of the interview, every partner allowed for their names to be mentioned. Afterward, all interview partners agreed to be open to further questions. Thus, they allowed follow-up-up contact via E-Mail if parts of their answers were unclear or additional information was needed.

6.5 Data Evaluation

After transcribing the interviews, a table was developed to collect the main message to each question of the interview. The transcribing process was done via the software otter.ai which needed to be adjusted and corrected afterward using voice recordings of the meeting. To find

out about overlaps within the answers, a keyword analysis was conducted using Maxqda. The software allowed to cluster the answers into subjects according to the research questions. This analysis will be introduced in chapter six of the thesis. The evaluation of outcomes followed an inductive approach to collect data, identify patterns, and use them to develop a conclusion or generate a theory from them.

The results from the analysis will be presented in the following chapters.

Following the seven proposed steps of successful SDG integration of van Tulder (2020), the analysis will follow the proposed series of actions and uses interview results and literature to identify the optimal way for the German automotive industry to engage with SDG 13.

7. Findings and Discussion

The theory described under section 3.1 ff. is, to a large extent validated by the interview partners. Nevertheless, the interviews gave more practical insights, which partly deviated from the selected theory. The interviews helped to approach a more specific view of the automotive sector contributing to SDG 13, whereas literature nowadays mainly focuses on the broader aspects of companies contributing to all the 17 SDGs. The findings underlined the difficulties of adapting to the changing environment and the urgency of the automotive sector to reduce emissions due to the high level of greenhouse gases they are producing. But it is not only the decision to take action and to reduce. Moreover, it is important that the automotive sector is not able to become carbon neutral on its own. Additionally, as the automotive sector has its main focus on tailpipe emissions, they have to now focus on decarbonizing the production and find solutions for the end of the life cycle.
The analysis and coding of the interview transcripts were done using the software MAXQDA 2022.

7.1 Interview Analysis

The conducted Interviews aimed to answer the proposed research questions and get a brief understanding of the understanding by the German automotive sector of the sustainable development goals. Therefore, six interviews were conducted with a variety of people with different stakes in the industry.

Analyzing the data, 83.3% of the interviewees were male, whereas only 16.6% of females volunteered to conduct the interview. Moreover, 50% of the interviewees are working directly at a German OEM, and the other 50% are working in other sectors, but with their position being directly exposed to the automotive sector. The nationality of the partners was diverse. Three are from Germany, two from Portugal, and one from Australia, which gave the interview different perspectives in terms of attitude towards sustainability.
Overall, the outcomes and results of the Interviews are similar in terms of actions and challenges that come in hand with SDG 13 and the related greenhouse gas reduction. The following paragraph originates from the VDA (German Association of the Automotive Industry), related to the interview results. They allowed to cluster the answers to the first research question into four main segments: Commitment to Climate Change, Climate Mitigation and Adaptation, Partnerships (Joint Effort), and the impact areas along the supply chain.

7.2 Discussion and Findings

RQ1: "How do German Automotive contribute to SDG 13 – reducing greenhouse gases throughout the value chain?

RQ2: "What are the most crucial aspects for the German Automotive industry to decarbonize the Supply Chain?"
To answer the research questions, the interviewees received questions regarding a successful contribution and the challenges and what could harm contribution to SDG 13 (Appendix 4).

Committing to Climate Change

As referred to under the chapter: "Literature Review", it is of great need for the automotive sector to decarbonize the industry. Regarding the interview partner of BP, some basic principles are crucial for the achievement:

"Within this specific SDG and others, this is more than anything about pragmatism, honesty and transparency and sometimes telling people what they do not want to hear."
(Appendix5#3)

Moreover, Robin Stalker referred to that managers have to understand the urgency to adapt the way they operate and to become proactive rather than being reactive to environmental changes, which is in line with the theory of van Tulder. The research of van Tulder also states that reversing materiality, moving to an outside-in approach, is essential for businesses to correctly implement SDG targets into the strategy, which also underlines becoming more

reactive. Changing towards an outside-in approach is also highlighted by the SDG Compass. Additionally, Mister Stalker added that especially German OEMs are able to guide the industry and become role models for international competition due to the established brand recommendation. In fact, all interview partners directly or indirectly stated that decarbonizing the industry and thereby contributing to SDG 13 requires German automotive makers to accept their responsibility as industry leaders to guide the sector and especially the related industries such as steel, plastic, and energy on their way to zero carbon emissions (Appendix5#4).

To successfully implement change, they have to understand their role as a leader in revolutionizing the industry and need to take the first step in replacing current vehicles with zero-carbon cars at consumer-friendly costs. They need to act rapidly as supply chain leaders to exploit those opportunities and drive change in the industry and other associated stakeholders. So to effectively contribute to SDG 13, OEMs need to take over the role as industry leaders and emphasize the use of innovative technologies across all relevant industries within the supply chain (McKinsey&Company, 2020).

Additionally, as mentioned above, transparency is a crucial factor for the SDGs to be achieved. Transparency implies correct and structured reporting of businesses, especially when contributing to SDG 13. Following the SDG Compass, it is important to continuously report on the progress towards your targets in relation to the SDGs as demanded by Stakeholders. Nevertheless, taking over the role as a leader means continuously communicating your progress towards the SDGs to ensure a proper guideline for followers and other industries. The German automotive sector will invest 220 billion dollars from 2022 to 2026 in research and development projects to drive electric mobility and digitalization to decrease emissions. This investment exemplifies the role as a leader of the German automotive industry as the interview partner from the German automotive association states (Appendix5#6).

Finally, governments can force businesses to reduce emissions by heavily taxing them to incentivize true commitment and contribution. As also stated by SDG 13, investments in projects are needed to offset emissions. Companies could invest in projects to capture greenhouse gases; thus, they are offsetting it by capturing it when emitting.

"So taxing heavily. I am aware of gross cost of energy, et cetera. But again, it is an exercise of pragmatism because, actually, we are not doing that. Instead of impacting the economy, we are impacting the environment. So it is just about choosing. And again, politicians do not want to tax emissions, really. Because they know the impact, it might have on the economy...So if you put that price in the right position, you create a fantastic environment for

technology to populate and the best technology for each segment to be successful." (Appendix5#3)

Putting a price on emissions is pushing innovation and is indirectly increasing the pressure on businesses to reduce pollution in each stage. The short-term economic cost might be high, but once the opportunities are exploited, it will profit the economy and especially the environment in the long run.

Supply Chain

Currently, the automotive sector is focusing mainly on their tailpipe reduction of CO2 emissions , as 65-80% of the emissions are due to a vehicle's powertrain. Therefore, main effort of the industry was put into the electrification of vehicles. But to become a zero-carbon industry, the industry now has to focus on the reduction of material production emissions, as a report by McKinsey and Company states. Germany is considered as a manufacturing country and therefore has a great potential to decarbonize and thereby contribute to SDG13, but there are still a lot of challenges to reduce or eliminate GHG gases within the different sectors (Appendix3). OEMs are mostly addressing issues under direct control, such as emissions from logistics, production & assembly, and the fuel supply and tailpipe. But to achieve the goals set for 2050, they should increase their focus on sourcing material, especially the end-of-life material recovery emissions. These emissions are not under direct control of OEMs and therefore require a high degree of transparency as well as complex and costly management of their suppliers. The report states that with the electrification of powertrains, the emissions from materials will drastically increase due to resources that are necessary for the batteries. In order to remain competitive, addressing these emissions is key. Most investments in new technologies might be costly and not feasible in the short run, but might be an opportunity for first movers in the future, as the process of decarbonizing is a long-term project – sustainability as a long-term strategy (McKinsey&Company, 2020).

As Mr. Heinz-Jürgen Büchner, Managing Director for the automotive and industrials Sector at IKB, states:

"Important is the restructuring of the production process, i.e., by using better recyclable raw materials through the use of sustainably produced raw materials. In many cases, this also means that purchased steel from China may not be as sustainable as steel that is already produced in Germany... But it is also important to look at how the entire production process and supply chain can be optimized to save resources. To reduce waste in the production process, whether recyclable or not, that means also energy saving during the production process." (Appendix5#5)

The quote above implies the importance of restructuring the whole supply chain and, most importantly, tracking emissions along each part of it. Additionally, it states the importance of decarbonizing the steel industry as they are responsible for a large fragment of emissions. Conducting an interview with Volkswagen Portugal confirmed the importance. Volkswagen is already tracking its emissions along the supply chain with strict control mechanisms to monitor and choose suppliers. They try to buy resources as sustainably as possible, with price negotiations after the screening for sustainable suppliers.

"....we have clear rules all over our supply chain, not only in procurement area with specific contracts, not only supply for production, as well other supplies for non-production materials where we already require a lot of fulfillment of environmental points concerning their activities. And by principle, Volkswagen is not accepting suppliers in the supply chain of production or even other non-production materials that we buy or services if the suppliers are not fulfilling certain rules concerning environmental sustainability. We even have, for instance, group policies that also establish a proper evaluation of the sustainability of our partners. (Appendix5#2)."

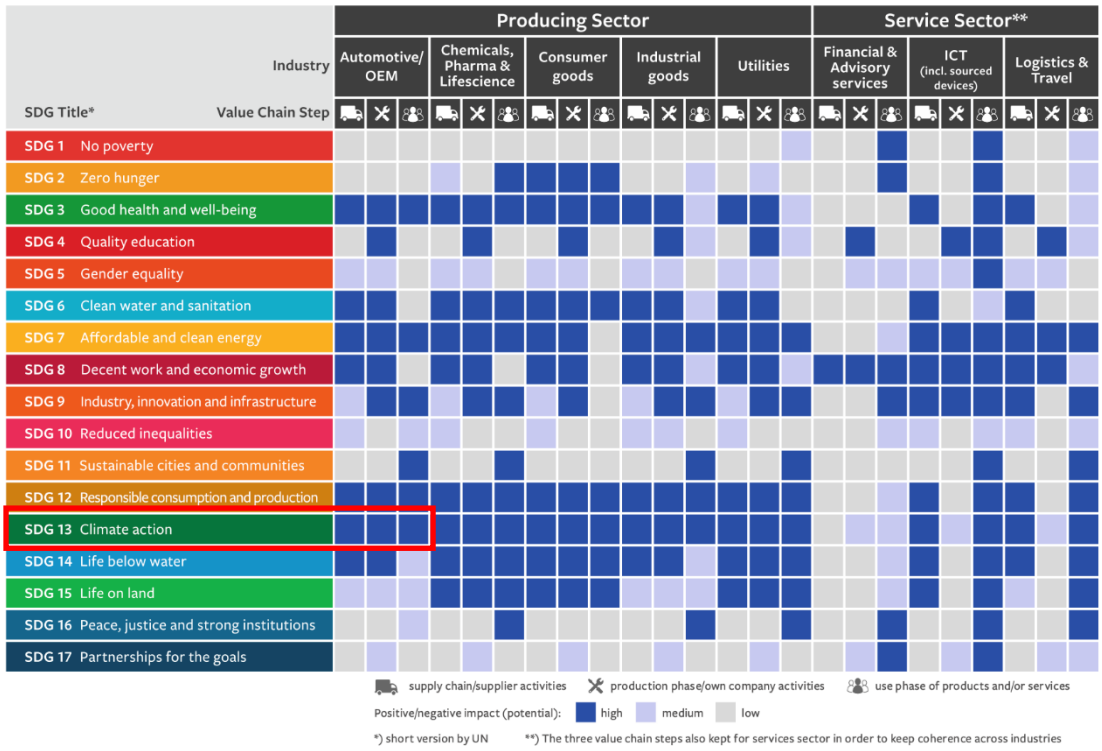
But as highlighted through the interviews, it is not only important to control the emissions of the production and resources. Evenly important is the development of a concept for the end-of-lifecycle. The automotive industry needs to develop a strategy, especially in relation to electric vehicles, on how to use and recycle cars after their life cycle:

"...we have to look at this lifecycle assessment also, what is the long term cost of these things? And definitely in favor of electrification, but we should not believe that that is the only answer, and we should not believe that that is now also the answer. And this will work out how are we going to produce batteries economically, how are we going to also recycle or dispose of these, and what is the energy mix that consumers are going to be using to put in their electric batteries?" (Appendix5#4)

So to conclude on the topic of the Supply Chain: For the German economy and especially the automotive sector, it is of great importance to innovate and take action to combat climate change, to remain competitive with international manufacturers. German automakers were successful decreasing the consumption of resources within the value chain, especially the production process. Among other things, this reduces water consumption by more than 60 percent per vehicle which is produced. The automotive industry is now able to recycle more than 80 percent of waste which is created during production. Also emissions from painting during the production process have fallen by 65 percent and reach the lowest level in international comparison (Umweltschutz in der Produktion, 2021).

The automotive industry is ever since researching for alternative ways of transportation and is rethinking the total value chain, as contributing to SDG 13 and reducing CO2 emissions

involves all stages throughout the value and supply chain for car manufacturing with individual impact at each value-adding stage (Umweltschutz in der Produktion, 2021):



Reference: (Econsense.de, 2017)

It is of great necessity to monitor and report suppliers and efforts to close the life cycle. As mentioned within the Literature Review, a circular economy model would be a proper strategy for companies, and especially the automotive sector as described in the literature review, to successfully contribute to the SDGs and especially to SDG 13. It is important to close the lifetime cycles of produced cars in order to optimize and reduce waste and emissions:

> *"... there is some debate about what is producing electrified automobiles. What is that we have to look at the lifecycle assessment, also, what is the long term cost of these things? ... if this will work out how are we going to produce batteries economically, how are we going to also recycle or dispose of them, and what is the energy mix that consumers are going to be using to put in their electric batteries?" (Appendix5#4)*

But decarbonizing all the related industries and developing technologies that could carry the change, German car manufacturers need strong partners. Achieving SDG 13 and driving Greenhouse gases to zero along the supply chain is only possible in a joint effort referred to by the SDG Compass. The VDA has set the following Vision to emphasize this aspect:

"As an automotive industry, we want to produce automobiles that are sustainable not only in operation but also in production." - (Umweltschutz in der Produktion, 2021)

The Vision displays the importance of drastically reducing pollution across the whole Supply and Value Chain – before and after the point of sale.

Joint Effort – Partnerships and Collaboration

A joint effort is one of the fundamentals of the SDGs. It means that achieving the target is only possible if everyone is working together. As there are many different suppliers among the supply chain which might pursue different strategies towards zero carbon output, most of them are mutually exclusive. Different suppliers can set different standards and thereby create higher costs through inefficiencies within the supply chain of the automotive manufacturer. These inefficiencies can delay decarbonization. Therefore tight supply chain management and corporation with suppliers is of great importance. In fact, any approach of decarbonizing cannot be achieved by a single segment of the supply chain, OEMs need to lead a coordinated and collaborative approach across the whole value and supply chain of the industry to maximize the impact on GHG reduction and to optimize costs associated with the zero-carbon industry.

To lead the shift, OEMs need to uncover the potential to reduce carbon emissions of the materials they use. They have to develop a strategy and set goals for decarbonization, identify opportunities related to new technologies and closely work together along the supply chain to adopt those technologies. As already highlighted in the section "Supply Chain," Volkswagen is already engaging in monitoring suppliers and setting standards across the supply chain. It amplifies that the German automotive industry recognizes its responsibility as stated in the following quote:

"...work a lot directly with suppliers in order to have a clean chain in the logistic areas. So this is really a strategy from Volkswagen to work on this on this orientation, not only Volkswagen itself but also the clusters behind the car - the production of the car itself." (Appendix5#2)

But not only the carmakers also the suppliers see great innovation potential in partnerships and co-innovation along the supply chain.

"...but we have a certain size, and we also have a certain innovation potential, which is, of course, interesting for our customers, and has potential in a partnership that is not just indirectly."(Appendix5#1)

But working together on a joint project not only creates efficiency and innovation but also increases the bargaining power those parties have on other suppliers, policymakers,, and

producers. As Porter states with his five forces framework, identifying great impact areas and jointly influencing them can create opportunities for a competitive advantage in the long run. For the process to be cost-efficient, OEMs could create alliances to excerpt pressure on suppliers for raw materials and, moreover, collectively invest in the new technologies to decarbonize the supply chain. Moreover, OEMs need to understand other related sectors such as the steel and power industry. Cross-Industry alliances, partnerships, or corporations can foster innovation towards a sustainable supply chain of the automotive industry (McKinsey&Company, 2020). Collaboration is essential, *"as everybody has skin in the game too for sure." (Appendix5#3)*

The German Association of the Automotive Industry has committed to the following Mission to underline the importance of working together and the importance of the SDG to combat climate change:

> *"Together with other associations and policymakers, we set common goals to achieve sustainable production for our entire industry. In doing so, we are guided by the Sustainable Development Goals (SDGs) of the United Nations, the Paris Climate Agreement, and the Global Compact Initiative." – (Umweltschutz in der Produktion, 2021)*

All members of the association have agreed to contribute and approach to a more sustainable future and thereby contributing to the SDGs. The automotive industry is increasing their efforts to make the production process more sustainable and to. Align the process with the SDGs. This involves anchoring economic, ecological, and social goals within the supply chain. Responsibility for sustainable business should be shared by companies, politicians, and society as a whole. The German automotive industry is making its contribution here. Manufacturers and suppliers actively commit to their responsibility to reduce emissions along the production process and use cycle of automotives: the selection of materials and the production in Germany, as well as making automotives more effective by optimizing the powertrain and to adapt circular economy models to close material cycles after the life cycle has ended. (Umweltschutz in der Produktion, 2021).

The next paragraph will discuss the most crucial aspects if the automotive industry successfully wants to implement the SDGs and especially SDG 13 into their strategy.

Strategic Implementation

As referred to in the literature review and the predeceasing interview results, implementing the SDGs and the contribution of SDG 13 is one of the most important factors to contribute and survive within the changing environment successfully. As van Tulder states in his

research and stated by the SDG Compass, companies can successfully contribute to the achievement of SDGs by adopting an outside-in strategy by reversing materiality and placing the SDG to the bottom line of operations. There must be a great commitment and recognition among the whole company. As stated under the paragraph "Sustainable Business", the strategy is not sustainability; sustainability is the strategy. To successfully implement, they first need to understand their role in the game as stated by Mr. Stalker:

"I suppose I should also say our role and that should basically set the framework for all of the decisions that are going to take in terms of, you know, strategy, profitability, competitiveness, all that is under that first umbrella of what is our role in the climate change." (Appendix5#4)

There is no universal approach for automotive businesses to implement the SDGs into their strategy. We can only use concepts such as the seven implementation steps of van Tulder or the ways companies can contribute, linking them to our findings regarding the supply chain and partnerships. We know it is a unique procedure for every single company and depends on the ability to restructure their dynamic capabilities. But to successfully implement the achievement of the SDGs, the strategy has to involve strong cooperative engagement with other parties in order to create value for society.

7.3 Challenges contributing to SDG 13

As a final part of this research, we will briefly summarize the challenges that arise for the German automotive industry when contributing to SDG 13. First of all, one of the major challenges when contributing to the SDGs is to assess the effects on other related targets within the agenda. Contributing to SDG 13 can also harm other targets of the development goals – such as water consumption during the production process of batteries. To avoid causing damage, proper assessment and impact monitoring are necessary. Also, the suppliers have to be monitored and regulated, which implies high costs. Those costs occurring through the tight supplier monitoring and selection process have to be regained through economic profitability. But as a fact, offering green cars with zero carbon impact is also costly due to the high sustainability standards needed for raw materials. Since supply for those raw materials is low and the demand is high, prices are far above the ones of common raw materials. As automotive businesses cannot carry those higher costs, consumers need to pay the price. But as already mentioned above, they are not willing to pay the premium for a zero-carbon car. This all leads to the final problem: as in every industry, decarbonizing operation is highly dependent on the energy mix Germany is providing – green energy is among the key factors.

The automotive industry is highly related and depends on other industries, sectors, and market participants. Thus, to decarbonize the industry, it is essential to cooperate closely with key stakeholders, especially governments, to ensure a common understanding and plan to contribute to SDG 13 by significantly reducing emissions.

8. Implications for future research

The dissertation aims at explaining management measures and strategic actions on how to contribute to the successful and rapid achievement of SDG 13. This is a brief overview of ways the automotive sector can improve its SDG performance, focusing on reducing emissions. For future research, the following has to be done:

- The discrepancy between demand for sustainable products of customers and the relatively low willingness to pay a premium for carbon-neutral cars
- Dive into the Supply Chain: Technical research on how much Greenhouse Gas can be saved in which step during the supply chain
- Case Studies: How many percentage points are manufacturers actually able to reduce emissions, and what measures do they use?
- Emerging Countries: Are those countries, especially plants and suppliers, able to have the speed to change into carbon-neutral producers/plants?
- Impact of the war between Russia and Ukraine on the Progress of SDG 13 and the decarbonization of the automotive industry.

The above-listed suggestions for future research require some technical knowledge, the ability to source the appropriate data, and some market research on consumer perception of carbon-neutral cars.

9. Limitations

Following the future research, which indicates some limitations of the study at hand, another issues is the size of the sample. To guarantee the significance of the results a bigger sample would be needed. Additionally, we would need to have a more diverse sample in terms of gender and age. The sample more or less consists of higher management persona – to elaborate on the technical ability of the automotive sector to contribute to SDG 13, the study should incorporate interviews with technicians or similar roles.

Moreover, the research based on the contribution of businesses in general is limited, and even more limited is the contribution the individual SDG 13 by the automotive sector. Also, technical ability of the researcher is limited, which is why there is the possibility of future researchers to conduct a more technical study. Therefore, this dissertation is not able to provide an optimal practices for the automotive sector, rather an managerial approach on which factors play a significant role in reducing greenhouse gas emissions and thereby contributing to SDG 13.

The last aspect that limits the research are the barriers on company insights. We cannot be certain about the actions of individual companies as many of them use the SDGs to greenwash their operations without actually committing to the SDG.

10. Conclusion

To conclude the research, we can say that the targets set by the United Nations are quite ambitious, but there is still a long way to achieve all the SDGs and especially for the automotive sector to become carbon neutral. The industry is aware of the issue and is directed its resources towards decarbonizing the industry. As stated above, they are not able to achieve carbon neutrality on their own. Achieving the SDGs requires a joint effort, especially for car manufacturers, as they depend on many other industries to become carbon neutral as well, such as the steel, plastic, and energy industry. As we can see in Appendix 3, the need to improve contribution on SDG 13 in Germany is high, not only for the automotive sector. Moreover, massive efforts in R&D are needed to optimize current mobility solutions and reduce harm those solutions are causing (e.g., electrification of the powertrain). As the literature describes, the implementation of Sustainability and SDG 13 is crucial for a successful contribution. The implementation requires costly measures such as monitoring emissions and moreover setting strict rules across the whole business. Businesses have to individually deploy their dynamic capabilities to adapt to the changing environment and to contribute efficiently.

Nevertheless, there is a mismatch between stakeholders' expectations such as customers, government, and the car manufacturer. Stakeholders expect a rapid change and transformation but are drawing boundaries through regulations and habits. Car manufacturers need time and have to offset investment costs. To rapidly change, customers would need to take the burden and pay higher prices, but they are not willing to:

"When we are speaking about manufacturing processes, we tend to forget customers and to what extent customers play a different role. And to be honest, customers on this agenda are quite selfish. What do I mean by this? You know, they want something but do not want to pay." (Appendix5#3)

This means to transform rapidly, the fundamentals have to change, such as the business model in terms of circular economy and decarbonizing the supply chain. But to successfully implement the targets of goal 13 into the strategy, they need also to respect customers and research on how to incentivize them to pay a premium for sustainability.

Finally, the research concludes that there is no perfect way to contribute to SDG 13, and it depends on the business and all other market participants. Fulfilling the targets of the United Nations requires a radical shift towards sustainability by each stakeholder of the automotive industry. But if one country could be the driver of change, it would be the German industry due to their recommendation, the establishment, and the capital they can invest in transformation.

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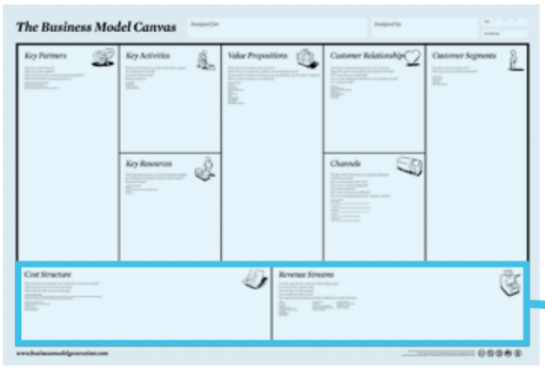
12. Appendix

Appendix 1: van Tulder, R. (2018). Business & The Sustainable Development Goals: A Framework for Effective Corporate Involvement. RSM Positive Change Series. Retrieved from http://hdl.handle.net/1765/110689

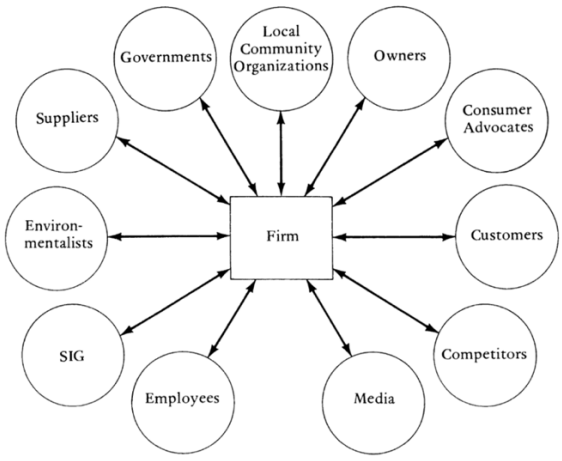


.... to an upgraded sustainability CANVAS model (PLUS)

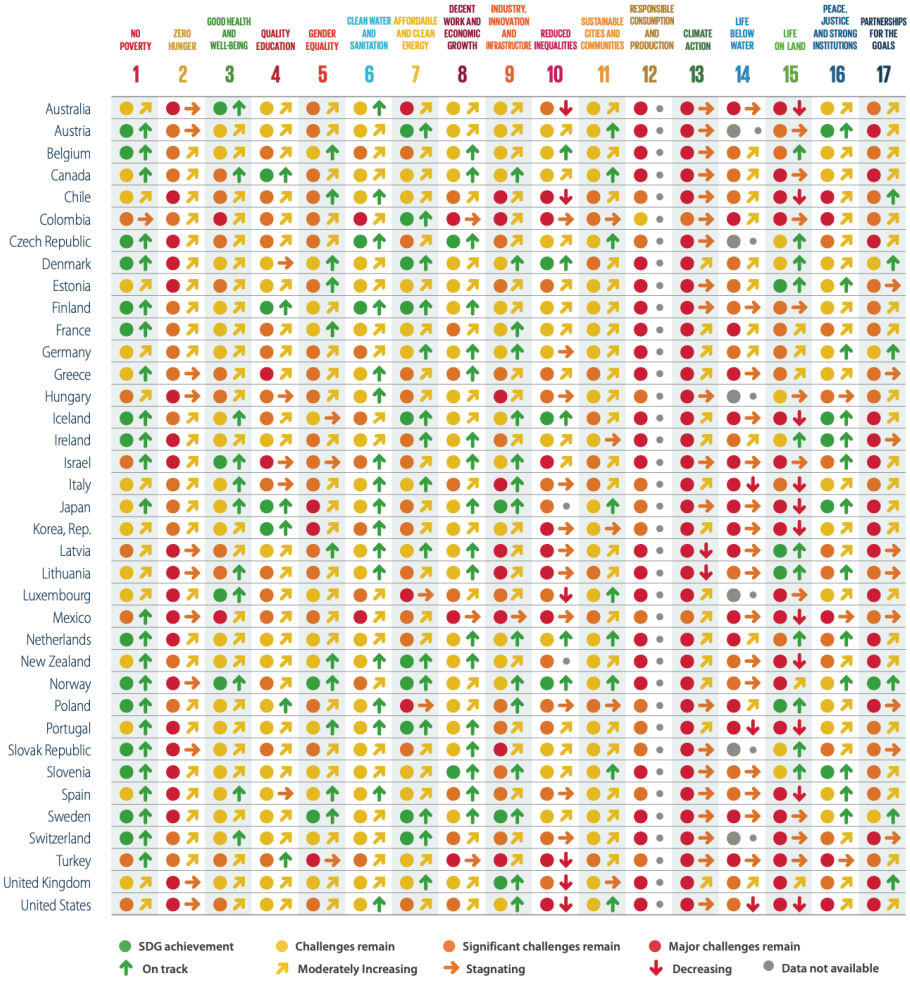
[1] KEY PARTNERS	**[2] KEY ACTIVITIES**	**[4] VALUE PROPOSITIONS**	**[5] CUSTOMER RELATIONSHIPS**	**[7] CUSTOMER SEGMENTS**
	[3] KEY RESOURCES		**[6] CHANNELS**	
[8.1] ENVIROMENTAL COSTS		**[9.1] ENVIROMENTAL BENEFITS**		
[8.2] SOCIAL COSTS		**[9.2] SOCIAL BENEFITS**		
[8.3] COST STRUCTURE		**[9.3] REVENUE STREAMS**		

Source: https://www.youtube.com/watch?v=wlKP-BaCOjA

Appendix2: Freeman, R. (1984). Strategic management. Boston: Pitman.



Appendix 3: Sachs, J., Kroll, C., Lafortune, G., Fuller, G., & Woelm, F. (2021). Sustainable Development Report 2021. doi: 10.1017/9781009106559



Appendix 4: Interview Transcript

1. What are the most important factors for the German automotive industry to contribute to the achievement of SDG 13?
2. Is the automotive sector able to facilitate climate mitigation/adaption?
3. What do you think are barriers for German car manufacturers to a rapid positive impact on SDG 13?
4. What are the key stakeholders in the industry that have the greatest impact during the process of achieving SDG 13? And Why?
5. What is the role of German OEMs within the process of transforming the industry to a zero-carbon sector?
6. In which area of the supply chain are OEMs able to have the greatest impact in order to decarbonize it? (i.e. steel production, plastics, etc.)

Appendix 5: Interview Results – Transcripts available upon Request

#1 - Schaeffler-Head of Sustainability

1. **What are the most important factors for the German automotive industry to contribute to the achievement of SDG 13?**
   - Minimize Downstream Emission
   - Low greenhouse gas emissions in production
   - Keep Upstream Emissions perfectly neutral
   - OEMs 95 percent use face → how to control use face?
   - Control Upstream Emissions (steel production)
   - Decide on how to control downstream emissions → now upstream!

- Transformation to E-Mobility but keep track of other emissions such as from production and end of life cycle emissions
- Strong Cooperation with government: What is the technology we should support?
- Adjust Business model to new sustainable trends
- Innovation: Recycling and rare resources for batteries
- Green Steel: BMW joint venture for example.
- Cross-Sector Partnerships: Aviation or Ship industry to increase bargaining power on steel supplier (for green steel)

2. **Is the automotive sector able to facilitate climate mitigation/adaption?**
    - Product Scope: Adaptation no; Mitigation yes
    - Mitigation: Products are produced/delivered which reduce carbon footprint of consumer and which contribute fighting climate change
    - Adaptation: not fully possible. Adaptation means increasing risks, which needs to be monitored (risk assessment): Water Risk Map → Costly. But it is more expensive if those risks come true. Therefore, autonomous we cannot solve those risks
    - Vertical integration to minimize supply risks: partnerships to monitor all risks
    - too high degree of vertical integration is risky: too far from core competencies.
    - Sustainable networks in terms of co-working to minimize risks
3. **What do you think are barriers for German car manufacturers to a rapid positive impact on SDG 13?**
    - No one can do it by themselves: Partnerships needed → Tackle those complex problems only in joint effort
    - To be successful with SDG 13, and to reduce emissions in the industry, Green Steel is crucial
    - Those who are able to produce green steel for a reasonable price, they gain power over their buyers
    - Green Steel is too expensive → slows down the transformation of the automotive industry, thus they are dependent
    - Willingness to Pay of consumers: Low/zero carbon cars are expensive since innovation is needed (innovation is capital intense) and companies have to regain those investments to survive, therefore higher prices would be needed in the beginning → Economic businesses that need to make money: use cash cows to invest in stars (BCG Matrix)
    - High demand for green resources, low supply → High Prices
    - Hurdles due to regulations and legal issues: e.g. the EU-taxonomy has many
4. **What are the key stakeholders in the industry that have the greatest impact during the process of achieving SDG 13? And Why?**
    - Customers, Governments, Suppliers and other businesses

5. **What is the role of German OEMs within the process of transforming the industry to a zero-carbon sector?**
    - Established companies who can set the tone and common practice
    - Schaeffler as supplier has big influence on manufacturer as many of them innovate in partnerships and are open for suggestions
    - Role as leader and pioneer
    - Strict direction of strategy of mature automotive giants such as VW, BMW and Daimler
    - Big Establishment with many old top managers: younger persons in management positions can bring innovation and the willingness to change

6. **In which area of the supply chain are OEMs able to have the greatest impact in order to decarbonize it? (i.e. steel production, plastics, etc.)**
    - Green Steel and aluminum –> resource supply
    - Co-Innovation

#2 – Volkswagen - Adelia Felicio

1. **What are the most important factors for the German automotive industry to contribute to the achievement of SDG 13?**
    - Electric vehicles and mobility (also in the plants and for every client)
    - Infrastructure and supply of batteries
    - Huge Challenge: Batteries → Think of circular economy
    - Providing everything for batteries → Sustainability of batteries?
    - Volkswagen opening Battery factory in Spain
    - Important to have Partnerships along the Supply Chain: to manage stakeholder portfolio and have a clean supply chain
    - Volkswagen: Strict sustainability rules across the whole supply chain: resources, production but also suppliers actions → Group Policies to evaluate sustainability of partners
    - Price check done post sustainability evaluation
    - Same supplier for parts across the whole Group → Bargaining Power and reduced price for customer
    - Not only the automotive sector everyone has to participate
    - Responsibility as one producing cars that damage environment

2. **Is the automotive sector able to facilitate climate mitigation/adaption?**
    - Responsibility to adapt and mitigate!
    - The new environment needs to be part of the strategy
    - To mitigate, climate change/sustainability should be in in the heart of the strategy the same as profits and other indicator: to mitigate providing sustainable products will guide customers
    - Not moving with environmental trends will decrease profits due to perception of stakeholder → contributing to the environment, the SDGs is an opportunity
    - **Paint Job** huge contributor to negative environmental impact: zero tech factory

3. **What do you think are barriers for German car manufacturers to a rapid positive impact on SDG 13?**

- Top down approach → maybe flatter hierarchies to increase innovation?
- Governments can be a bottleneck; need to redirect budget
- Time and resources: partner
- High Investments needed to adjust strategy and production + raw materials

4. **What are the key stakeholders in the industry that have the greatest impact during the process of achieving SDG 13? And Why?**
   - Governments: in Germany substitutions are higher due to financial power of the country
   - Customers
   - Societal Actors
   - Customers and governments in the countries: legal issues for combustion engines

5. **What is the role of German OEMs within the process of transforming the industry to a zero-carbon sector?**
   - Use supplier network and established business environemnt
   - Take responsibility as an role model
   - Innovation with suppliers
   - Customers and governments in the countries: legal issues for combustion engines

6. **In which area of the supply chain are OEMs able to have the greatest impact in order to decarbonize it? (i.e. steel production, plastics, etc.)**
   - Steel production
   - Partnerships through the supply Chain, Alliances with other OEMs to increase bargaining power on supplier.

#3 – BP Portugal – Pedro Oliviera

1. **What are the most important factors for the German automotive industry to contribute to the achievement of SDG 13?**
   - Most important factor: Pragmatism
   - Mismatch between stakeholder expectation and what actually is done
   - Stakeholder tend to think that automotive emissions are a large fragment, whereas they only make up for a small part → Drives investments to the wrong problem
   - Pragmatism, Honesty and transparency
   - Transparency: Value and Supply Chain
   - Control over emissions in the Steel industry
   - German Car Manufacturers are Material, they could drive the agenda further
   - Taxing emissions
   - Invest in technology that offsets the emitted greenhouse gases

2. **Is the automotive sector able to facilitate climate mitigation/adaption?**
   - Politicians want to impact the Technology → Incentives that don't do anything create a lot of entropy and lines within the system

3. **What do you think are barriers for German car manufacturers to a rapid positive impact on SDG 13?**
   - Politicians want to impact the Technology → Incentives that don't do anything create a lot of entropy and lines within the system
   - Optimizing current technology will reduce emissions more in the medium run than any new technology
   - Automotive companies should decide which technology to pursue, market drives them to mutual equilibrium
   - Policy makers are directing investments

4. **What are the key stakeholders in the industry that have the greatest impact during the process of achieving SDG 13? And Why?**
   - Automotive industry well established among suppliers and stakeholder: Therefore there is a huge interdependency among them to achieve a common goal
   - BP is working hand in hand with the automakers – totally collaborative environment
   - Partnerships in regard to SDG 17 – Governments and NGOs
   - Those stakeholders involved in the process are equally weighted
   - Customers: They are selfish, they demand sustainability and they want it cheap

5. **What is the role of German OEMs within the process of transforming the industry to a zero-carbon sector?**
   - Taking over the role as industry leader
   - Capital intense
   - Drive technology and heavily invest in transformation

6. **In which area of the supply chain are OEMs able to have the greatest impact in order to decarbonize it? (i.e. steel production, plastics, etc.)**
   - Getting a zero carbon car requires to every sector to drive down emissions. As car manufacturers are already dealing with the powertrain, resources are important, such as the steel industry.
   - Increase bargaining power by squeezing substitute products

#4 – Schaeffler AG – Robin Stalker

1. **What are the most important factors for the German automotive industry to contribute to the achievement of SDG 13?**

- Recognition: The need to do something under SDG 13
- Recognize the need to do something without regulators or customers pushing it
- Understand that there is risk involved when not doing anything → Rapid transformation: diesel scandal, diesel is not accepted anymore
- Proper risk management
- Recognize the German market as significant employer and innovator: Responsibility
- Implementation should set the framework for all decisions
- There are certain things that happen in the market, where companies react. IN this scenario we need to take responsibility and stop reacting and become more proactive → Automotive sector should be an innovative sector in Germany
- Become a provider for MOTION and not only a car manufacturer
- We do not need more market places, we need innovation in what we are doing, in the market places that exist
- What is the energy mix we are using
- Social responsibility of the automotive sector

2. **Is the automotive sector able to facilitate climate mitigation/adaption?**
   - Mitigate for sure by providing low emission cars, adaptation should not be a topic since companies should be proactively combating climate change
   - Mitigation: new ways of transportation
   - Schaeffler wants to mitigate by creating motion – what part does a company want to have in the new environment?
   - Communication of the new business plan to and with employees and customers (stakeholders) to actively ensure full commitment

3. **What do you think are barriers for German car manufacturers to a rapid positive impact on SDG 13?**
   - Lifecycle assessment of electric cars
   - Many attempts to greenwash or at least "paint something green", therefore the taxonomy needs to be monitored and transparent reporting and operations are necessary: Show what companies are really doing – no harm and helping SDG 13 for example
   - What is the infrastructure in Germany we need to remain competitive in Germany
   - Fundamentals need to change: Providing green energy to eliminate indirect emissions
   - Problem with planning and infrastructure for pledge land which the automotive industry can't change – slows down the development of sustainable energy
   - Politics: Especially communities, local, state and federal politics
   - Compared to Scandinavia or other countries, they have better conditions for green energy
   - Dependency on China and purchase from them → they use coal energy which is not green → Produce locally?
   - China is a relevant market for profitability – prepare for challenges in the Chinese market
   - Different standards among different markets – especially China
   - It took to long for the German automotive sector to transform

4. **What are the key stakeholders in the industry that have the greatest impact during the process of achieving SDG 13? And Why?**
   - Customers, consumers, employees, financials/investors and regulators
   - Similar to every industry
5. **What is the role of German OEMs within the process of transforming the industry to a zero-carbon sector?**
   - Taking over the role as industry leader
   - Seeing the transformation as an opportunity rather than regulatory constraint
   - Education System in Germany: know-how and skills lead to innovation
   - Ability to finance creative ideas around the world
   - Existing range of systems

6. **In which area of the supply chain are OEMs able to have the greatest impact in order to decarbonize it? (i.e. steel production, plastics, etc.)**
   - Green Steel: pushing the industry
   - Education: talented people will drive innovation in other sectors
   - Energy mix: How to push sustainable energy further

#5 – IKB Deutsche Industrie Bank – Heinz-Jürgen Büchner

1. **What are the most important factors for the German automotive industry to contribute to the achievement of SDG 13?**
   - Increased effort in e-mobility
   - Restructuring of the production process: using products that can be recycled
   - How to save resources across the supply chain and make it more energy efficient
   - Are the resources in batteries sustainable? Lithium and Cobalt
   - Use taxation and fines for imported steel from China

2. **Is the automotive sector able to facilitate climate mitigation/adaption?**
   - Sell electric vehicles to the customers to reduce their carbon footprint; this
   - is highly dependent on the energy used to power electric vehicles

3. **What do you think are barriers for German car manufacturers to a rapid positive impact on SDG 13?**
   - Development of green energy in Germany
   - Bureaucracy in Germany – takes too long to get legal allowance
   - Charging infrastructure, far beyond what Germany would need

4. **What are the key stakeholders in the industry that have the greatest impact during the process of achieving SDG 13? And Why?**
    - Customers, consumers, employees, financials/investors and regulators
    - "China" as supplier of cheap steel and market potential
5. **What is the role of German OEMs within the process of transforming the industry to a zero-carbon sector?**
    - Also German OEMs have to use sustainable raw materials
    - Leader and innovator to guide transformation

6. **In which area of the supply chain are OEMs able to have the greatest impact in order to decarbonize it? (i.e. steel production, plastics, etc.)**
    - Green Steel: pushing the industry
    - Recycling of raw materials: Circular economy

#6 – VDA – Loic Geipel

1. **What are the most important factors for the German automotive industry to contribute to the achievement of SDG 13?**
2. **Is the automotive sector able to facilitate climate mitigation/adaption?**
    - 1 and 2 are answered together.

    - The German automotive industry is taking up the challenge of climate protection. Our goal is climate-neutral mobility throughout Europe by 2050 at the latest - in line with the Paris climate protection agreements. The German automotive industry will invest around 220 billion euros in research and development worldwide from 2022 to 2026. The lion's share of this spending relates to electromobility and digitalization. The German automotive industry is thus driving the transformation toward climate-neutral mobility.
    - The rapid ramp-up of electromobility is a clear priority for us up to 2030, especially for passenger cars and light commercial vehicles. By the end of 2023, our customers will be able to choose from more than 150 different e-models. To achieve the goal of climate-neutral transport in 2050, alternative powertrains and fuels such as hydrogen and e-fuels will also be part of the solution. These technologies can make an important contribution to climate protection in transport because they reduce CO2 emissions in the vehicle fleet and are a good complement to electromobility when phasing out fossil fuels.
    - Attractive framework conditions are key. This includes, as a priority, the accelerated development of a Europe-wide charging infrastructure. Alternative fuels from sustainable resources must also be supported so that they can make their contribution to climate-neutral transport in 2050. In Germany and Europe, the course must now be set for this and funding must be initiated.

3. **What do you think are barriers for German car manufacturers to a rapid positive impact on SDG 13?**
    - The climate targets can only be achieved if the ramp-up of alternative drive systems and electromobility pushed by the automotive industry is accompanied by a massive expansion of renewable energy, an ambitious entry into the hydrogen economy and green infrastructures across the board. Increasing the share of renewable energies in electricity consumption to 80 percent is the right goal. But to achieve this, the expansion of wind and solar energy must be more than tripled by 2030. Distribution grids must be comprehensively modernized and digitized in order to supply 15 million electric vehicles with renewable electricity without interruption. Nationwide, at least 2,000 public charging points must be added every week, nearly ten times more than last. The necessary charging and hydrogen infrastructure for heavy-duty vehicles must also be taken into account. And finally, as far as alternative fuels are concerned, a clear commitment is needed that the vehicle fleet can also be driven in a climate-neutral manner.

4. **What are the key stakeholders in the industry that have the greatest impact during the process of achieving SDG 13? And Why?**
    - For reasons of antitrust law, the VDA is unable to comment on question 4

5. **What is the role of German OEMs within the process of transforming the industry to a zero-carbon sector?**
    - Last year (2020), electromobility achieved its breakthrough in Europe (EU including the UK and the European Free Trade Association, EFTA). New registrations of electric passenger cars rose 143 percent to 1.368 million vehicles. Europe thus overtook China as the largest e-market last year. The German automotive industry is already the European champion in electromobility. In Germany, German group brands have increased their market share to two-thirds of all new electric registrations. The example of Norway shows that German manufacturers have the best offerings, especially in highly developed e-markets. By the end of 2023, our companies will more than double their e-range to 150 models

6. **In which area of the supply chain are OEMs able to have the greatest impact in order to decarbonize it? (i.e. steel production, plastics, etc.)**
    - The introduction of alternative drive technologies based on renewable energies - whether in the form of electricity, hydrogen or synthetic fuels - will lead to a shift in the CO2 hotspot from the use phase to the production and material supply chain of a vehicle with its approximately 7,000 components and parts in the coming years. The German automotive industry's strategy for reducing its carbon footprint therefore goes far beyond the product's use phase and considers the entire life cycle of a vehicle, from raw materials to manufacturing and recycling. Nevertheless, it is not only stakeholders that can be directly attributed to the automotive industry - such as steel manufacturers - that are called upon here.