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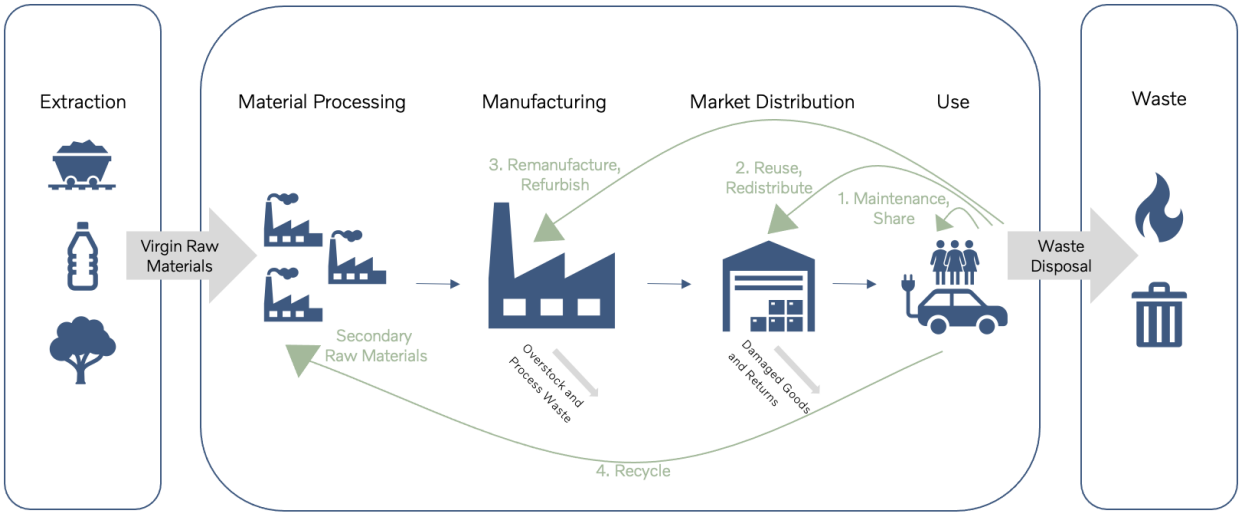

Managing Sustainability in Strategic Decision-Making

Life cycle thinking for sustainable innovation - A case study at Volvo Cars

Master's thesis in Management and Economics of Innovation

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Cover: Use life cycle thinking in order to optimize for a circular closed-loop system, and reduce extraction of virgin raw materials and waste.

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Abstract

To comply with the Paris Agreement, focusing on reduction of greenhouse gas emissions to keep global warming during the 21st century below 2°C, companies worldwide have to incorporate sustainability into their business models. The automotive industry is an example of an industry that needs to change to provide mobility in a more sustainable way, and to make a difference the change has to go beyond just shifting to electric motors. A pervasive shift involving all business units is needed to take lead in this. The study's aim is to investigate how decision-making with regard to sustainability assessment is done in the automotive industry, where circular life cycle thinking will be considered. This qualitative study is designed with stakeholder theory in mind, where a literature review and iterative, semi-structured interviews with project leaders will be used to construct a sustainability assessment tool to support decision-making. Additionally, a sustainability benchmarking was performed to investigate Volvo Cars' and ten other companies' sustainability performance. The study found that to incorporate sustainability in strategic decision-making, the top-down perspective, integration with existing formal processes, and standardization are key. Carbon pricing could be a useful tool to prepare for upcoming regulations as it is easy to understand, but very risky if the wrong price level is used. Finally, the study also shows that a green tax change could incentivize companies to be more sustainable and increase their competitive advantages by becoming climate-neutral.

Keywords: sustainability, decision-making, innovation, management, life cycle thinking, mobility, automotive, circular economy, stakeholder management, green tax change

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Beatrice Bergström, Gothenburg, June 2021
Henrik Edstrand, Gothenburg, June 2021

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Abbreviations

CO2e	Carbon Dioxide Equivalents
ETS	Emission Trading System
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GHGP	Greenhouse Gas Protocol
ICP	Internal Carbon Pricing
KPI	Key Performance Indicator
LCA	Life Cycle Assessment
LCM	Life Cycle Management
LCT	Life Cycle Thinking
MCDM	Multi-Criteria Decision-Making
MVP	Minimum Viable Product
PMO	Project Management Office
PPP	Polluter Pays Principle
PS&L	Parts Supply and Logistics
SBTi	Science Based Targets initiative
SCM	Supply Chain Management
SDG	Sustainable Development Goals
SFA	Strategic Focus Area
VCSB	Volvo Cars Service Business
ZEV	Zero-Emission Vehicle

1

Introduction

This chapter will provide a brief background regarding sustainability as a topic followed by a description of the case study conducted in collaboration with Volvo Cars. The study's aim, research questions and delimitations will also be presented.

1.1 Background

Despite various calls to action to save our environment, greenhouse gas emissions are still increasing globally (Ritchie & Roser, 2020). For example, the Brundtland Commission's definition of sustainable development, Sustainable Development Goals introduced by the United Nations, countries worldwide committing to the Paris Agreement (UNDP, 2018; UNFCCC, n.d.; WCED, 1987). The CO2e reductions worldwide will have to come faster the longer the world waits with embracing sustainability (Ritchie & Roser, 2020).

The transports sector, where automotive is included, accounts for 25 percent of the total greenhouse gas emissions in the European Union (European Commission, 2019). Due to this fact, the automotive industry is currently facing a technology transition toward providing mobility in a sustainable fashion. New, disruptive entrants focusing on electric vehicles have emerged on the automotive market lately (Song et al., 2019).

According to Christensen (2013), incumbents in an industry that is about to be disrupted have to invest in the new technology to secure its position on the market. If they do not realize this in time, they will be outcompeted by new disruptive entrants. Traditional automotive companies are facing a technology transition toward electric vehicles. This transition is further driven by the fact that electric vehicles do not have any emissions during the use-phase (Ellsmoor, 2019). The legislative environment will further favor sustainable companies, which leads to this firm technology push from two directions.

1.2 Case Situation: Parts Supply and Logistics, Volvo Cars

This study includes developing a Sustainability Assessment Tool for a department called Parts Supply and Logistics (PS&L) working with the aftermarket supply chain at a global automotive company called Volvo Cars. For a more thorough company description, see Volvo Cars on page 6. PS&L's Project Management Office (PMO) continuously run projects to optimize the spare parts distribution to car workshops worldwide and needs to consider sustainability early on in all projects. The sustainability assessment tool intends to support project leaders considering sustainability in their strategic decision-making.

1.3 Aim and Research Questions

The aim is to investigate how decision-making with regard to sustainability assessment is done in the automotive industry, where circular life cycle thinking will be considered. Furthermore, an assessment tool aligned with Volvo Cars' sustainability strategy will be developed to emphasize environmental impacts in the decision-making process.

The project will aim to answer the following questions:

RQ1. How can ecologic sustainability be considered early on in strategic decisions?

RQ2. How should emissions be accounted for in decision-making? Should CO2e be converted to monetary terms or be budgeted for separately?

RQ3. How would an automotive company, like Volvo Cars, be affected by a green tax change policy?

1.4 Delimitations

This study will mainly focus at ecologic sustainability. Social and economic sustainability, will also be considered but will not be in focus. The tool developed will consider only strategic decisions made by the aftermarket department PS&L at Volvo Cars.

1.5 Project Outline

The report starts with a *Literature Review* chapter where major concepts such as regarding sustainability in projects, innovation, and stakeholder theory are defined. The *Literature Review* is followed by a *Methods* chapter which explains how the study was conducted. The study started with literature review combined with interviews to understand the context surrounding the case company and its industry. The main interview study, which lasted for 8 weeks in total, was used to develop a sustainability assessment tool for the case company. Finally, the tool was integrated to the company's formal processes to ensure that it is being used and considered early in all projects at PS&L. The *Results* chapter describes the features for the final version of the Sustainability Assessment Tool. Furthermore, key messages from expert interviews throughout the study are also documented here with short abstracts of the interviews' minutes. This is followed by a comprehensive *Analysis* that aims to further investigate the three research questions, based on this study's results combined with theory. The *Discussion* chapter highlights strengths and weaknesses in this study. Finally, the research questions are answered in the *Conclusion* chapter.

2

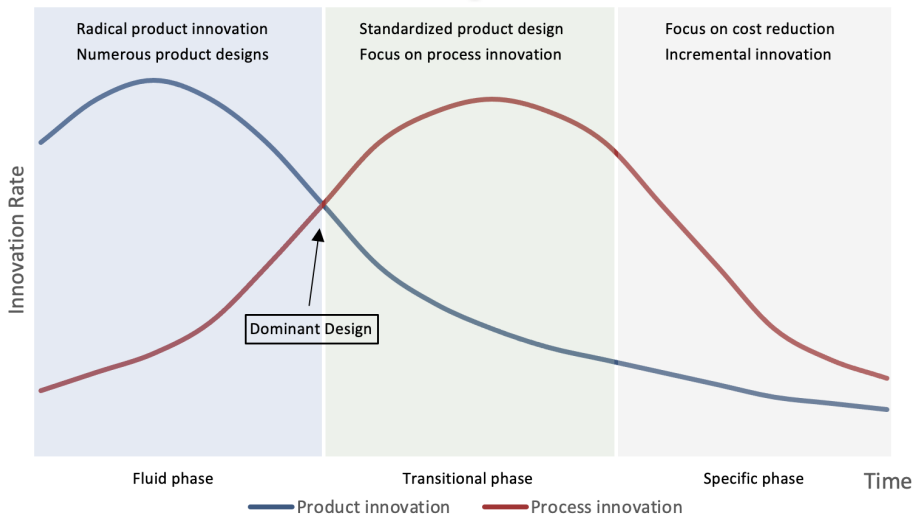
Literature Review

The literature review act as a basis to get knowledge and insights in the area of research. The chapter is divided by subjects that have to be introduced for the analysis or to describe contextual nuances regarding sustainability in the automotive industry, life cycle thinking, and innovation management with stakeholders in mind during technology transitions.

2.1 Technological Transition and Innovation Management

When introducing an innovation, the change in performance, function, and design is abundant (Abernathy & Utterback, 1978). The product line varies depending on customers' needs and preferences, which at this point is not yet specific. This is called the fluid phase of innovation. With time in the fluid phase, there is a consolidation of different designs converging to one single design. This design gets more frequently adopted and popular and is called the dominant design. Before the transitional phase, the process innovation is kept relatively low compared to the product innovation (Abernathy & Utterback, 1978). When a dominant design though is reached, process innovations surge to improve quality and optimize the production. When both a dominant product design and process design have been found, the focus shifts to incremental innovations to reduce production costs. This is represented by the specific phase in Figure 2.1 (Abernathy & Utterback, 1978).

Figure 2.1: Three phases of innovation, based on Abernathy and Utterback (1978). Characteristics of each phase are presented in the figure.



2.2 Stakeholder Theory

Many project failures stem from project managers fail to identify the group of entities that affect or are affected by the project (Eskerod & Jepsen, 2013). These entities are called project stakeholders and can, for example, be a person or a department within or outside the company (Mitchell et al., 1997). Stakeholders are somehow always represented by individuals with their beliefs and interests, and those have to be identified and not just treated as black boxes as the management literature often does with stakeholder theory according to Eskerod and Jepsen (2013). Project stakeholder management is a structured way to identify the project's stakeholders and analyze them. Eskerod and Jepsen (2013) suggest the following framework for identifying project stakeholder:

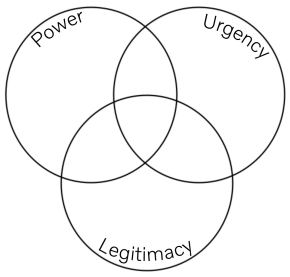
1. Identification: Who can be affected by the project process or the project deliverables?

2. Assessment: How should each stakeholder contribute to creating a project success? What are the motivations of each stakeholder?

3. Prioritization: Which stakeholders are currently most in need of attention?

The result of this framework may be presented in a table summarizing the stakeholder brainstorming exercise (Eskerod & Jepsen, 2013). Mitchell et al. (1997) propose a theory to identify and categorize stakeholders based on their salience in the organization by using the three words power, legitimacy, and urgency. From a stakeholder theory perspective, (Mitchell et al., 1997, p. 854) defines salience as "the degree to which managers give priority to competing stakeholder claims". Power is when person A gets person B to do a certain thing that person B otherwise would not have done. Even if power is hard to define, it is still most often easily recognized when it is exercised. The second category, legitimacy, can be described using power. If a stakeholder with power makes illegitimate decisions, it will lose the power as the decisions are not morally legitimate. If one stakeholder has both power and legitimacy, then the stakeholder has authority. The third category, urgency, is defined as when someone calls for immediate action. The urgency often appears when a claim is time-sensitive and important for the stakeholder. When identifying those different stakeholder types, a single stakeholder can hold one or many identification categories. If the first one has power, the second one has legitimacy, and the third one urgency, they will become competitive together (Mitchell et al., 1997).

Figure 2.2: Based on a conceptual model from Mitchell et al. (1997), showing stakeholder identities and different stakeholders have to cooperate to become competitive.



2.3 Sustainability in Mobility

The automotive industry is facing a big technology shift as customers are getting more aware of the carbon footprint their way of transporting cause (Laya et al., 2020). The increased customer need, firmer emission regulations, a more accessible charging infrastructure, and lowered costs of batteries have given electrified vehicles an upswing (Gao et al., 2016). Today, one-fourth of all emissions in the EU come from transports, and this number is still increasing (European Commission, 2019). To achieve the goal of climate neutrality by 2050, transport emissions need to be reduced by 90%. To accomplish this, the European Commission has set up milestones for 2030 and 2050 regarding zero-emission vehicles (ZEV) (electric vehicles powered by green energy). By 2030, there is a need for at least 30 million ZEVs to be on the roads in Europe, and by 2050 this number will have to increase to include nearly all cars on the roads (European Commission, 2020). From 2019 to 2020, the global sales of electric cars surged by 43% and 10 million cars (IEA, 2021).

An alternative to using cars as a transport mode in cities is electric scooters. Voi, a Swedish electric scooter brand, was established in 2018 and has now been spread in parts of Europe (Voi, n.d.). When introduced, the rechargeable scooters had built-in batteries, so the scooters had to be collected from the street and transferred away to be charged. In 2020, Voi introduced scooters with interchangeable batteries, thus a battery could be exchanged on the spot without taking the scooter off the street. According to Voi, this change led to operational emissions dropping by 95% (Voi, n.d.). It is also possible for the scooters to have 100% up-time as the scooters are not taken off the streets to be charged.

2.3.1 Conflict Metals in Battery Electric Vehicles

Even though electric vehicles help to fight climate change, they also pose a risk for the environment regarding manufacturing and waste management (UNCTAD, 2020). As lithium-ion batteries require a lot of raw materials that primarily are extracted in developing countries. Hence, these countries have to pay the environmental costs of the batteries (UNCTAD, 2020). In The Democratic Republic of the Congo, where 50% of all the cobalt in the world today is found, around 40.000 children are working in the mines, inhaling the toxic dust from the extraction (UNCTAD, 2020). According to Ellsmoor (2019), there is a problem with how batteries are manufactured in China as it currently produces up to 60% more CO2e than producing a combustion engine. However, the emissions can be lowered by 66% by adopting European or American production techniques. From cradle-to-gate, the electric vehicles have a larger carbon footprint, but when the entire life cycle is accounted for the electric vehicles still outcompete traditional internal combustion engines as electric vehicles do not have any tailpipe emissions (Ellsmoor, 2019).

2.4 Volvo Cars

Volvo Cars was founded in 1927 and has its headquarters in Gothenburg, Sweden. Nowadays, Volvo Cars and its strategic affiliates, Polestar and Lynk & Co, are part of the Geely Group that is based in China (Volvo Cars, 2021). The company has 38000 employees worldwide and sells cars in around 100 countries. Currently, the automotive markets in China and the United States show the largest sales growth for Volvo Cars. Car subscription services are offered by Volvo's "Care by Volvo" business model and by the carpool service "M - Volvo Car Mobility" (Volvo Cars, 2021).

Volvo Cars is currently in a technological transition. In 2017, Volvo Cars publicly announced that they are shifting focus to electric vehicles while phasing out the internal combustion engines. In addition to that, Volvo Cars will also convert to selling cars online. Safety has traditionally been a core value at Volvo Cars, but now they intend to make sustainability just as important as safety. This is further expressed in the sustainability strategy's three pillars: Climate Action, Circular Economy, and Ethical and Responsible Business. The sustainability strategy connects to five of the SDG goals: 5 (Gender Equality), 8 (Decent Work and Economic Growth), 11 (Sustainable Cities and Communities), 12 (Responsible Consumption and Production), and 13 (Climate Action) (Volvo Cars, 2021).

Parts Supply and Logistics (PS&L), which is part of Supply Chain Management at Volvo Cars, forms distribution concepts and achieves market implementation together with national Volvo Cars sales companies. The responsibility covers the entire material flow from suppliers to retailers during the cars' entire lifecycle. The business is built around a central distribution warehouse in Gothenburg, with over 50 distribution centers worldwide, where PS&L is responsible for supplying spare parts and accessories.

With the company's bold ambitions and targets, PS&L faces the challenge of turning the strategy into action while delivering reliable customer service to a growing car park. PS&L has the vision of environmental sustainability in everything they do. Their environmental impact and alignment with the company's sustainability strategy must be secured in the strategic decision-making. Shifting to a business model with sustainability as a core value, where electric vehicles are an important step but far from enough to fulfill all the goals, poses Volvo Cars to a challenging technology transition.

2.5 Sustainability Initiatives at Other Companies

A sustainability benchmarking was conducted to describe how Volvo Cars' initiatives are positioned compared to ten other businesses. They are all international, producing companies. Three of them are in the automotive industry, while the remaining seven operates in different industries. The companies chosen for the benchmarking are AstraZeneca, BMW, Electrolux, General Motors, Husqvarna, IKEA, SKF, SSAB, Volkswagen, and Whirlpool. A full description of the benchmarking can be found in Appendix E.

Table 2.1 shows that CO2 ambitions vary from a holistic perspective to an extended life cycle thinking that includes the product's use phase. The transition to circular flows and the use of renewable energy shows that Husqvarna has come the furthest, which is also supported by that the sustainability work is integrated into decision-making. Whirlpool's 2-degree goal is in line with the ambition of the GHG protocol and decision making. Husqvarna does follow-up on the product's CO2e footprint as an alternative to LCA.

Table 2.1: Benchmarking with companies within home appliances

	Husqvarna	Electrolux	Whirlpool
Paris agreement	1,5-degree target	1,5-degree target	2-degree target
CO2 targets	2025 reduction 35% in value chain	2025 reduction 80% in production and 25% in products 2030 climate neutral operations (1 & 2) Reduce emissions from sold products by 25% 2050 climate neutral value chain	2030 reduction 20% in products use, Reduction 50% scope 1 & 2 Reduction 20% in product use phase (scope 3)
Circularity	50 innovations		2025, 18% recycled plastic in products
Renewable energy	100%		
Mission	Lead transition to low-carbon and resource smart economy, climate action urgency	Sustainable leadership and sustainable strategy	Protect environment
Actions	Indicators: product carbon footprint	Energy efficient products Life cycle thinking Indicators at business area level	LCA
Governance	Top management, integrated in decision making	Top management, partly integrated in decision-making	Top management, considered in decision-making

From Table 2.2 it is seen that both Volkswagen and BMW report according to the GHG protocol, but in comparison with General Motors, they report CO2 targets within Scope 3 with a product focus on the use phase. Volkswagen seems to have come the furthest in the transition to circular flows with the ambition of reducing the amount of waste in the products. How is not clearly described whether there is a better use of materials in the production or reuse of components. From Appendix E, it seems that Volkswagen is hoping for investors, which makes the 2-degree goal interesting. It is clear that European car manufacturers have come further in climate change than American ones.

Table 2.2: Benchmarking with companies within the automotive industry.

	GM	BMW	Volkswagen	Volvo Cars
Paris agreement	2-degree target	1,5-degree target	2-degree target	1,5-degree target
CO2 targets	2050 reduction 31% (scope 1 &2)	2025 reduction 50% in EU fleet	2025, Reduction 30% of decarbonization index/vehicle 2051 Neutral carbon footprint	2025, Reduce CO2 by 40% per car 2040, Climate neutral company
Circularity				2040, Circular business
Material	2050, 50% Sustainable material in vehicles		2025 reduction of waste by 45% per vehicle	
Renewable energy	2040, 100% globally	2021, 100%		2025, 100% at tier 1 suppliers
Mission	Climate is change real in transportation	Sustainability considered a premium offer worldwide	Sustainable investments, Build future mobility	Freedom to move in a personal, sustainable and safe way
Actions	Green tariffs Scope 3 cover targets which accounts for 98% of emissions	LCA	Decarbonization index, 20 Euro/tonne CO2 Internal CO2 fund	2030, Pure electric car company LCA
Governance	Top management, Cross-functional teams, considered in decision-making	Top management, sustainable and mobility department, integrated in all decision-making	Top management, integrated in decision-making	Board of Directors set direction and approve sustainability strategy, Executive Management Team governs, execute and implement strategy, and Global Sustainability Team day-to-day governance

Seen in Table 2.3, SSAB is working towards the 2-degree goal, which is not surprising since the steel industry is CO2 intensive. SKF has the same type of CO2 targets as the companies in the automotive industry and AstraZeneca is in the same position as Whirlpool when it comes to CO2 goals, but that they can easily switch to renewables and thus completely remove CO2 emissions. Just like Husqvarna, IKEA also has a value chain perspective and uses carbon footprints as an indicator. Interesting activities are SKF's choice when selecting suppliers and AstraZeneca's Score card.

Table 2.3: Benchmarking with companies within other industries.

	IKEA	SKF	SSAB	AstraZeneca
Industry	Furniture	Manufacturing	Manufacturing	Pharmaceuticals
Paris agreement	1,5-degree target	-	2-degree target	1,5-degree target
CO2 targets	2030, reduce by 50% the climate footprint in value chain, Reduce 15% GHG emissions	2025, reduction in production by 40% per tonne sold product Reduction in transportation by 40% per tonne sold product 2030. Carbon Neutral	2032, reduce scope 1 & 2 CO2 emissions by 35% 2045, fossil free operations Fossil free steel	2025, reduction 100% of emissions in scope 1 & 2 Reduce 25% emissions scope 3
Circularity	Business in Transition			
Material			Recycling of steel	
Renewable energy	2030, 100% in value chain	2030, 100% renewable electricity		2025, 100% renewable electricity globally
Mission	Products and services that are affordable and good for people and the environment	Acting on climate change to reduce risk in operations and the environmental impact	Sustainability is good for business	Access to sustainable heath care and global leadership in managing environmental impacts
Actions	Life cycle perspective	Selecting suppliers with low CO2 emissions	CO2 costs	LCA Sustainability scorecard
Governance	Strategic sustainability counsel, Integrated into decision-making	Top management, integrated decision-making	Top management, Sustainability officer operative, considered in decision-making	Top-management, cross functional working groups, considered in decision-making

In Table 2.4 below, a summary of the sustainability benchmarking with ten other companies and Volvo Cars is presented. As seen, all chosen companies have goals for their CO2e emissions, which is the only thing all companies have in common. All companies also state that they report Greenhouse Gas (GHG) emissions from all three scopes, but two of them could not easily be found in the annual reports. Furthermore, all companies except SKF are aligned to keep global warming below 2°C, while only 6 of the 11 companies are aligned with the 1.5°C target. More interesting is the comparison of GHG emissions related to the company's revenue. This comparison makes it easier to compare the companies to each other and see which of the companies has more emissions per revenue than the others.

Table 2.4: Summary of the benchmarking with Volvo Cars and ten other companies.

Company / Initiative	Astra-Zeneca	BMW	Electrolux	General Motors	Husqvarna	IKEA	SKF	SSAB	Volkswagen	Volvo Cars	Whirlpool
CO2 goals	x	x	x	x	x	x	x	x	x	x	x
LCA	x	x	x		x				x	x	x
Carbon Pricing									x		
SBTi targets set	x	x	x		x	x		x	x	x	x
1.5°C goal	x	x	x		x	x				x	
2°C goal	x	x	x	x	x	x		x	x	x	x
Total x	**5**	**5**	**5**	**2**	**5**	**4**	**1**	**3**	**5**	**5**	**4**
Revenue (in billion USD)	26.6	120.64	12.63	137.2	5.02	28.84	7.49	7.98	275.2	28.38	19.46
# Employees (in thousands)	76	134	48	164	12	25	40	14	665	38	78
Industry	Pharma-ceutical	Automotive	Home appliance	Automotive	Consumer durables	Retail	Industrial goods	Steel	Automotive	Automotive	Home appliances
Headquarter location	Cambridge, UK	Munich, Germany	Stockholm, Sweden	Detroit, USA	Stockholm, Sweden	Delft, Netherlands	Gothenburg, Sweden	Stockholm, Sweden	Wolfsburg, Germany	Gothenburg, Sweden	Benton Harbor, USA
GHG emissions (in million tonnes)	8.26	76.0	-	255	5.10	21.2	1.32	15.6	376	34.3	-
GHG emissions per revenue (kg/USD)	0.31	0.63	-	1.86	1.02	0.74	0.18	1.95	1.37	1.21	-

2.6 Life Cycle Thinking

Life cycle thinking (LCT) is a systems approach focusing on the environmental impact from a product's entire supply chain (Baumann, 2013). LCT contains all the tools and actions to achieve the goals of promoting sustainable production (Mazzi, 2020). The goal of LCT is to improve the social, economic, and environmental impact of a product or service through its lifetime and to reduce resource usage and emissions (United Nations' Life Cycle Initiative, 2020). The approach focuses on the whole chain for the product, from raw material extraction to usage and finally waste disposal. By taking a systems perspective into account LCT avoids moving the burden from one part of the supply chain to another (Sonnemann et al., 2015). By this, it can be avoided that one step of the product's life chain does not create a bigger burden in another step of the chain.

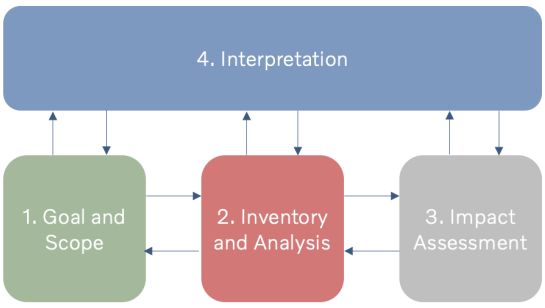
To minimize impacts from a product or service, five areas can be looked into in LCT: lifetime extension, dematerialization, manufacturing efficiency, substitution, and recovery (Olivetti & Cullen, 2018). Trade-offs between these areas can be avoided by taking into consideration the whole life cycle and the implications on the environment, economic and social pillars (Mazzi, 2020). As a result of considering the whole chain, the transition to sustainable development is faster than if the decisions were isolated. There are different kinds of tools and techniques that can be found within life cycle thinking, for example, Life Cycle Assessment, Life Cycle Management, Life Cycle Costing, Cost-Benefit Analysis, and Input-Output Analysis (United Nations' Life Cycle Initiative, 2020).

2.6.1 Life Cycle Assessment

Life Cycle Assessment (LCA) is an important and well established tool within life cycle thinking (Baumann, 2013). The LCA looks at a product or service material consumption and energy flows throughout the complete process chain. The LCA has been standardized by the International Organization for Standardization (ISO) in ISO 14040 (Baumann, 2013). As a product often passes through several different organizations throughout its lifetime, the responsibility of the product and the footprint that it makes is spread over multiple firms (Arthur, 2008). The LCA assesses the environmental impact, hence it does not consider the economic and social sustainability dimensions connected to the product itself (Curran, 2016). The purpose of only looking at this aspect is to find the most fulfilling option according to environmental consequences.

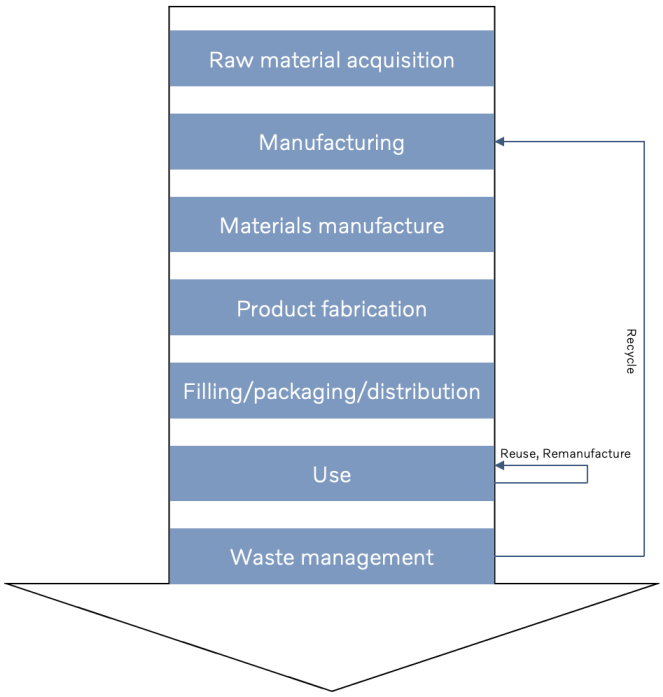
The LCA method has four complementary phases (ISO, 2006). These are the definition phase for the scope and the goal, the inventory analysis phase, the impact assessment phase, and the interpretation phase. The phases can be seen in Figure 2.3 below.

Figure 2.3: The four complementary phases in an LCA.



An LCA begins with clearly stating a goal (Curran, 2016). This will help set the scope for the study and navigate the data inventory. Connected to the goal is also to identify which function the analysis should fill, and all environmental impacts are connected to this function. According to Curran (2016) the following stages in the life of a product are included in the analysis: raw material acquisition, manufacturing, materials manufacture, product fabrication, filling/packaging/distribution, use/reuse/maintenance, and recycle/waste management. At the end-of-life of a product, the material should preferably go back into the material loop again through either reuse, remanufacturing, or recycling, see Figure 2.4. The results from different LCA are only comparable if the underlying assumptions and context are similar, that is, LCA deals with functional units (ISO, 2006).

Figure 2.4: Material stages in a life cycle assessment.



2.6.2 Life Cycle Management

Life cycle management (LCM) is a concept which combines a life cycle approach for companies to oversee their value chains to improve their sustainability performance. It is applied in industrial and service sectors to help with the improvement of products and services (Sonnemann et al., 2015). The goal of LCM is not to develop methods in each separate company, but rather to organize the environmental work among the actors within a system (Baumann, 2013), and the product or service is looked upon throughout many organizations (Hunkeler et al., 2004). The framework should be applied at all levels of the organization as every single decision will impact a product's or service's life cycle. There are different ways to implement LCM, so a key is that it has to remain flexible for different business units. Needed are though concepts, programs, and techniques (tools) (Hunkeler et al., 2004), and also continuous support from top-level management (Sonnemann et al., 2015). To get this continuous support, it is not enough to show environmental and social benefits, it also needs to point out economic benefits that the company can gain.

2.6.3 Greenhouse Gas Protocol

Greenhouse Gas Protocol (GHGP) is an international standard for reporting emissions that drive climate change (Ranganathan et al., 2004) based on LCT. The protocol is divided into three scopes where Scope 1 and 2 are mandatory to report and Scope 3 is optional (Barrow et al., 2013). Scope 1 includes the direct emissions that are controlled by the reporting entity, Scope 2 covers the indirect emissions that come from the consumption of purchased electricity, heat, or steam, and Scope 3 is related to other indirect emissions, such as waste or end-of-life treatment of sold products (Barrow et al., 2013).

The GHGP is based on the ISO 14064 standard (Arthur, 2008). Scope 1 and 2 are more precisely defined to get comparable results between companies (Ranganathan et al., 2004). Besides the comparability, it is also crucial that emissions are not counted twice for example in a company group with a parent company. Scope 3 is not as well defined and it is not optional to report. In some business contexts, Scope 3 will include most of the emissions if the company for example uses a lot of subcontractors and, by that, not control the emissions themselves in a direct way (Ranganathan et al., 2004). While an LCA focuses on a product or service's emissions throughout the life cycle, the GHGP takes a company perspective instead and tries to capture emissions caused by a single company.

2.7 How to Incorporate Sustainability in Decision-Making

The achievement of sustainable methods is becoming an increasing challenge for organizations to face as stricter government regulations are forcing companies to become more sustainable (Cabot et al., 2009). As more stakeholders, such as investors and customers, are becoming increasingly aware of the impacts companies have on the sustainability transition in society, they can benefit companies that are engaged in sustainable activities (Calabrese et al., 2019). However, if companies try to engage in sustainability without having a strategic approach, they risk devoting time and effort to activities that do not support their business strategy, which is important to achieve competitiveness and wellbeing of stakeholders and employees. According to Porter and Kramer (2006), sustainability strategies need to be formulated to generate shared value for the different stakeholders. Cabot et al. (2009) suggest incorporating sustainability in decision making by seeing it as an additional requirement that the business or system must meet. For the implementation of sustainability in the business to be successful, it needs to come from the top management and go top-down in the firm (Kiesnere & Baumgartner, 2020). Otherwise, the sustainability initiative risks not getting the support and attention it needs. The key challenge for both large and small businesses is that they lack the arrangement to integrate sustainability in decision-making (Shields & Shelleman, 2015).

2.7.1 What Gets Counted, Counts

Understanding the interrelatedness between economic value creation and sustainability performance is not an easy task. Epstein and Wisner (2013) argue that by developing performance metrics for internal use, managers will be held accountable to a greater extent for the sustainability performance. The act of capturing data and having a close relationship between the metrics and the strategic sustainability approach will create awareness and help sustainability initiatives gain importance. Balance scorecards for sustainability will provide a standardized method for a business to highlight strengths and weaknesses in their sustainability initiatives (Epstein & Wisner, 2013).

Furthermore, Epstein and Wisner (2013) suggest that reporting sustainability not only will help decision-makers internally but will also be useful for external stakeholders. Schaltegger et al. (2017) present from an accounting perspective that external stakeholders can only favor sustainable options if they report sustainability metrics. For companies that are pioneering in sustainability, it is key to report and communicate metrics regarding sustainability performance as accounting is supposed to depict a true picture of a company's performance (Schaltegger et al., 2017). Sustainability metrics have to be measured and reported to both internal and external stakeholders to be fully accounted for.

2.7.2 Different Business Strategies

The business model itself is important for sustainable innovation according to Bocken et al. (2015). Sustainable business models consider stakeholders beyond only customers and also take society and the environment into account. By internalizing the environmental damage, they change the way business is done (Bocken et al., 2015). Sustainable business innovation can give competitive advantages through improved customer value and at the same time contributing positively to the environment.

Traditional strategies, Transitional strategies, and Transformational strategies are three environmental strategy categories that are saying to which degree companies manage to integrate sustainability into their corporate strategy (Borland et al., 2019). Traditional business strategies are not concerned with ecologic sustainability at all, instead, they are only focused on making economic profits. The system is built in a linear fashion where products flow in a cradle-to-grave process. The whole system is an open-loop where used products are seen as waste (Borland et al., 2019). Transitional business strategies also operate in a cradle-to-grave fashion, open-loop system, but with an assumption that eco-efficiency should be pursued within the system. The strategy firms in this category are trying to achieve can be seen from a 5 R's perspective: reduce, reuse, repair, recycle and regulate (Borland et al., 2019). Transformational business strategies are the strategies that consider ecologic sustainability the most. Here are ecocentric companies that embrace ecologic sustainability. These business strategies operate in a closed-loop system, in a cradle-to-cradle fashion. The 5 R's from the transitional business strategies have evolved to new R's: rethink, reinvent, redesign, redirect and recover (Borland et al., 2019).

According to Borland et al. (2019), the three different types can be described as follows: the business model is not including sustainability at all (traditional), sustainability is an add-on requirement, but is centered around people and not sustainability (transitional), and having ecologic sustainability as a central, fully integrated part (transformational).

2.7.3 Different Decision Methods

The way to incorporate sustainability into decision making is still a question under investigation (Dobrovolskienė & Tamošiūnienė, 2016). There have though been several different models developed to assist in the incorporation. LCA-based approaches are among the most dominating models (Seuring, 2013). These are built upon environmental assessment techniques, and take a broad perspective to analyze impacts in a whole product system or service system (De Benedetto & Klemeš, 2009). How the approach is implemented depends from company to company based on their needs (De Benedetto & Klemeš, 2009).

Multi-criteria decision-making (MCDM) methods can help to support decision making when there are several decision criteria or alternatives which are conflicting that needs to be investigated (Dobrovolskienė & Tamošiūnienė, 2016). That is, MCDM methods try to find a compromise between different requirements in the decision-making process. Other models often used are equilibrium models that try to identify an equilibrium between different parameters (Seuring, 2013). This kind of technique is already well established, and one way to approach this is to look at the LCA of the decision.

Another method that companies can use is Internal Carbon Pricing. It is a practice to consider sustainability that companies adopt voluntarily (Bento & Gianfrate, 2020). Putting an internal carbon price can be done for several reasons: to help in risk management as companies increasingly are exposed to regulatory and financial risks, it allows to see which operations are vulnerable to increased carbon prices, and it can also be used as a factor in decisions involving greenhouse gases decisions (Bento & Gianfrate, 2020). More information regarding carbon pricing can be found in the section Internal Carbon Pricing.

2.8 Regulatory Measures to Reduce Emissions

There exist several different regulatory measures to reduce CO2e emissions. Concepts such as carbon tax, emission trading system, and green tax change are all measures controlled by regulatory bodies with the purpose to limit individuals and companies' climate impact.

The tragedy of the commons occurs when resources, that are limited but free of charge, are used by individuals or companies to serve their interests (Granstrand, 2007). Polluters today can often emit carbon dioxide and other climate gases into our atmosphere without having to pay for it (World Bank, 2018). Still, there is a cost for society to repair the damage that these polluters cause. From an economic perspective, this climate pollution is called a negative production externality that should be internalized for example by using carbon pricing (Khan, 2015). By doing this, the Polluter Pays Principle (PPP) is applied and the negative production externality is being internalized and reflected in the product or service's price. Khan (2015) continues to explain that during the Rio Summit in 1992 when Agenda 21 was agreed upon, it was also decided that the PPP should be applied in environmental legislation globally. The PPP has yet not been put into practice on a global level, which explains why individuals and businesses today can pollute at no extra cost. Some countries have introduced ways to price GHG emissions, but how the tax is applied varies from country to country and with varying success rates (Khan, 2015). Granstrand (2007) suggests multiple ways to solve the tragedy of the commons problems where environmental taxes is one possible way to go.

2.8.1 Carbon Tax

A carbon tax is a regulatory and mandatory measure used by some countries, but far from all countries have yet adopted carbon taxation systems. The advantage of such a system is that it is very predictable as the price for every tonne of pollution is predetermined (World Bank, 2018). In Sweden, a carbon tax was first introduced in 1991. From 1990 to 2018, the GDP has increased by 83% while the GHG Emissions have decreased by 27%. Given those numbers, this carbon tax seems to work (Government Offices of Sweden, 2021). The Swedish system does not measure actual emissions but puts an additional tax on all fossil fuels. Initially, the price was 250 SEK per tonne of fossil carbon dioxide and by 2021, the price had increased to 1200 SEK per tonne (Government Offices of Sweden, 2021).

2.8.2 Emission Trading System

Emission Trading System (ETS) is an alternative to the carbon tax where a nation for example has predetermined how many tonnes of GHG emissions can be emitted, and then a market is created where polluters trade for the rights to pollute (World Bank, 2018). This system, which sometimes also is referred to as a cap and trade system, is not as predictable as carbon tax because the market sets the price. The EU has established a system that in general follows this design to fight climate change within the EU (European Commission - Climate Action, 2017). It was introduced in 2005 as the world's first international ETS. The EU ETS argues to capture 40% of the EU's total GHG footprint and applies to heavy energy-using plants and airlines (European Commission - Climate Action, 2017).

2.8.3 Green Tax Change

Companies are today paying taxes for labor, and this has not been questioned until recently. A reform called Green Tax Change has lately started to gain attention and is being more frequently discussed. The green tax change can be seen as a powerful tool to acknowledge the transition to a more sustainable economy (Labeaga & Labandeira, 2020). The green tax change is in general suggesting lowered taxes on labor and entrepreneurship in exchange for a new environmental tax that for example can depend on a companies material usage (Government Offices of Sweden, n.d.). Environmental taxes are meant as a consequence to discourage the consumption and production of polluting products and activities by increasing the cost of it (OECD, 2017). The general idea is to assign taxes to climate-hazardous activities in exchange for other tax reductions. The following list presents potential and actual green tax change examples:

- The bonus-malus system for cars that increased taxes for cars with high CO2e emissions in exchange for climate bonuses paid by the government on environmentally friendly cars (Government Offices of Sweden, n.d.).
- Put a tax on manufacturing companies' usage of virgin raw materials in exchange for reduced employer contribution fee (labor costs).
- An increased tax on the energy produced from power plants using fossil fuels in exchange for tax reductions on energy from climate-friendly resources.

There is a discussion regarding if double dividends will follow from a green tax change or not (De Miguel & Manzano, 2011). If a double dividend will occur it will imply a welfare gain not only in pollution reduction but also welfare developed from a reduction in distortionary taxes. If this double dividend exists, it means that there is no cost for the economy to improve the environment. If green taxes are introduced independently, it can lead to additional costs for national industries in international markets (Albrecht, 2006). Powerful industries that are effectively organized will in that case lobby for tax deductions. To gain political support, there can be special measures for some chosen industries. In conclusion, according to EEA (2019), the green tax change could decrease income tax, stimulate innovation in the society, and at the same time lower pollution. Even if the initiative is still in its infancy, if implemented, it can change a lot in society. Albrecht (2006) states that drastic tax changes will lead to short-term, high adjustment costs.

2.9 Alternatives for Companies to Reduce Emissions

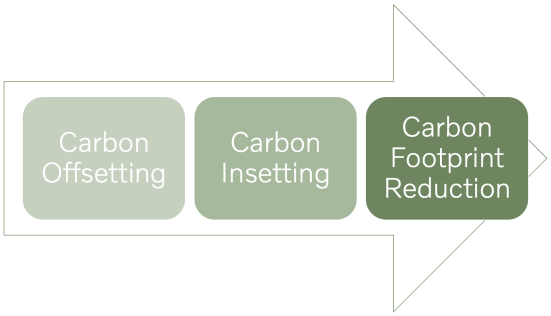
In general, there are three overarching alternatives for companies to reduce their GHG emissions: carbon offsetting, carbon insetting, and carbon footprint reduction. Carbon footprint reduction is the most tangible way to reduce GHG emissions compared to the other two alternatives. In addition to those three reduction methods, Internal Carbon Pricing will also be introduced as a potential solution to reduce CO2e emissions.

Carbon offsetting is a mechanism that aims to remove atmospheric carbon dioxide or reduce CO2e emissions at other companies or for other individuals (Hyams & Fawcett, 2013). Both organizations and individuals can contribute to this by supporting schemes such as planting trees. The contributions will reduce the company's baseline for carbon emissions, but the actual impact cannot be measured in a tangible way (Rahn et al., 2014).

Carbon insetting is slightly stricter than carbon offsetting but is still based on the same principles. The reduction activity has to be linked to the company's supply chain in one way or another to qualify as an insetting (Rahn et al., 2014).

Carbon footprint reduction is the third and final category of GHG-reducing activities. This is the strictest and most tangible option as this option actually is reducing one's emissions. Both offsetting and insetting can be found fuzzy and possibly not generate as much reduction as forecasted (Rahn et al., 2014).

Figure 2.5: The colors represent that Carbon Offsetting is the least and Carbon Footprint Reduction is the most tangible alternative to reduce GHG emissions.

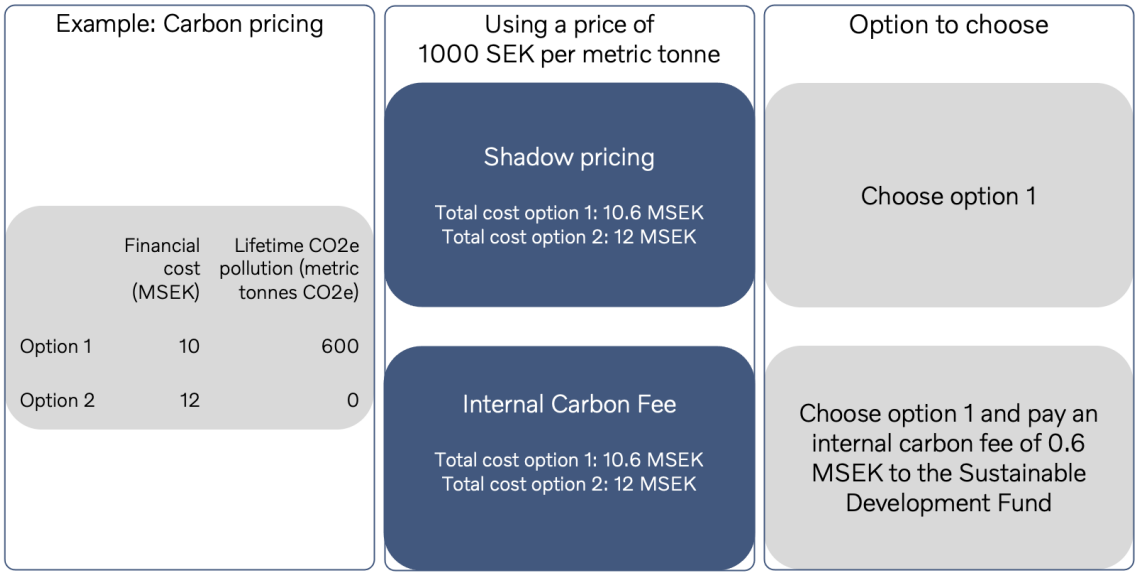


2.9.1 Internal Carbon Pricing

Internal Carbon Pricing (ICP) is a tool that some companies use voluntarily to incentivize low-carbon options (World Bank, 2020). There are many examples of how this can be done, but two recurring examples are using a shadow price or an internal carbon fee that raises money to a sustainability fund (World Bank, 2018). ICP has become a common corporate practice to consider climate risk and prepare for tougher regulations. According to an article published in Harvard Business Review by Aldy and Gianfrate (2019), there has been a rapid growth of companies using ICP over the past years. According to data by the Carbon Disclosure Project presented in the article, there were 1400 companies in 2017 that were already using or were planning to start using it shortly. Companies will likely be held accountable for their carbon emissions even more in the future as global warming is threatening the planet's survival (Aldy & Gianfrate, 2019).

ICP is a way for companies to take responsibility for the negative externality cost even if it today only is hypothetical. It is also a way to prepare for the environmental legislation that may come one day to ensure compliance with what countries worldwide agreed upon during the Agenda 21 in Rio, Brazil (Khan, 2015). The first option, to use a 'shadow price' is to put a price on every carbon dioxide equivalent in the daily operations (World Bank, 2018). Note that in the shadow system, the carbon price is just here for calculation matters but the cost neither affects the department's budget nor the income statement at a company level. The second ICP system is an 'internal carbon fee' that affects the department's budget by charging the department for the GHG emissions that they are accountable for, and the fee is used to fund a sustainable development fund (World Bank, 2018). The fund can then be used to invest in sustainability projects and by that the company compensates for its pollution in some way but it is still on voluntary premises.

Figure 2.6: The difference between using a Shadow Price or an Internal Carbon Fee.



Furthermore, the project or investment's time period is key when choosing how to price the CO2e emissions. Alphabet Inc (Google's parent company) used a price for their annual sustainability report in 2016 of 14 USD per tonne CO2e as that was the average price for the ETS system in California that year. Though, using today's carbon price level to hedge for future risks of a higher carbon price, might give a false sense of security (Aldy & Gianfrate, 2019). ExxonMobil is another company that uses ICP and they have set the price to 80 USD per tonne CO2e as they do more long-term investments and they foresee the risk of a higher carbon price worldwide (Aldy & Gianfrate, 2019).

3

Methods

This section will present the chosen methods for this study and that are needed to answer the research questions and, by that, fulfill the study's aim. A literature review was conducted to get an understanding of the context and gain area expertise. Interviews were held with experts from Volvo Cars as well as iterative interviews in conjunction with the tool development. The sustainability assessment tool was developed with key stakeholders at the company in mind. Finally, the Methods chapter presents analysis strategies.

3.1 Literature Review

The study started with reading articles and theories regarding sustainability, and more specifically sustainability in mobility. The main purpose of the literature review was to gain an understanding of the context. The literature review was mainly done in project week 1-4 but was to some extent ongoing throughout the study. The literature search focused on the following keywords: *battery electric vehicles, greenhouse gas protocol, decision-making + sustainability, life cycle thinking, stakeholder management,* and *green tax change*. External articles and information were retrieved through the Chalmers Library database and Google Scholar. Some articles were also provided by the study's supervisor from Environmental Systems Analysis at Chalmers University of Technology. Alongside with external information, internal documents from Volvo Cars were also studied regarding the company's sustainability strategy. The internal information from Volvo Cars was mainly used to build the customized sustainability assessment tool later on.

3.1.1 Sustainability Benchmarking

The companies were selected through a convenience sampling and were limited to producing companies. The benchmarking was conducted by reading the selected companies' sustainability and/or annual reports (the latest reports were used for each company, see sources for exact version), focusing on key areas such as CO2 reduction, temperature goal, life cycle assessment, sustainability governance, and GHG scopes. These areas helped in concluding which initiatives the companies have, how they plan to achieve them, and why they are doing it. The companies' reports were scanned for goals and targets related to the Paris agreement, CO2 goals in general, carbon pricing, product LCA, and targets validated by SBTi. The companies' revenue, number of employees, industry, headquarter location and GHG emissions were also depicted to be able to compare the size of the companies. For GHGP Scope 2 emissions, the location-based allocation method was used to calculate each company's the total emissions (Ranganathan et al., 2004). The location-based method used emissions from grids where the company actually use energy

in contrast to the market-based where the company can purposefully choose energy mixes by using different kind of contracts. Finally, the companies' eco-efficiency were computed. The benchmarking outcome of the companies can be found in Appendix E.

3.2 Interview Design

Semi-structured interviews were chosen for this qualitative study. All the interviews were conducted by both thesis authors to ensure all questions and possible follow-up questions were asked. The video conferencing tool Microsoft Teams was used for all interviews and all interviews lasted for 30 minutes. The full interview list can be found in Appendix A. Interview notes were taken, the interviews were recorded, and time-codes were noted upon asking every new question. One interviewer asked all the questions and could focus entirely on the interviewee, while the other interviewer took notes and dealt with time-coding. All interviews except for one were in Swedish as all participants were native Swedish speakers except Interviewee G. Insights have been extracted mainly from the interview notes and these have together with the recordings been the basis for the data analysis.

3.2.1 Expert Interviews

Expert interviews were conducted with people in close vicinity to the department in focus. For these interviews, a purposive sampling method was used by the thesis authors together with the supervisor from Volvo Cars. This method was suitable to find experts for the study's aim. These interviews were held to understand Parts Supply and Logistics (PS&L) daily operations and to see what tools that currently were in use to support decision-making. In addition, ideas from corporate role models were extracted to be incorporated into the sustainability assessment tool. Each expert interview had a unique subject, so no general interview guide was composed. Open-ended questions were made prior to each expert interview, and follow-up questions were asked depending on the answers given.

3.2.2 Iterative Interviews

Five interviewees out of nine project leaders at PS&L were selected for the iterative interviews. They were chosen in close collaboration with the supervisor at Volvo Cars to get a diversity sampling. To ensure the usability and that the tool made sense in decision-making, the interviewees were selected with a focus on diversity to make it represent the set of employees working at the department.

In addition to diversity in projects, the diversity sampling also considers intersectionality. In the iterative interviews, all interviewees were intended users of the final sustainability assessment tool. The interviews were semi-structured and all interviewees received the same questions. The interview templates used are reported in Appendix B.

The reference group, as a collection, was identified as a stakeholder in order for the project to succeed. The outcome of the interviews was a comprehensive list of requirements and wishes of how the tool could be further improved. The interview approach was used to brainstorm ideas with respondents that later on were tested in the following iteration of the tool to ensure the tool's user-friendliness and that it was aligned with the corporate sustainability strategy. In addition to the tool-specific questions, sustainability at Volvo Cars was discussed with the interviewees to capture the context and how detailed sustainability assessments the decision-makers require today.

3.3 Sustainability Assessment Tool

The sustainability assessment tool was created in Microsoft Excel. The tool aimed to assess sustainability in general, and is mainly focused at the ecologic dimension. The intended users are the project leaders at PS&L and the tool should be used in all projects carried out by the PMO team. The use of the tool is connected to the internal project phases. The project phase 'Funnel' occurs when a project idea has been voiced out but it is still not determined whether the project should be initiated or not. This is the first time the tool may be used to answer general and reflective questions. When the project reaches the 'Analyze' phase, the previous answers in the tool should be reviewed and the project leader may also answer some more questions that involve approximate calculations. In the 'Analyze' phase, a pre-study is conducted for potential solutions.

3.3.1 Project Stakeholders

Stakeholders were identified, assessed, and prioritized according to the frameworks presented in the Stakeholder Theory section (Eskerod & Jepsen, 2013; Mitchell et al., 1997). Stakeholder identification and assessment were important and central parts of this study's method. The stakeholder groups needed contribution, general requirements and wishes, and concerns are presented. The reference group forms a stakeholder group and their requirements and wishes were continuously extended during the tool's development process.

3.3.2 Tool Development

Microsoft Excel was chosen as a platform for the tool because both the thesis authors and Volvo Cars were familiar with the computer program. At first, a minimum viable product, version 0, of the sustainability assessment tool was created based on the needs expressed during the initial exploratory interviews and on insights from the literature review. As the tool's intended outcome was not clearly defined at the beginning of the study, it was found suitable to use an iterative interview and development process. Version 0 of the sustainability assessment tool was tested on the reference group in a workshop. The feedback from this open group discussion was used to create version 1.

Version 1 of the tool was a slightly modified version of an environmental checklist that already existed within the organization, which few project leaders knew of. From this version and onward, individual interviews with each of the members in the reference group were held after every new release of the sustainability assessment tool. The feedback acquired in the interviews was used as a basis for the upcoming version of the tool. Each version of the tool is described in the Results chapter where useful features are listed. Trade-offs between correctness and usability were evaluated throughout the tool development.

3.4 Analysis Strategies

This section will describe different strategies used to analyze the result of the study in the Analysis chapter to answer the three research questions. The analysis takes relevant material from both the literature review and the results chapter into account, hence a strategy is needed for how the analysis should be conducted.

3.4.1 Environmental Considerations

To understand Volvo Cars' current business situation, theory regarding innovation and technology transition has been important. Furthermore, management literature explaining the importance of top-down perspective, standardization, and integrating sustainability assessments in the formal process are among the main themes. Theory, combined with insights from the interviews were used to develop a customized tool for PS&L's PMO.

3.4.2 Carbon Pricing

The study has also analyzed how sustainability should be integrated in the business decision. By using qualitative data from the interviews together with theory, the second research question analyzes whether carbon pricing or carbon footprinting should be used. Furthermore, it investigates if carbon pricing could be used to prime to organization for upcoming regulations. To this research question, the benchmarking also provides information from other industries and if they successfully use carbon pricing.

3.4.3 Green Tax Change

By using data from an LCA of the XC40 (Volvo Cars, 2020b), a smaller SUV car by Volvo Cars, the study simulates how Volvo Cars would be affected by a green tax change. The concept is vaguely defined by EEA (2019) and Government Offices of Sweden (n.d.) and a possible application of it is fabricated by the thesis authors to be used in a hypothetical calculative example. The application is possible but has not been precisely formulated by any regulatory body that this study uses. To simplify the calculations, it is also assumed that all cars sold during 2019 were of the same XC40 model and that they are charged with global electricity mix during its use phase.

4

Results

This chapter will start with presenting key messages from the interviews, followed by an analysis of project stakeholders. The final version of the sustainability assessment tool developed for PS&L at Volvo Cars is also presented together with a sustainability benchmarking and potential impacts of a green tax change.

4.1 Key Messages Identified from Interviews

Key takeaways and insights from both the expert and iterative interviews will be presented in this section. The section is divided by themes that emerged from analyzing the interviews. The full interview schedule can be found in Appendix A.

4.1.1 No Best Practice to Assess Sustainability

The first identified theme is that there were no best practices in how to incorporate or consider sustainability in decision-making. If one wanted to make a sustainable decision, there was no standardized way how to weigh this against a more financially feasible alternative. In addition, it was not integrated with the project model to conduct a sustainability assessment. There were only occasionally requested by project stakeholders. Hence, several projects were executed without any thorough sustainability evaluation.

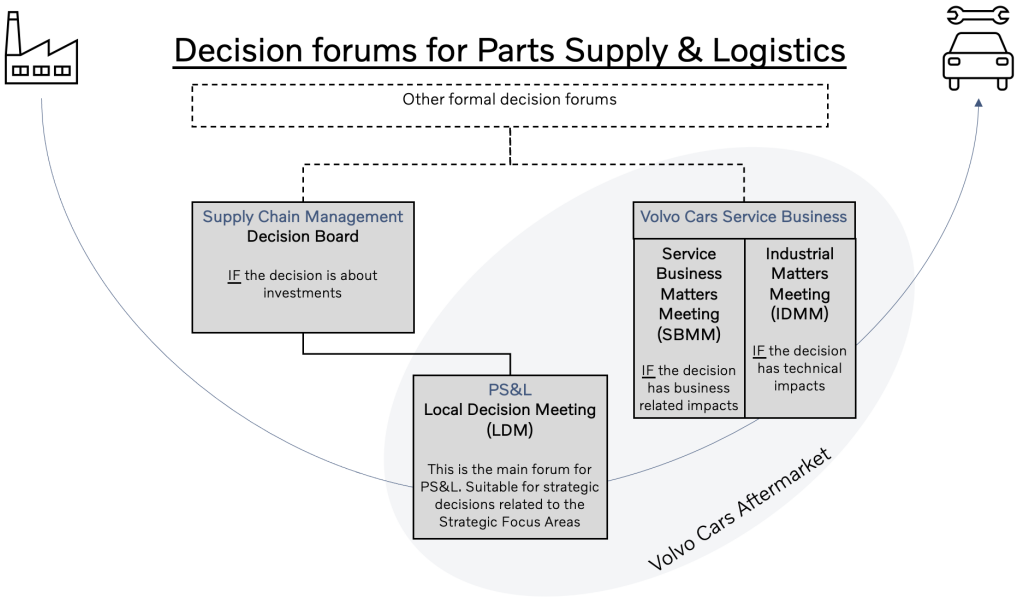
The employees felt uncomfortable in evaluating sustainability impacts in projects. It was found that when the environmental impacts had been evaluated, there was still not a standardized way of doing it. For example, the project leader could not find guidelines for how to calculate GHG emissions and standardized emission factors were not easily found. If an evaluation was conducted, it was hard to compare the evaluations between different projects or options due to a lack of standardization.

The initial expert interviews also revealed that other business units within Volvo Cars had emission factors for calculating CO2e emissions, but they were not spread within the organization and to PS&L. Some of these emission factors were approved by Volvo Cars Data Release Board and should be used as a standard within the company. This led to the insight that the thesis project was more about standardizing already existing tools and practices and make them accessible for everyone to use.

4.1.2 Ambiguous Decision-Making Process

During the early interviews with key people working at or in close vicinity to PS&L, an uncertainty of which decision-making body to consult in different scenarios was identified. The reason for this uncertainty was due to a recent reorganization of the business units. Parts Supply and Logistics (PS&L) had previously been subordinate to the Volvo Cars Service Business (VCSB) but was now part of Supply Chain Management (SCM). To simplify, PS&L was previously one step closer to the car repair shops (VCSB) but was now one step closer to the central logistics function (Figure 4.1). This could explain why project leaders argued that the decision-making process was ambiguous.

Figure 4.1: Decision-making forums. The solid line between PS&L and SCM illustrates that SCM was superior to PS&L in the organization's governance structure.



4.1.3 Ambitious Corporate Strategy

Various employees at Volvo Cars expressed that the corporate sustainability strategy was very ambitious compared to its competitors. Employees were interested in the ongoing transition highlighting sustainability as a core value within Volvo Cars. The interviewees acknowledged that the ambitious goals from the strategy were in place, but there was still work to be done to get the full roadmap in place on how to accomplish them. Even if the strategy was widespread all over the company, it was still not integrated into all work processes at PS&L. Therefore, the employees anticipated that there was room for the business unit to further commit to the corporate sustainability strategy.

In the projects led by PS&L, there were continuous steering group meetings that made decisions throughout the project. In these decision-making processes, sustainability was lacking as a formal requirement. One employee said that in some environmental projects, the question may occur occasionally. The department's focus was on offering aftermarket logistics worldwide at low cost while still keeping the customer service level within satisfactory levels. Sustainability was not necessarily considered in a standardized way.

4.1.4 Willingness to Price CO2e Emissions

Many interviewees asked for a price for CO2e emissions to be able to grasp the CO2 emissions' magnitude. Some business areas at Volvo Cars had incorporated Internal Carbon Pricing (ICP) temporarily in pilot studies, but no common price for CO2e emissions had yet been defined. In the pilot studies conducted, the CO2e cost seldom had an impact on the decision-making as the CO2e cost was too low to alter to the sustainable option. The takeaway for the environmental manager from the pilot studies was that CO2e could better managed and budgeted for in absolute terms.

The fact that ICP had been tested by various business units internally was later confirmed in an interview with a person working with climate action in the global sustainability team. In total two pilot studies were conducted and both used the shadow pricing model. Until 2025, Volvo Cars has clearly stated that they will not do any carbon offsetting for emissions, instead, the focus will be on shrinking their overall carbon footprint. However, from 2025 and onward the company humbly confessed that they may have to investigate offsetting alternatives to become climate neutral by 2040.

4.1.5 Circular Initiatives

To map circular initiatives, interviews were held with employees working with circular economy from both a strategic and operative perspective. The first interview was with a person working in the central sustainability organization with circular economy from a strategic perspective. The second person was working operationally with circular economy and more specifically with the logistics around component value retention.

A general circular mindset within Volvo Cars includes increasing the value of waste by, for instance, reusing parts from old cars and design for recycling to increase end-of-life recycling. The company will retain material in a closed-loop cycle, which supports both the circular economy and the climate action goal. When the value of waste has increased, it will no longer be labeled as waste but as material.

The component value retention at Volvo Cars was depending on a deposit system for repair shops. When a car repair shop replaced an engine, for instance, they were expected to return the damaged engine to the local distribution center. If they did not return the old component, the price for the new one would be significantly higher. The remanufacturing or recycling process would start when there were a significant amount of damaged components in stock. The damaged components were either shipped to an external partner or to a Volvo Cars-owned facility somewhere in the world. When the components were remanufactured, they still have to maintain the same quality standards as a new component. This deposit system was used before Volvo Cars initiated their circular economy strategy. When a car model was no longer produced, the deposit system was key to secure the supply of spare parts for already sold cars. Furthermore, it was a way to ensure exchanged components were not used in an unintended way or used by a competitor that may harm Volvo Cars brand. The electrification of Volvo Cars' vehicles was projected to increase the number of components returned to distribution centers from car repair shops.

4.2 Project Stakeholder Analysis

Table 4.2 below illustrates the identification and assessment phases described by Eskerod and Jepsen (2013). The identified stakeholders can be found in the left column combined with the assessment of each stakeholder in the other columns.

Table 4.1: Identified stakeholders and assessment of each stakeholder.

Stakeholder	**Stakeholder's wished for (W) and necessary (N) contributions**	**Stakeholder's requirements (R) and wishes (W)**	**Stakeholder's concerns**
Project Supervisor and Strategic Focus Area Leader for Environmental Logistics	N1: Redefine needs N2: Act as Product Owner N3: Take part in detail-oriented discussions W1: Suggest experts that might have insightful ideas for the tool	R1: User-friendly tool R2: Align with KPIs for the SFA Environmental Logistics R3: Compliance with sustainability initiatives at SCM W1: Use emission factors approved by Volvo Cars	Top management has to prioritize the tool to make project leaders at PS&L to use it.
Head of Project Management Office at PS&L	W1: Take part in one midterm evaluation W2: Provide feedback for further development	R1: General sustainability tool that emphasizes environmental considerations early on in all projects W1: Sustainability Benchmarking	Due to the ongoing coronavirus, the study has to be conducted fully on remote which might affect the thesis writers' on-boarding process
Reference group	N1: Devote time to test the tool N2: Give feedback in the development phase W1: To provide appropriate feedback, the project leaders have to reflect over sustainability in their projects	R1: Using the tool should help in considering the corporate sustainability strategy in projects W1: A tool which is simple and approximate rather than exact and too complex	Haven't worked with sustainability in a direct way before this project and may therefore not be a suitable reference group.
Environmental Manager Logistics	N1: Introduce sustainability within Volvo Cars in general and more specifically at SCM W1: Provide field expertise	R1: Compliance with sustainability initiatives at SCM W1: Provide a youthful and creative perspective and should not be limited by corporate practices	The tool may be a step in the right direction but to make a persistent change. This is outside the thesis authors' scope.

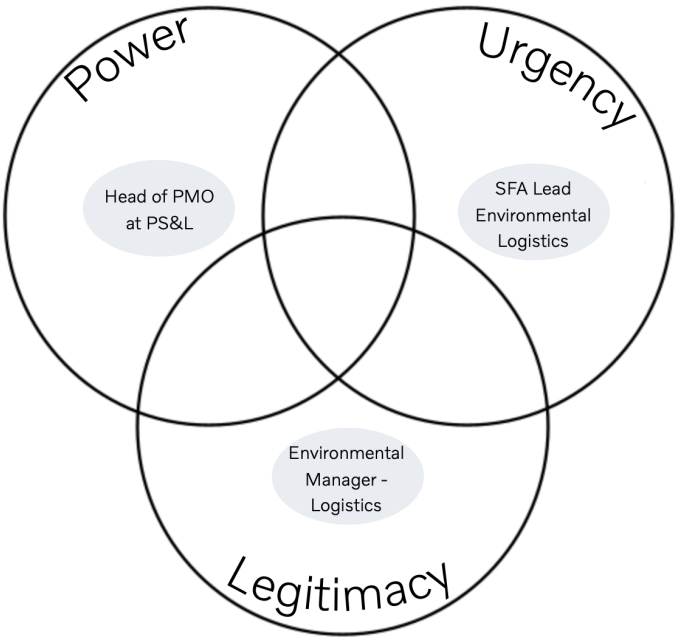
The thesis authors' requirements have mainly been to get continuous feedback during the tool's development. All stakeholders emphasize that compliance with sustainability initiatives at other departments in close vicinity to PS&L is key. A user-friendly and approximate tool that has connections to the already existing KPIs at the department is also asked for by multiple stakeholders. The main concern is that the tool will not change anything if sustainability is not prioritized by the business leaders at all levels in the company. The framework by Mitchell et al. (1997, p. 854) was used to categorize the project stakeholders. For sustainability to be incorporated in all projects led by PS&L's Project Management Office (PMO), these three stakeholders have to be prioritized, as according to Eskerod and Jepsen (2013) is the final step in their framework.

Power: The PS&L management team has delegated Power to the PMO's manager, Interviewee B. No matter which decision forum the project leaders consult, their manager is still coordinating them and serves as their one-stop-shop for minor decisions.

Urgency: The person in charge of the SFA Environmental Logistics, Interviewee I, defines KPIs that are monitored by the management team. In general, this stakeholder is responsible for breaking down the corporate sustainability strategy into department-specific objectives. If this stakeholder, and other roles with similar responsibilities in other departments, fail in doing this, the whole sustainability strategy will also fail.

Legitimacy: The Environmental Manager at Logistics, Interviewee A, has legitimacy as he is in charge for sustainability at SCM which is superior to PS&L.

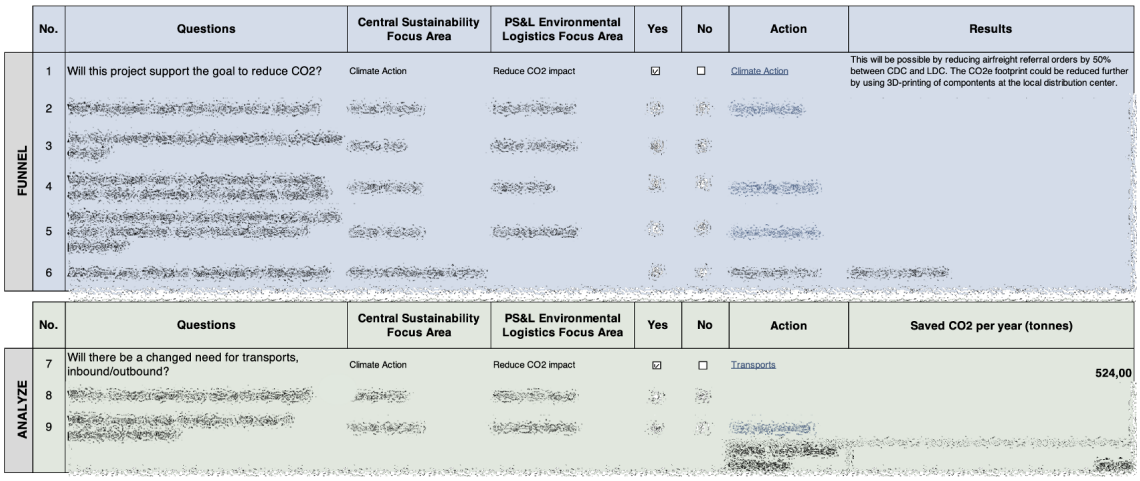
Figure 4.2: There is no single salient stakeholder (Mitchell et al., 1997), so multiple stakeholders have to cooperate for PS&L's sustainability initiatives to succeed.



4.3 Sustainability Assessment Tool

The results from the final version of the tool are presented by showing a picture of the checklist page (Figure 4.3). The user starts with answering Yes/No on the first six questions. Depending on the user's answer, an action might be generated. By clicking on the hyperlink in the Action column, the user will be sent to another tab to answer more detailed questions regarding the sustainability focus area the question focuses on. A summary of the answers for all detailed questions will appear on this checklist page, in the Results column. On the left-hand-side, a bar indicates in which project phase the question should be answered. In general, questions in the Funnel phase are free-text questions of reflective character and in the Analyze phase, the user is asked to perform approximate calculations to further support the text-based answers.

Figure 4.3: The checklist tab in the final version of the Sustainability Assessment Tool. Some details have been omitted to preserve trade secrets.



	No.	Questions	Central Sustainability Focus Area	PS&L Environmental Logistics Focus Area	Yes	No	Action	Results
FUNNEL	1	Will this project support the goal to reduce CO2?	Climate Action	Reduce CO2 impact	☑	☐	Climate Action	This will be possible by reducing airfreight referral orders by 50% between CDC and LDC. The CO2e footprint could be reduced further by using 3D-printing of compontents at the local distribution center.
	2							
	3							
	4							
	5							
	6							

	No.	Questions	Central Sustainability Focus Area	PS&L Environmental Logistics Focus Area	Yes	No	Action	Saved CO2 per year (tonnes)
ANALYZE	7	Will there be a changed need for transports, inbound/outbound?	Climate Action	Reduce CO2 impact	☑	☐	Transports	524,00
	8							
	9							

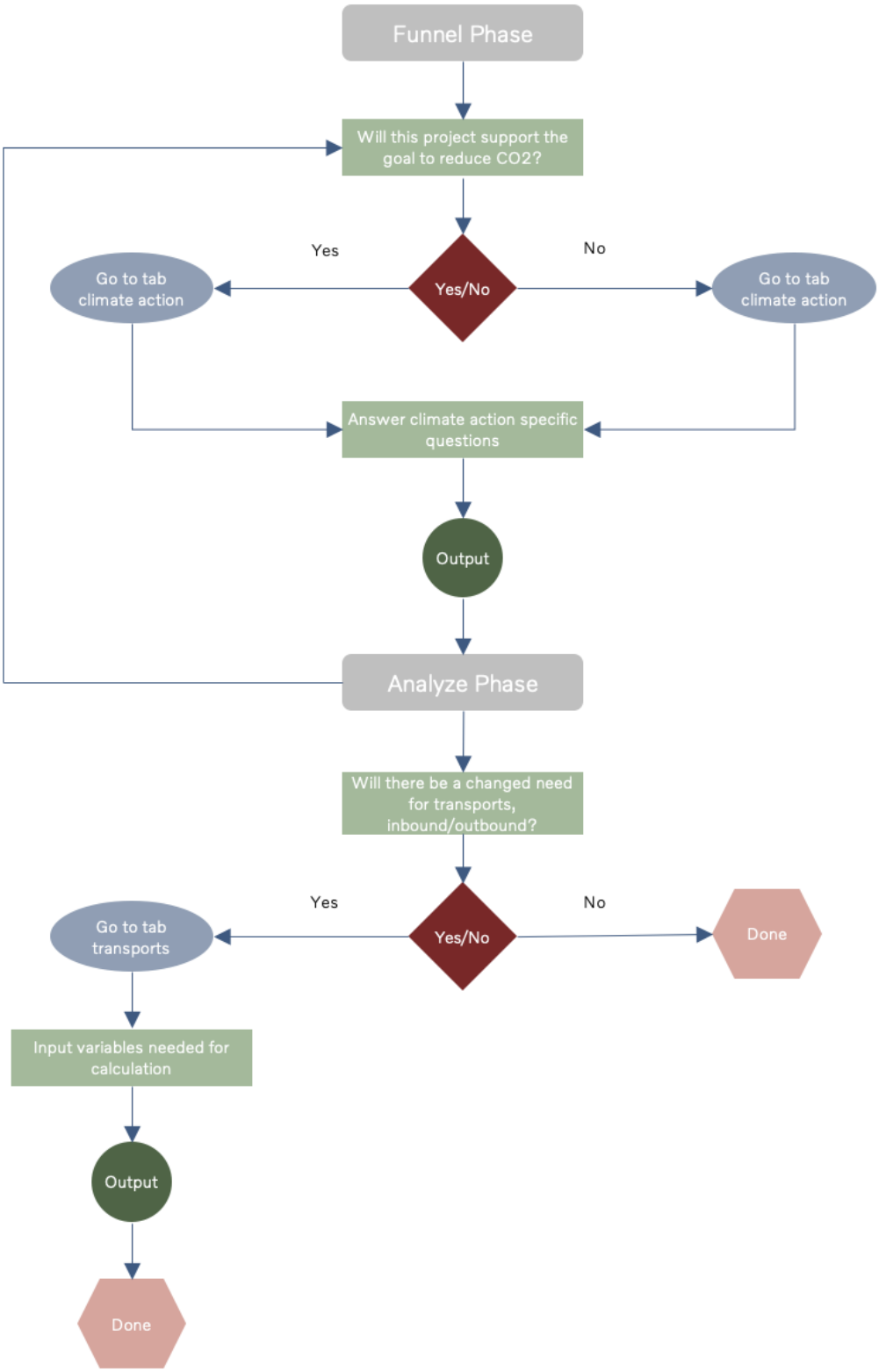
4.3.1 Features in the Final Version

A schematic overview of the process flow for the final version of the tool (Figure 4.4) is illustrated for two questions, one question out of a total of six questions in the funnel phase and one question out of three questions in the analyze phase.

The six initial questions in the funnel phase are connected to one of Volvo Cars' three strategies: climate action, circular economy, or ethical and responsible business. After ticking in the check box, an action will appear for the user. The answer will be either yes or no and the user gets different actions depending on the answer to the question. The user is asked to go to a specific tab in the Excel file and answer more specific questions related to the specific sustainability strategy in focus. After answering the questions, the tool will generate an output based on the answers.

The user will later enter the analyze phase of the project. Here, the user will first revise previous answers and update them if necessary. After the revision, the user should continue to the questions made for the analyze phase. The questions in this phase are also in a yes/no character, and the user chooses which answer suits the project the best. If answering no to the question, no action from the user is required and the sustainability assessment is finished. However, if the answer is yes, the user gets an action to go to a specific tab in the Excel file. In this tab, the user is asked to enter different variables needed to calculate CO2e emissions for the project for, in this case, the transport. The tool will then generate an output revealing the CO2e change in emissions from the project. After retrieving the output, the user has completed the sustainability assessment tool.

Figure 4.4: Flow chart of the final version of the tool.

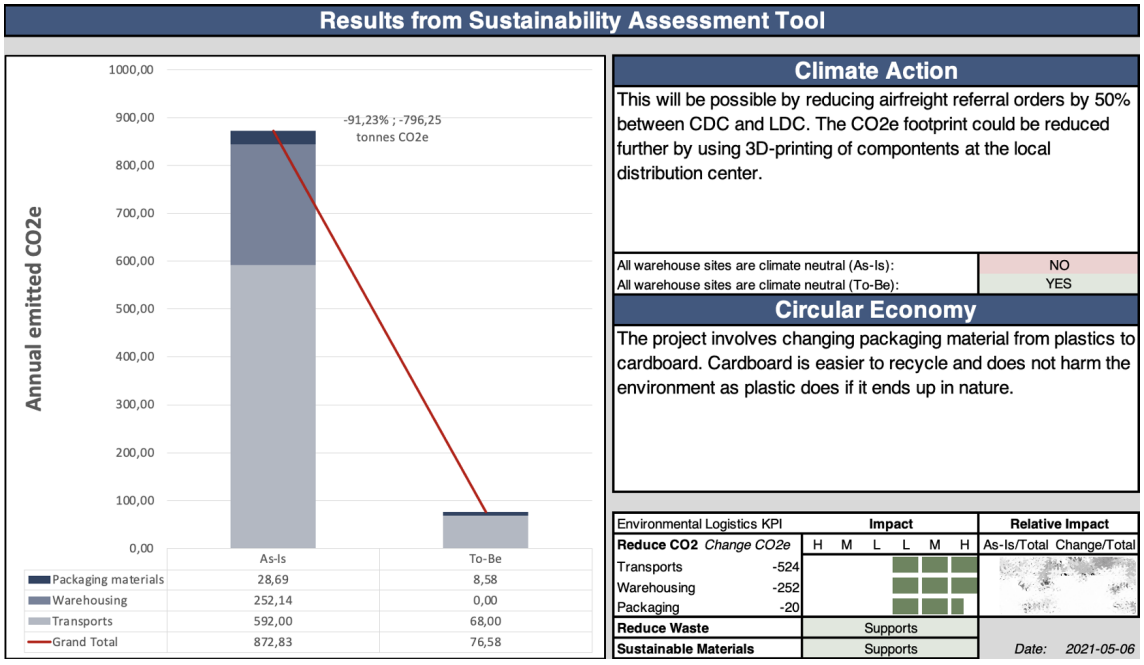


4.3.2 Measures to Comply with the Formal Decision-Making Process

The Project Supervisor from Volvo Cars had concerns that the tool will only be used if it is integrated into the formal decision-making process and if decision-makers ask questions regarding the environmental impacts of a project. To mitigate the risk, the summary tab (Figure 4.5) was created, which may be exported to PowerPoint presentations. For example, when a business case will be pitched for the management team, environmental impacts have to be addressed directly. Every project at Volvo Cars has a project one-pager and the bottom-right part of this slide, showing a project's impact on KPIs connected to the Environmental Logistics focus area, should be included in that one-pager.

Both the Summary tab and the part of the Summary tab that should be included in the one-pager are measures to make sure this tool is not just developed as a thesis project. The department needs a structured and user-friendly way of addressing sustainability in their projects especially early on in projects but also throughout the project process.

Figure 4.5: The Summary tab of the Sustainability Assessment Tool. Some numbers are blurred out to preserve trade secrets, this example is made up by the thesis authors.



4.4 Impacts of a Green Tax Change

The XC40 Recharge is a fully electric vehicle whose carbon footprint from the use phase is highly dependent on the electricity mix used to charge the car (Volvo Cars, 2020b). If we hold Volvo Cars accountable for the car's entire carbon footprint in every stage of the life cycle and assume that the global electricity mix is used for charging, the car emits 54 metric tonnes of CO2e, according to Figure 4.6, during its lifetime.

Volvo Cars (2020b) produced 705,000 vehicles in 2019. If all the cars sold were of the model XC40 Recharge, and all of them were charged with global electricity mix during the use phase. Since the XC40 is one of the smaller vehicles in the portfolio, the actual carbon footprint would likely be bigger if all data were accessible.

705,000 cars * 54 metric tonnes CO2e per car = **38.07 M metric tonnes CO2e**

If a green tax change would be enforced, Volvo Cars employer contribution fees could be waived entirely in exchange for a tax related to the company's carbon footprint, for example. It would be constructed as a voluntary agreement that eligible companies can enter with the Swedish Tax Authority for a predetermined time period, for example, 10 years. Note that this is a hypothetical, but possible, scenario made up by the thesis authors. A green tax change could be designed in many different ways, see the Literature Review chapter. This example suggests waiving employer contribution fees which also might reduce the unemployment rate, hence it would be beneficial for society.

Employer contribution fees for employees in Sweden are today 31.42% (Swedish Tax Authority, n.d.). Note that Volvo Cars (2020a) states a slightly higher value, which might be due to additional costs for fees to the workers' union. This example is simplified to only consider the mandatory fee collected by the Swedish Tax Authority.

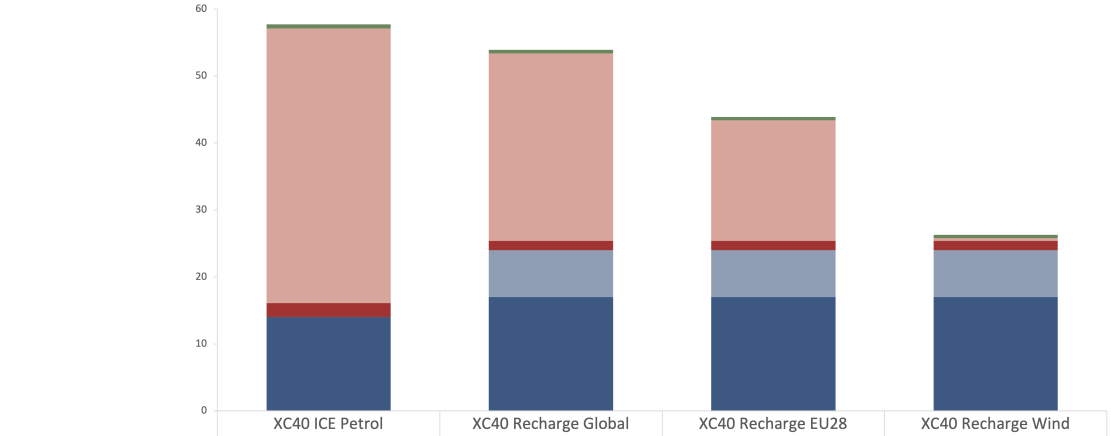
Salaries in total at Volvo Cars were in 2019 22736 MSEK (Volvo Cars, 2020a), which gives employer contribution fees (31.42% of salaries) of **7144 MSEK.**

Subsidies: Volvo Cars paid 7144 MSEK in employer contribution fees. This tax will be waived in exchange for the new environmental tax.

New environmental tax: To make this initiative cost-neutral initially the new carbon footprint tax will total 7144 MSEK, corresponding to 188 SEK per metric tonne CO2e.

If the company's CO2e emissions remain unchanged, this green tax reform would be cost-neutral for the company. However, it opens for cost reductions if CO2e emissions are reduced. Considering that the CO2e emissions mainly come from material usage, the company should go from being material usage intensive to becoming labor-intensive. Especially since the employer contribution fees are temporarily waived.

Figure 4.6: Based on the XC40 LCA Report Volvo Cars (Volvo Cars, 2020b). The figure clearly shows that a combustion engine has its most emissions in the use phase, while for an electric motor, the use phase emissions can be reduced by changing the electricity used.



	XC40 ICE Petrol	XC40 Recharge Global	XC40 Recharge EU28	XC40 Recharge Wind
End of life	0.6	0.5	0.5	0.5
Use phase emissions	41	28	18	0.4
Volvo Cars manufacturing	2.1	1.4	1.4	1.4
Li-ion battery modules	0	7	7	7
Materials production and refining	14	17	17	17
Total Metric Tonnes CO2e	58	54	45	27

4.5 Benchmarking

The comparison of the ten companies from different industries and Volvo Cars focuses on the companies reporting on climate actions. The motivates between industries may vary, but the inventory of activities helps to put Volvo Cars' initiatives in perspective. The comprehensive benchmarking is found in Appendix E. The topics covered are performance indicators and the companies systems of governance. Due to the variety in the companies' reports, it may be hard to compare companies to each other, especially if they are operating in different industries. Some performance indicators have been compared, together with a discussion regarding how the companies plan to achieve their goals.

4.5.1 Performance Indicators

Half of the ten companies, and Volvo Cars, presented goals aligned with the 1.5°C target, while four of the companies had goals aligned with the 2°C target. One of the companies did not specify any target related to the Paris Agreement at all. All companies have goals for CO2e emission reductions. Some companies have started performing LCAs for their products, even if far from all products have LCAs yet. Only one out of ten companies currently uses ICP. As seen in Table 4.2 below, Volvo Cars is distinguished among the top four companies and is also the second-best automotive company when looking at initiatives and eco-efficiency, Emissions per Revenue (EpR).

Table 4.2: This table summarizes the performance indicators showed in Figure 2.4. The Score column is based on how many initiatives each company has committed to. The eco-efficiency column presents total GHG Emissions per Revenue (EpR) in kg/USD. The table is sorted firstly on scores (descending) and secondly on eco-efficiency (ascending).

Company	**Score**	**Eco-efficiency (EpR)**
AstraZeneca	5	0.31
BMW	5	0.63
Husqvarna	5	1.02
Volvo Cars	5	1.21
Volkswagen	5	1.37
Electrolux	5	-
IKEA	4	0.74
Whirlpool	4	-
SSAB	3	1.95
General Motors	2	1.86
SKF	1	0.18

4.5.2 Sustainability Governance

In Appendix E, eight of the companies mentioned that they have implemented their strategy so the board of directors or a superior organization monitors the performance of the sustainability strategy. But sustainability is not only centralized but incorporated on every level in the hierarchy at most companies. In the Greenhouse Gas Protocol, it is only required by law to report Scope 1 and 2 emissions, but all companies in the study have chosen to report Scope 3 as well. Life cycle assessment for their products is the second most common governance practice. Six out of the ten companies states that they are looking at this. Lastly, only Volvo Cars and one other company in the study states that they are planning to transform their whole company into a circular business.

5

Analysis

This chapter analyzes all three research questions one by one. The analysis is based on combining data presented in the Results chapter with the theory presented in the Literature Review. A summary of the argumentation will follow after each research question.

5.1 How Can Ecologic Sustainability Be Considered Early On in Strategic Decisions?

It has been described that there has been an internal need to incorporate sustainability early on in all strategic decisions made in projects at PS&L. How to do this has been unclear. Furthermore, it has been observed that decisions in projects run by PS&L's PMO are mainly made by formal decision-making forums such as the projects' steering committee meetings and other decision forums. Neither of these forums have standardized requirements regarding sustainability and how it should be assessed in projects. From this, the first research question for this project was derived.

5.1.1 Sustainability in Decision-Making

Volvo Cars has historically had a focus on sustainability initiatives that both reduce costs and CO2e emissions. An example of that was that share of goods transported by airfreight was being reduced. Still, this contributed to reducing the CO2e emissions, but the change would probably have been carried out even if it did not reduce any CO2e at all. Since it mainly was an initiative for reducing costs, the sustainability dimension was just considered a good bonus. Volvo Cars has traditionally been good at optimizing scenarios like this. During the early interviews, most examples that were provided were concerning initiatives that both reduced costs and CO2e. Most often, the CO2e reduction was not even calculated but assumed to be reduced. To clarify, optimizations that both reduce CO2 and costs are just as good as any other, and for sure it is smart to start with initiatives where multiple core values are going in the same direction. However, as there have not been any standardized way to calculate CO2e emissions, initiatives that may have had a positive climate impact but negative financial impact have not been prioritized as no calculations of emissions have been carried out. In order for Volvo Cars to reach net-zero emissions, stronger efforts are needed. The need for standardized ways to take CO2e emissions into account is obvious, and one way to do so is to ask for CO2e emissions in every projects to be able to compare different projects with each other and see their climate impact.

5.1.2 Why Early On?

To be able to include sustainability early on in strategic decisions it needs to be considered already in the early phases of a project. This was raised by the project initiator as a requirement. An assessment is needed before a decision to run the project is made, and this is why the Sustainability Assessment Tool should be used the first time here. By including sustainability early on, employees are forced to think and reflect on environmental impacts which is reasonable to do before a project starts. Considering it early will create a more natural integration of sustainability and will not be seen as an add-on criterion that comes at the end. The answers in the tool are followed up at a later stage when the tool is used once again to ensure accurate information and assumptions have been made in the early phase. Employees should update their previous answers and in addition to that also calculate CO2e emissions from the project. Using the tool twice ensures that sustainability is considered early on and its validity as the answers later on are revised.

5.1.3 Sustainability Performance at Volvo Cars

Volvo Cars' strategy today would be described as a transitional business model as sustainability has been highlighted as a core value but it is still not fully integrated into the business model (Borland et al., 2019). Volvo Cars has three main pillars in their sustainability strategy, but (1) climate action and (2) circular economy are the most relevant ones for Parts Supply and Logistics (PS&L) daily operations. The interviews revealed that project stakeholders only occasionally asked for a sustainability assessment as a basis for decision in any of the project phases and that sustainability assessments were not incorporated in the formal project process. When business leaders occasionally asked for sustainability impacts, there was no standardized procedure at PS&L saying how it should be considered. For example, the project leaders have no unanimous way of calculating CO2e emissions.

Figure 5.1: 5Rs model by Borland et al. (2019) applied on Volvo Cars. The green color indicates that the initiative already is included in Volvo Cars' work. The gray color indicated that the initiative has not yet been incorporated.

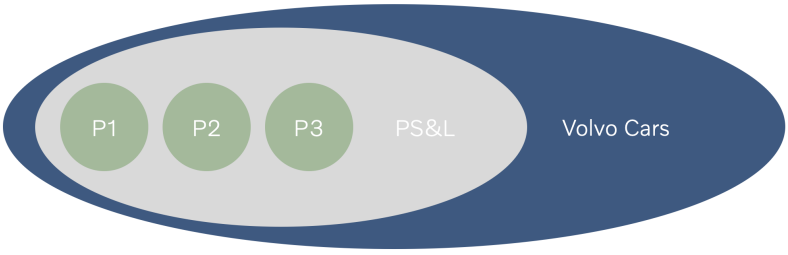
Transitional 5Rs	Transformational 5Rs
Reduce	Rethink
Reuse	Reinvent
Repair	Redesign
Recycle	Redirect
Regulate	Recover

Based on this case study's scope, the PMO at PS&L, the business model could be assessed as a transitional business model, where the focus is on reduce, reuse, repair, recycle, and regulate their products and materials as far as possible (Borland et al., 2019), see Figure 5.1 above. The tool can help by comparing different solutions that solve the same problem in a project. As sustainability is just one of many core values, project leaders will pose a trade-off where core values are conflicting. Multi-Criteria Decision-Making (MCDM) is a structured way of solving such conflicts of interest (Dobrovolskienė & Tamošiūnienė, 2016), where for example sustainability, service-level, and cost can be decision-making criteria. By having sustainability as one of many criteria indicates that PS&L has not yet come to the point where sustainability is a fully integrated part of the business.

Figure 5.1 above indicates that Volvo Cars' sustainability strategy is ambitious and that they intend to become a transformational business where sustainability is included in everything they do (Volvo Cars, 2021). Volvo Cars has a sustainability strategy but all details are not in place, yet. In the Voi example, the company thought that the dominant design was set when launching chargeable scooters. However, they were later replaced by scooters with interchangeable batteries (Voi, n.d.). Volvo Cars have to prepare themselves for an unpredictable future where something similar might happen to their batteries due to the dynamics of being in a fluid phase where the dominant design is not set. This example illustrates the complexity in starting with optimizations of the supply chain, which is a process innovation, before the dominant project design is set.

To become transformational, the business model that builds on continuous growth in the number of sold cars has to be redesigned (Borland et al., 2019). Is a car just a car or a means for mobility? Is it sustainable to create new components from virgin materials? Volvo Cars has started the initiative, M, a car-sharing pool, which brings them one step closer to become a transformational business. The car-sharing pool gives Volvo Cars ownership of the cars and the control of what happens with the components when the cars can no longer be used. But there is still a long way to reach a transformational business model, as M is a small, isolated unit. At this point, the tool developed in this project help to optimize separate cases but is not optimizing the business as a whole. Even if one part of a system is optimized to the fullest, it is still unclear whether the entire company improves. Even if the tool helps in reducing CO2e at PS&L, the entire Volvo Cars ecosystem has to be considered to make difference. Life Cycle Thinking (LCT) is a systems approach that emphasizes considering environmental impacts beyond project or company boundaries (Baumann, 2013). To keep track of this, Volvo Cars might need a digital twin of the entire company to simulate how a small change affects other business units in an unforeseeable way. Improvements can be simulated beforehand in the digital twin so one can see the outcome of an investment before investing.

Figure 5.2: P1, P2, and P3 represent projects within PS&L's project portfolio. Optimizing these projects will affect PS&L, which in turn affects Volvo Cars' entire organization.



5.1.4 Other Companies Sustainability Performance

When looking at how other companies take sustainability into consideration in their business, many companies have a common focus on CO2e emissions. However, some companies state more clearly than others that the environment is critical and set ambitious goals to achieve by 2025. Other companies do not have as ambitious goals and set their targets for a longer time. There can be many different reasons for this difference between companies, for example, the country where the company have its origin do not focus as much on sustainability as other countries or that the company is not subject to competition within the area of sustainability and hence do not focus on it.

Furthermore, all companies report they measure GHG emissions in scope 1, 2, and 3 even if they only is obliged to report emissions in scope 1 and 2 (Ranganathan et al., 2004). Scope 3 emissions can be hard to calculate and is mostly estimated. Still, the fact that all companies make an effort to include scope 3 is a sign that they have understood the importance of including it in external reporting, as Schaltegger et al. (2017) argue. Other reasons for including scope 3 could be that the companies prepare for future regulations, and want to promote themselves as industry leaders within sustainability. As Schaltegger et al. (2017) argue, the act of measuring sustainability performance indicators is important not only for external stakeholders, but it also helps internally as managers can be held accountable for their emissions (Epstein & Wisner, 2013).

Many of the companies have implemented their strategy so the board of directors or a superior organization monitors the development and execution of the environmental strategy. According to Kiesnere and Baumgartner (2020) involving the top management team and making sure that changes come from the top, its success is more likely. Hence, the companies follow the best practice from literature to govern sustainability. Still, we cannot take for granted that companies work with sustainability in the same manner as they account for in their communication. Even if the accounting is supposed to depict the truth, the reports are still authored by the companies themselves.

5.1.5 Will Project Leaders Start Using the Tool Voluntarily

Even if the tool satisfies the requirements there is still a concern that it will just be "another tool" and end up in a desktop folder without being used. By including the sustainability assessment tool in the formal project process, the requirement for using the tool comes from above and the concern is mitigated. This is also backed up by the literature, according to Kiesnere and Baumgartner (2020), implementing something from the top is the best way to succeed with initiatives in a company. The inclusion of the tool in the formal decision-making process also has another reason. This omits the need to teach every person at Volvo Cars how to make more sustainable decisions, as there is no common view of what a sustainable decision is. Instead, using the tool in the formal process will show which project decision is more sustainable and make the decision easier.

Even if having a good tool and including it in the formal process can solve many problems in the question of how to incorporate sustainability in strategic decisions, there is still one more that is needed to keep in mind. Mitchell et al. (1997) raise the importance of taking key stakeholders who possess power, urgency, and/or legitimacy into consideration. If this is not done, then there is a risk that initiatives are not found trustworthy and get any support. By satisfying requirements expressed during the project and by mitigating voiced concerns, the project manages to satisfy key stakeholders.

Having the stakeholders who possess power, urgency, and/or legitimacy coherent in what needs to be done and how to do it is crucial. When all of these persons give the same answer in how to proceed with an issue, it can be seen as being the formal process.

To sum up, the top-down perspective might be a solution to consider sustainability in all projects. The business leaders have to ask questions in a standardized way, highlight and promote sustainability in projects, and integrate sustainability in the formal process. This requires the project leaders to use the same tool to get comparable results.

5.2 How Should Emissions Be Accounted For in Decision-Making? Should CO2e Be Converted to Monetary Terms or Be Budgeted for Separately?

As seen in the Results chapter, interviewees expressed that PS&L had a strong willingness to find and put a price on CO2e emissions in order to get a better understanding of it. Initially, the project sponsor discussed carbon pricing as an easy method to consider ecologic sustainability in projects, and based on that research question two was written.

5.2.1 Regulations

Companies are today affected by regulatory costs based on their contribution to climate change. For example, there are certain carbon taxes and emission trading systems that limit a company's pollution. But to put a price on CO2e in general, it is not a regulatory measure that comes in place but a voluntary application of Internal Carbon Pricing (ICP).

The use of ICP can help a company to take environmental considerations into account when investing in new projects or making certain decisions. In this case, sustainability becomes an additional requirement just as suggested by Cabot et al. (2009). To put a price on CO2e has a clear communication value in the organization and could be a suitable practical application for a company like Volvo Cars that aims for net-zero CO2e emissions by 2040. For a change management initiative like this to work and succeed, it has to come from the top-down in the organization (Kiesnere & Baumgartner, 2020). The sustainability assessment tool could be used as a rule of thumb in the trade-off situation that appears when a company has to choose between reducing cost or CO2e emissions, even if the low-carbon alternative does not have to be more expensive at all times.

ICP is suggested as a risk mitigation measure and can help in preparing the company for upcoming regulatory measures (Aldy & Gianfrate, 2019). However, many companies using ICP today set the price based on the current price for carbon emissions which probably will not be in line with upcoming regulatory measures. So the fact that a company is using ICP does not necessarily imply that they are more prepared for the future. It all depends on the price level that they are using for their ICP.

5.2.2 Carbon Footprint Reductions Before Offsetting

Volvo Cars has a goal to be a net-zero polluter by 2040 and to shrink the annual emissions as much as possible first before using offsetting. One risk with using a carbon price at the departmental level is that it will work almost like offsetting, but at a local level in the company. Using today's price levels from the Californian emission trading system as Alphabet Inc did for instance pose you to a risk of oversimplifying the question.

If the carbon price is set to low, it might still be cheaper to pollute than to transform processes to become more sustainable. Implementing carbon pricing at PS&L might be a good solution, and there are some pros with doing it that have been mentioned in this section. During this study, some interviewees have been positive about the idea of using an internal carbon fee. The fact that the fee is used to raise capital for a sustainable development fund helps sustainable initiatives in two ways, (1) it enables the decision-maker to choose low-carbon alternatives to some extent even if it is slightly more expensive in purely monetary terms and (2) the fund holds targeted funds to support sustainable investments.

5.2.3 How to Handle Internal Carbon Pricing

Implementation of carbon pricing needs an appropriate price that, for example, could be chosen by doing a sensitivity analysis on old decision-making situations. From that data set, a suitable price can be chosen. Using ICP without having a correct price could be risky and give users a false sense of security. For the time being, there is no access to such data to do a sensitivity analysis and therefore this will be a suggestion for future studies.

The first day a new employee starts working for Volvo Cars, it is quite hard to get a sense of how much money is considered to be a lot for the company. By constantly measuring and optimizing costs as every company does to stay competitive, its employees will eventually get acquainted with the company's finances. As sustainability gets more and more important for companies, the employees will get a similar sense of environmental considerations too. It may be hard to grasp the magnitude of 200 tonnes CO2e and determine if it is a considerable amount or not today. Internal carbon pricing could be helpful as a tool there. Still, internal carbon pricing is not the only tool that a company can use and it might even be harmful if it is implemented improperly. If companies get just as good at following up their carbon footprint as their expenditures, the situation would probably be easily solved. Carbon footprint is not harder to calculate than expenses, CO2e is just another currency that you have to get used to.

5.3 How Would an Automotive Company, Like Volvo Cars, Be Affected by a Green Tax Change Policy?

Government Offices of Sweden (n.d.) defines green tax change as an initiative where environmental taxes are increased and tax on labor and/or corporate taxes are decreased in exchange. The initiative is hypothetical and still under preparation, which means that lobbyists from the business world can be, and probably are, in a position to set the new rules in favor of themselves. This research question aims to give an example of how companies could be incentivized by tax regulations within the framework of green tax change to faster enact an ecologically sustainable business model.

5.3.1 Current Situation at Volvo Cars

The participating employees perceived that they were part of a very ambitious corporate sustainability strategy. The overall sustainability goals are broken down into smaller and more specific objectives for each department at Volvo Cars. Their ambitious strategy is also confirmed when Volvo Cars is compared to ten other companies on their sustainability work. Volvo Cars is distinguished among the best as they are one of the companies that are committed to the 1.5°C target, which is stricter than the Paris Agreement.

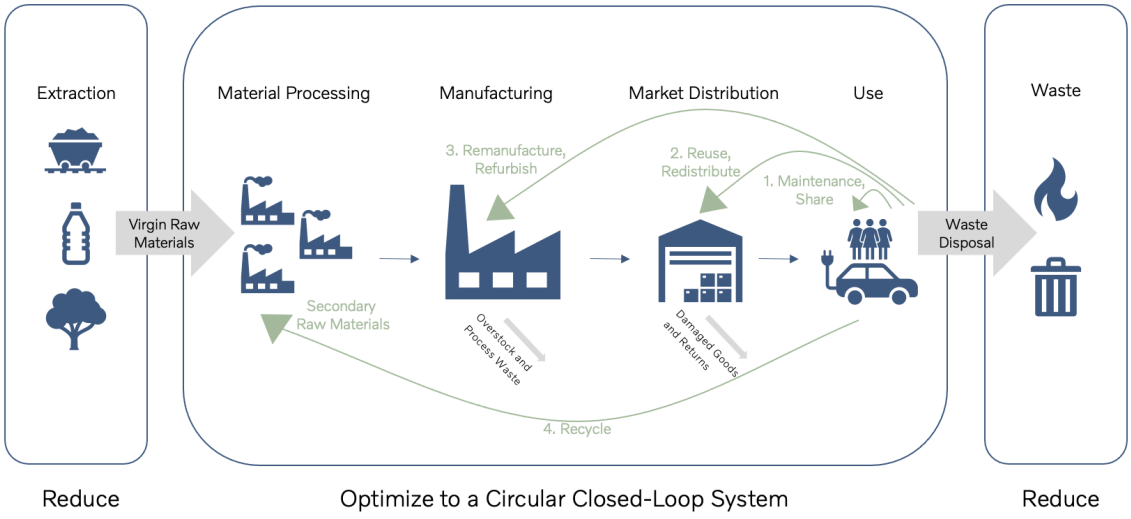
Still, ten companies are not enough to conclude from. The sustainability work that Volvo Cars does today is more ambitious than the law requires and that can be explained by saying that Volvo Cars is preparing for tougher environmental legislation and that sustainability has good branding value. This can be concluded as Volvo Cars is ranked as the fourth-best company in the sustainability benching and the second-best automotive company out of the 11 companies included in the benchmarking.

5.3.2 Minimizing the Carbon Footprint from Electric Vehicles

Figure 4.6, on page 31, clearly illustrates that if the XC40 cars are charged with renewable electricity, the carbon footprint from its use phase will be eliminated. Optimizing electricity production worldwide is a huge problem, but that problem has already been acknowledged and is considered to be outside this study's scope.

The ongoing activity to get climate-neutral manufacturing operations by ensuring renewable energy will help to reduce the carbon footprint from the production of materials and car components. Though, this goal only includes the electricity used and not the scrapping and waste of products. The remaining two parts which contribute to the XC40's carbon footprint are material production & refining and li-ion battery modules. The use of virgin raw materials has to be reduced to the fullest to reduce electric vehicles' CO2e footprint, which Figure 5.3 demonstrates. This fact uncovers that circular life cycle thinking and circular economy have to be utilized to fulfill the climate action goal.

Figure 5.3: Keeping the cars and their components in a circular closed-loop system will help in minimizing the CO2e footprint (Lutter et al., 2016).



The following four examples, quantify the benefits of employing a more circular business model based on values from the XC40 LCA, (Figure 4.6):

1. **Maintenance and Share**: This is the smallest circular loop (Figure 5.3). By maintaining the car within the use phase as long as possible, CO2e emissions will be minimized. This implies that if two people share one car, instead of having one each, a total of 25.9 tonnes (17 + 7 + 1.4 + 0.5) CO2e emissions will be saved.

2. **Reuse and Redistribute**: This is the second smallest circular loop, and the second-best choice for reducing CO2e emissions. Instead of passing the material to waste disposal or recycling, the material value is maintained by reusing components. The material is sent back to the dealer, re-sold, and used by a new end-consumer. Each reuse cycle can save 25.9 tonnes (17 + 7 + 1.4 + 0.5) CO2e emissions.

3. **Remanufacture and Refurbish**: Sending a car or car components back to the manufacturer creates the third loop. Remanufacturing or refurbishing constitutes to a total of 24.5 tonnes (17 + 7 + 0.5) saved CO2e emissions.

4. **Recycle**: This is the final circular loop in the closed-loop system. When the three previous loops are not possible, material recycling has to be done. This process will send secondary raw material back into the material processing and create new components from it. This recycling loop will help to save a total of 12.5 tonnes ((17+7)/2 + 0.5) CO2e. There is no separate data for material processing and extraction, to simplify it has been assumed they have equal contribution to CO2e emissions.

Important to note is that this is a simplified representation of reality. In reality, the different loops will themselves contribute to some extent to CO2e emissions, and hence this is why a smaller loop is better than a big one. But as these emissions are small in comparison to the value chain of the virgin raw material, it is in this case neglected.

5.3.3 Circular Economy Will Help to Reduce Costs

Becoming a circular business will help in achieving the climate action goal, but it will also provide potential cost savings. Reshaping a business to become more climate-friendly is essential to prepare for tomorrow's society. It may seem to be a costly process in the beginning since the electric vehicle industry is still in a fluid phase with high innovation rates and rapid changes according to Abernathy and Utterback (1978), (Figure 2.1). When the business has fully transformed to circular, there will be a reduced demand for new components as a closed-loop system has been implemented. When the legislative environment shifts to promote more circular solutions, pioneering companies like Volvo Cars might benefit from being prepared for this change.

These cost-saving potentials from becoming circular would be further catalyzed if a green tax change comes into force. A circular business can also provide new revenue streams, for example when users buy mobility as a service from a carpool such as Volvo Cars' M, there are continuous cash flows that didn't exist in the traditional business model where cars were sold. To not only get the circular pioneers but every company to change, legislative measures will be needed. The fact that the Swedish government and various functions within the European Union among others are investigating tax reforms to consider sustainability more directly is an indicator that such regulations eventually will come.

5.3.4 Implications of a Green Tax Change Policy

Even if the green tax reform, presented in the Results chapter is cost neutral initially, it opens up for cost savings. For every saved tonne of CO2e emissions, the company also saves 188 SEK. Shrinking their carbon footprint would get a competitive advantage in terms of tax reductions. Circular initiatives are often labor-intensive. By removing employer contribution fees temporarily, the labor cost is also reduced, which may open

up for hiring new staff. From a governmental perspective, revenue streams are lost as the employer contribution fee is waived, but as the unemployment rate is reduced, it could potentially cover up for the lost tax revenue. The cost for raw materials today is not high enough to cover the caused production externalities. Hence, this environmental burden falls on society. The climate-positive impacts of internalizing the cost of carbon into the raw materials' price is another benefit of enforcing green tax change. When a single pioneering company applies life cycle thinking and has more circular material flows the carbon footprint is reduced, which connects circular economy to climate action.

6

Discussion

This chapter presents a discussion regarding how the research has been conducted, its delimitations, contributions of the study, and future areas to investigate. The discussion raises both strengths and weaknesses as well as the reliability of the data found.

6.1 Strengths and Weaknesses of the Study

A strength in this study is the collaboration with Volvo Cars. The collaboration with Volvo Cars has been characterized by clear and continuous communication and transparency, where an early account of the study's academic goals has been given and announcements of what changes and progress has been continuously made. Thus, this collaboration is considered to fall within the framework of good research practice. When collaborating with external clients or companies, the Swedish Research Council (2017) emphasizes the importance of openness and regular communication with the external party. This is to avoid any misleading. This has been done in the study to a great extent.

A weakness in this study is that it did not succeed in finding a valid price to use for Internal Carbon Pricing (ICP). However, this weakness sheds light that the concept of ICP can be easy to understand but might be difficult to use in practice.

6.1.1 Choice of Methods

According to Bryman and Bell (2015), critique has been directed toward qualitative research approaches due to their subjectivity, transparency, and difficulty to be replicated or generalized. The chosen method is, though, motivated by the exploratory character of the research questions which often propose a qualitative approach (Bryman & Bell, 2015).

The self-selection method of interviewees was used to get a reference group corresponding to the diversity of project leaders at Parts Supply and Logistics (PS&L). Based on their relevance for this research, their knowledge, and their experience, interviewees have been selected from the PS&L department to support the research by providing the most value. The supervisor from Volvo Cars was involved in the self-selection method which can pose a risk that the supervisor intentionally or subconsciously may have chosen to include, or not include, some participants. There are nine project leaders in total at PS&L. The study's outcome would possibly have been different if all project leaders or five of them chosen randomly would have taken part in the reference group. Including all project leaders would have been too time-consuming, and selecting five randomly could harm the diversity of the group. Furthermore, as this case study is conducted in collaboration with Volvo Cars, their interests were considered which may have had impacts on the research quality.

The chosen method does not only affect the duty from a scientific perspective but also in an ethical way. In the handling of research material should four central concepts be evaluated; secrecy, professional secrecy, anonymity, and integrity (Swedish Research Council, 2017). The decision to detach all respondents from their opinions and not use quotations is a measure to preserve anonymity and deal with sensitive material with care. Material retrieved from internal documents at Volvo Cars has not been included in the report if the documents do not explicitly state that the information is public. As the identity of individuals is not relevant in this study, it has been possible to promise this anonymity in accordance with the Swedish Research Council's publication from 2017. Furthermore, the concept of integrity has been treated in the study by not collecting any private information or other information that could violate the interviewee's personal integrity.

6.1.2 Limitations and Assumptions

One limitation found is the sample size used for the development of the sustainability assessment tool. Not having all project leaders included in the reference group may have led to not having all requirements implemented in the tool. Furthermore, only researching one small business unit at Volvo Cars makes the study too limited to generalize over other departments and even other companies. It was beyond the scope of this study to look at other departments too, hence this delimitation was known from the start.

One limitation encountered during the study was that a sensitivity analysis could not be conducted to determine a carbon price for PS&L. Enough data from previous projects were not available to be able to analyze different price level and find a price for CO2e emissions that would have made a difference in the project outcome.

6.1.3 Reliability and Credibility in Data Collection

By providing details of how the study was conducted, it can later be replicated. Both Thomas and Magilvy (2011) and Guba (1981) (shown in parenthesis) suggest four similar criteria, for a qualitative research method to be trustworthy; truth value (credibility), applicability (transferability), consistency (dependability), and neutrality (confirmability).

To establish truth value, the biggest concern lies in testing the credibility of the findings (Guba, 1981). This is often done by doing so-called member checks. In this master's thesis research, the member checks were conducted by holding several interviews with different individuals at PS&L to get a broad view of reality. The findings from these interviews were compared to get a reliable picture of reality.

Applicability means that the study should be made in such a way that chronological and situational variations are irrelevant to the results and findings (Guba, 1981). By describing the research context and the method, selection of interviewees, interview design, and data analysis, others will be able to replicate the study and judge its transferability.

Consistency does not imply non-variance, but rather that the variance can be traced and ascribed to sources. It is in that fact dependability, meaning that it embraces both reliability and traceability to explain changes (Guba, 1981). To meet this requirement, all meetings and interviews have been documented by taking extensive meeting notes. Furthermore, the iterative interviews have also been documented by recording the conversation, and transcription has also been made on important sayings.

Neutrality is established when the three previous requirements are met (Thomas & Magilvy, 2011). The research must have a sense of openness and be able to unfold its results. The research should also be self-reflective, that is how the researcher's preconceptions can affect the research itself and the results of the study. Guba (1981) means that the researchers need to find evidence, not for the method used, but for the confirmability of the data produced. The research meets this by not letting any researcher do any part of the study alone, and interviews and analysis have been made together to make sure it is not influenced by anyone's individual beliefs. By thoroughly motivating the method and selections made in the research, personal values are minimized.

6.2 Contribution to the Subject Area

The literature review presents that integrating sustainability in decision-making is a challenge for many companies (Shields & Shelleman, 2015). The Sustainability Assessment Tool developed in this study contributes with an example of how sustainability can be considered in strategic decision-making. The analysis highlights success criteria that need to be considered for a tool like this to be used by project leaders.

The green tax change example contributes to how policymakers can design legislation with companies' interests in mind. Volvo Cars aims to become a sustainable pioneer among the automotive companies, but is still a for-profit enterprise. As the study is carried out in collaboration with Volvo Cars, their interests have been considered. The green tax change example suggests a cost-neutral tax change, optioning for cost savings if the business becomes more circular. Tax changes have to be done in collaboration between regulatory bodies and companies, and if possible take the companies' interests into consideration, which in the long run may also help the macroeconomy.

The green tax change example also contributes to show that if companies are prepared for future changes in regulations they can benefit from being ahead of the regulations. By being prepared for the regulatory changes, climate hazardous activities that may be subject to taxes can be reduced before a cost for them are initiated. This means that companies ahead of regulations can get cost benefits if regulations are changed.

6.2.1 Future Studies

This section will present ideas and findings that have not been fully investigated as they have been outside the scope for this study. These topics are connected to this master's thesis and are found to be interesting to further explore. The future studies could be investigated by Volvo Cars themselves or be topics for upcoming research projects.

Determine Price Levels for Internal Carbon Pricing

In this study, multiple benefits from using ICP are presented. It is not the only way for a company to reduce their CO2e emissions, but since many interviewees and stakeholders have asked for it suggests that it may be useful and could engage more people. It can be useful to exchange CO2e emissions to monetary terms to evaluate the total cost of ownership, where ecologic sustainability is taken into account for different investment options. If PS&L would like to use ICP to prime the organization for potential upcoming environmental taxes, they must first determine a valid price. Companies hedge for potential future price increases and tend to use higher prices for the long-term than short-term

carbon pricing calculations. This study recommends conducting a sensitivity analysis and simulate which price level is needed for PS&L to change the behavior. Predictions for what price levels of CO2e emissions are possible in the future also have to be taken into account as it is critical to not choose a price that is lower than the price of upcoming regulations. No one can know the specifics of upcoming regulations, but if the price level is too low, long-term investment calculations will not be valid. Another option could be to investigate techniques for capturing emissions from the atmosphere. By pricing this technique a carbon price for investment calculations can be determined automatically.

Internal Policy for Comparing Sustainability Initiatives

The market will determine the price for carbon offsetting, but there will likely be a premium price for the carbon offsetting alternatives as more and more companies realize the benefit of being more sustainable. Volvo Cars needs a decision-making rule that regulates how much money sustainability initiatives are allowed to cost. Some sustainability initiatives provide value in terms of branding to the company, but it would be useful to have an internal policy regulating how much each metric tonne CO2e may cost to offset in a sustainability project as Volvo Cars partner up with different sustainability organizations.

Define KPIs Corresponding to Ethical and Responsible Business

Volvo Cars' sustainability initiative consists of the three pillars climate action, circular economy, and ethical and responsible business. The corporate sustainability areas are formulated in department-specific KPIs for PS&L which clarifies what to achieve and supports the department's action plan. The third focus area, ethical and responsible business, does not have any corresponding KPIs at PS&L. Due to that fact, this study is focusing on the climate action and circular economy too, even if ethical and responsible business to some extent also is targeted in the Sustainability Assessment Tool. This has made it hard to identify what can be done and how PS&L can contribute to achieving the higher goals within this area. It is reasonable for a department like PS&L to prioritize climate action and circular economy, as most of the department's greenhouse gas (GHG) emissions come from transports and warehousing. However, to comply with the overarching corporate sustainability strategy, KPIs are needed for the third pillar too.

Measure Circularity

The climate action target can be measured quite easily by monitoring GHG emissions and set up actions to reduce them. However, the second focus area for this report, circular economy, is not as tangible and concrete. This focus area has corresponding sub-targets and KPIs for PS&L, but still, interviewees express that circular economy is hard to quantify. This concern may lead to climate action initiatives are being prioritized over circular economy initiatives. This study recommends PS&L to express the level of circularity in a numerically way to engage employees to work towards increasing that number. For example, the number of components circling back into the distribution system could be used as one variable in a circularity calculation. Another possible approach is to measure how both (1) virgin materials and (2) waste are reduced.

7

Conclusion

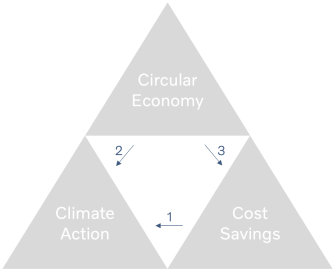
To consider sustainability early on in strategic decision-making, (1) a top-down perspective, (2) a standardized procedure, and (3) an integration of sustainability in the formal processes are crucial. Volvo Cars' business model is transitional but not yet transformational as of today (Borland et al., 2019). Safety lies in Volvo Cars' heritage as a core value, but today the ultimate safety test is climate change. Ecologic sustainability is hence a critical competitive advantage to gain for Volvo Cars to secure its future.

This study does not provide enough evidence to convincingly recommend carbon pricing for now. Some benefits of using Internal Carbon Pricing (ICP) have been identified, but using an invalid price could be risky. The lack of data for conducting a sensitivity analysis to suggest a valid price leads to not recommending ICP for now. However, the increasing amount of companies using it could be a reason to further investigate it.

To get companies to minimize climate-hazardous activities, legislation is needed. How a green tax change can affect companies depends on the specifics of the reform. Investing in the technological transition towards sustainability in mobility is risky as the electric vehicle industry still is in a fluid phase (Abernathy & Utterback, 1978), but having sustainability as a core value is not only for legislative purposes but is also favorable for branding.

In summary, this study's aim can be addressed by altering toward a transformational business model where sustainability is an integrated part of the business. Becoming a circular business will reduce CO2e emissions and provide cost-saving opportunities for the company as it no longer depends on virgin raw materials. The cost savings would further be catalyzed by a green tax reform. How the following concepts interrelate to each other is illustrated in 7.1 that aims to convey the report's overall message in one picture.

Figure 7.1: (1) Demonstrates how the company has worked historically with sustainability. (2) Captures the work that is currently in focus. (3) Represents the potential cost savings from being circular when environmental legislation comes into force.



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A

Full Interview List

Table A.1: Interview list

Interviewee	**Position**	**Date**	**Subject**
Workshop A	PS&L PMO Team	26/1-2021	Sustainability Kaizen Workshop
Interviewee A	Environmental Manager – Logistics	27/1-2021, and 8/3-2021	Environmental Consideration in Decision- Making
Interviewee B	Head of Project Management Office at PS&L	27/1-2021, 23/2-2021, and 24/3-2021	Decision Making Process and Tool Feedback
Interviewee C	Head of VCSB Sustainability Strategy	29/1-2021	Environmental consideration
Interviewee D	Packaging Engineer	10/2-2021 and 6/4-2021	Calculating CO2 Emissions in Packaging
Interviewee E	Project Leader PS&L	10/2-2021	Network Analysis in America
Workshop B	Reference Group	11/2-2021	Project Goals for the Tool
Interviewee F	Project Leader PS&L	16/2-2021, 24/2-2021, 10/3-2021, and 7/4-2021	New Car Projects
Interviewee G	Global Sustainability & Volvo Car Strategy	17/2-2021	Carbon Pricing
Interviewee H	Energy Efficiency Specialist	18/2-2021	Energy Usage
Interviewee I	Project Leader PS&L	24/2-2021, 10/3-2021, and 7/4-2021	Iterative Interviews Tool Development
Interviewee J	Project Leader PS&L	24/2-2021, 10/3-2021, and 7/4-2021	Iterative Interviews Tool Development
Interviewee K	Project Leader PS&L	24/2-2021, 19/3-2021, and 7/4-2021	Iterative Interviews Tool Development
Interviewee L	Project Leader PS&L	25/2-2021, 10/3-2021, and 7/4-2021	Iterative Interviews Tool Development
Interviewee M	Sustainability Director	6/4-2021	Circular Economy
Interviewee N	Core Manager	6/4-2021	Component Value Retention
Workshop C	Reference Group	20/4-2021	Onepager

B

Interview Guides

This chapter will present the interview guides used for the semi-strucutred interviews in each itreration.

B.1 Questions used for Iteration 1

Sustainability at Volvo Cars:

- How do you incorporate sustainability into your decisions today?
- What do you think is good about Volvo Cars' environmental work?
- Is sustainability always required in your projects today? Who sets these requirements? In what way is it in demand?

Ease of use:

- How easy is it to understand what we are asking for in the tool?
- Is there any functionality you lack with the tool?
- Are there any user-friendliness adjustments that can be made?
- What do you think in general about the user-friendliness of this version (scale 1-10)?

Short concluding questions:

- How long did it take you to complete the template?
- How much time are you willing to spend filling in the documentation in the future?

B.2 Questions used for Iteration 2

Ease of use:

- Can you tell us from start to finish how you filled in the tool?
- How easy is it to understand what we are asking for in the tool?
- Is there any functionality you lack with the tool?

- Are there any user-friendliness adjustments that can be made?
- What do you think in general about the user-friendliness of this version (scale 1-10)?
- What would you like to include in the tool for the next version?

Short concluding questions:

- How do you see that this tool can be involved in daily activities?
- How long did it take you to complete the tool?
- How much time are you willing to spend filling in the documentation in the future?

B.3 Questions used for Iteration 3

Ease of use:

- How did you fill in the tool when you made the case?
- How clear are the questions on the "Checklist"?
- How easy is it to understand what we are asking for in the tool?
- Are there any user-friendliness adjustments that can be made?
- What do you think in general about the user-friendliness of this version (scale 1-10)?

Sustainability at Volvo Cars:

- What do you think is good about Volvo Cars' environmental work?
- Is sustainability always required in your projects today? Who sets these requirements? In what way is it in demand?

Short concluding questions:

- Do you have any idea how this can end up / look in the one-pager?
- How long did it take you to complete the tool?
- How much time are you willing to spend filling in the documentation in the future?

C

Detailed Results from Iterative Interviews

This chapter presents wishes and requirements from interviewees during the iterative interview study. All requirements were incorporated into the tool and the wishes that had business value were also implemented. The wishes marked in red were not incorporated.

Table C.1: Wishes and requirements for the tool

Version	Requirements	Wishes
Version 0	1. More questions needed, it's not only about carbon dioxide calculations. Both general questions that can be answered in every project and more specific ones are needed. 2. Most projects involve changes in the warehouse setup (warehouse locations and transports), make sure the tool captures that.	1. Toolbox with add-on features, such as Power Purchase Agreements, that could offset some of the CO2e in a project.
Version 1	1. Make sure the initial phase of a project is covered by asking general, basic questions connected to the corporate sustainability strategy. 2. A guiding, interactive checklist that can customize the Sustainability Assessment Tool based on the project specifics. 3. Be able to compare one transport mode with another and see the environmental impacts of using airfreight, for instance.	1. Different tabs for different kinds of decisions. 2. Tabs with actual project examples for how the tool may be used. 3. An extra tab that describes in general if transport optimizations are more important than warehousing questions, for example.

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Table C.1 – continued from previous page

Version	Requirements	Wishes
Version 2	1. Make the start page clearer, have a project outline with milestones instead of project layout. 2. Summary at the end of how much CO2e the project will save in total per year. 3. Clarify what you mean with inbound and outbound transport. 4. Explain what Climate Action and Circular Economy means in the tool to inspire the users.	1. Enable users to insert their own emission factor for packaging material. 2. Be able to choose both countries and a specific electricity mix for each country. This enables the user to choose energy from renewable sources. 3. Create hyperlinks instead of text-based actions on the Checklist tab. 4. Provide more guidance in how the tool may be used, add guidelines. 5. Have one tab for different business case scenarios. 6. Divide the questions on the Circular Economy tab into different tables following the key performance indicators for the strategic focus area “Environmental Logistics”. 7. Have another tab for the two first questions if one chooses No, or rewrite the questions to suit in both the Yes and No scenario. 8. Provide an average value for how many kWh a warehouse consumes per square meter. 9. It is hard to relate to the Grand Total CO2e value that each project saves, what value is good?
Version 3	1. Describe the tool’s purpose on the Start tab. 2. A packaging material can be made up by a mixture of recycled and virgin materials. Enable for this option in the Packaging materials tab.	1. Add the date for when the emission factors were last updated on all calculation tabs. 2. Adapt the font and colors to the corporate standards at Volvo Cars. 3. Separate weight and distance into two different columns on the Transports tab. 4. Use conditional formatting of cells to hide weight for some transport modes that only depend on distance.

D

Feature List for Obsolete Versions

New features for each version of the Sustainability Assessment Tool are described in this section. The features have either been requested by users during interviews or are needed for the tool to comply with superior sustainability initiatives.

D.1 Version 0

The first version of the Sustainability Assessment Tool was designed after the initial interviews and contained one in-data tab, two tabs with emission factors retrieved from Volvo Cars, and one calculation tab.

The indata tab

Contained emission factors for electricity use for three countries: China, Sweden and Belgium. The emission factors showed g CO2e/kWh of used electricity based on the normal electricity mix in that country.

Packaging data tab

This tab contained emission factors for the most common kinds of packaging material used at Volvo Cars: Cardboard, Corrugated Cardboard, ABS, LDPE foil, LDPE foam, LDPE, HDPE, PE, PP, PA, EPS, PET, PUR, Steel - hot rolled Steel sheets and coils, Steel - structural hollow systems, Stainless Steel, Textile, and Wood. All of these materials had three emission factors based on three different types of origins: EMEA, APAC and Americas. The emission factor showed g CO2e/kg material.

Transportation data tab

This tab contained emission factors for different transportation modes: Rail, Sea, Inland WaterWays (Barge), Road FTL, Road LTL, and Road Van. Even if the emission factors for all transportation modes existed in this tab, only Road FTL and Road LTL were actually used in the calculation tab. Road FTL had five different emission factors based on the weight of the truck: 0-5 tonnes, 5-10 tonnes, 10-15 tonnes, 15-20 tonnes and 20-25 tonnes. The emission factors were expressed in kg CO2e/km. Road LTL had three different emission factors based on where the transportation took place: EMEA, APAC or Americas. The emission factors were expressed in kg CO2e/tkm.

Calculation tab

This tab was built up by three different table areas. The first one focused on packaging material and calculated CO2e emission with regards to type of material, the origin of the material and how much of the material which was used. At the bottom of the table there was a summary row which summed up the entire CO2e emission from all packaging material used in the project. The second table focused on the use of electricity and transportation. The electricity part calculated CO2e emissions based on total watt used, the amount of time the device or product was running per year and operating country (China, Sweden or Belgium). The transportation part calculated CO2e emissions based on the weight of the transported goods, the distance the transport had to go, type of transport (road FTL or Road LTL), the region the transport was conducted, and number of transports of this type that were conducted per year. At the end of the table there was a summary row which summed up the CO2e emissions from both electricity use and transportation work. The last table focused on recycled material. If the material used for packaging went to recycling, it was seen as some of the CO2e was given back. It was made exactly as the material table but used a minus sign in the calculation part.

D.2 Version 1

Version 1 of the tool took a completely different direction compared to version 0 of the tool. After finding an internal checklist which was used to assess environmental impacts in early phases of the project within the manufacturing operations, this checklist was used as a base for this version of the Sustainability Assessment Tool. The checklist was made up by two tabs: General Information and Environment Checklist.

General Information

This tab contained fields to describe the project in general. It was asked for issue date, project responsible, environment responsible, others involved, project description (such as time plan, location plan, layout etc), program prerequisites, layout highlights, and steps in the project.

Environment Checklist

This tab used four columns: one for the questions, one where the project manager answered the questions, one where the environment responsible evaluated the answers from the project manager and one column where the questions were followed up at the end of the project. The questions were categorized into 11 categories: 1. Incidents/accidents/emergencies, 2. Ground level construction, 3. Air, 4. Water, 5. Energy and Climate, 6. Waste, 7. Packaging, 8. Transport, 9. Hazardous products/chemical handling, 10. Noise/Vibration, and 11. Others. Within these 11 categories there were 1 to 5 questions to assess the environmental impact from this specific category.

Not incorporated in version 1

A toolbox with add-on features, such as Power Purchase Agreements, that could offset some of the CO2e in a project was not incorporated into version 1 of the tool. This feature was considered to be out of scope for the project.

D.3 Version 2

Checklist tab

A subset of the questions from version 1 were edited and reused. The questions were made more general to ensure all projects can answer them. Checkboxes were added to the initial questions that trigger actions based on the users answers.

Climate Action and Circular Economy tabs

More detailed questions regarding the two pillars Climate Action and Circular Economy were added. A brief description of the sustainability initiatives were added to inspire the users.

Warehouse Network tab

A dedicated tab to evaluate changes in the warehouse setup was added. The overall setup is to compare the As-Is and To-Be scenarios. It takes inbound transports, warehouse operations, and outbound transports into account. For the transports' CO2e calculations, the user is instructed to use NTM calc. For warehouse operations, electricity is the only driver that can be measured.

Transports tab

The transports tab was added to support the users when the transports are being evaluated in an isolated case. The user is being instructed to use NTM calc here too.

Packaging material tab

A slide for changes of packaging materials was added. The user inserts data regarding how the material has been produced, which kind of material, its country of origin, and the weight for the yearly consumption. A similar setup was developed for how the same packaging material was being recycled, and if one could ensure that the material was recycled the overall CO2e emissions could be reduced. Though there are uncertainties regarding how this can be calculated.

Electricity tab

A dedicated tab for use of electricity was added. It is intended to be used for the annual electricity consumption for a warehouse building. However, the same calculation can be done for a certain device that is consuming electricity. Besides the number of kilowatt hours, the operating country is also a variable to determine the yearly CO2e emissions from use of electricity as different countries have different electricity mixes.

Heating/Cooling tab

This tab only supports heating or cooling powered by electricity due to lack of emission factors.

Not incorporated in version 2

For version 2, tabs with actual project examples for how the tool may be used was not implemented in the tool. Instead, guidelines of how to answer the questions was seen as enough help in showing how to use the tool. Furthermore, an extra tab that describes in general if transport optimizations are more important than warehousing questions, for example, was neither not included. This was due to not all projects considering both transports and warehousing all the time, and some might not involve them at all. Hence it is hard to generalize which factor that would make the biggest impacts in CO2e reduction in a project.

D.4 Version 3

Start tab

The start tab was cleared up a bit and is explaining during which project phases the tool may be used. The user is no longer asked to provide a brief explanation of the project as this information can be found in the project's onepager (another document that each project has).

Summary tab

A tab that summarizes the results was created. This slide is intended to be exported to different presentations that the project leaders do for the decision-makers. The As-Is and To-Be scenarios are being reflected with numbers and a short summary of the users text-based answers are also included.

Checklist tab

Text-based actions were improved to hyperlinks to simplify the user's navigation through the different tabs. Besides exporting the result for how many CO2e per year this project could save on every tab, a summary for the grand total savings was also added on the checklist page.

Climate action and Circular Economy tabs

Columns for example of answer and for guidelines were added to each question. Users are well aware of the sustainability strategy in general, but not specifically how it impacts their own projects. These columns intend to inspire and help.

Warehouse networks tab

This tab was entirely removed as the same functionality can be found by using the Transports and Warehousing tabs in combination.

Transports tab

To simplify, the user no longer has to use NTM calc for transports. Based on emission factors for different transport modes, the CO2e from transports are calculated directly in Excel. The option to use NTM for more precise calculations still remains.

Warehousing tab

Besides electricity, more drivers to CO2e emissions for warehousing were added. The user can now find electricity, heating, and cooling in the tool. There are also more specific options if the user for instance knows that the electricity is renewable. Note that these new emission factors only consider the CO2e emissions during the energy generation (use-phase) and do not take building energy producing resources into account in the emission factor.

Not incorporated in version 3

In version 3, enabling users to insert their own emission factor for packaging material was not incorporated due to users seldom receiving an emission factor for the material they use, and the packaging material used at Volvo exists in the tool with an average value which is considered as good enough. There was also a request to have a tab for different business case scenarios, but as no projects are the same, it was decided that it is better to explain and train people to use and understand the tool properly, so they knew how to use it for their case. Furthermore, for the questions 1, 2, 4, and 5, users got the same action no matter if they answered “yes” or “no” on the question. It was asked for being directed to another tab or another question if one answered “no” instead of “yes” in order to not get confused. It was though decided to instead rewrite the question on the page the user got directed to so the question would suit both the “yes” and the “no” answer. Finally, it was expressed that it was difficult to get a grasp of the grand total CO2e value that each project saved, was it a lot or not? In order to increase the awareness of CO2e and what number that is considered as much and not, it was determined not to relate the total CO2e number to anything and instead teach people with time to evaluate the number themselves.

E

Benchmarking

Table E.1: Summary of initiatives in other companies.

Company	What	Why	How	GHG
AstraZeneca (AstraZeneca, 2021)	- By 2025, 100% reduction in Scope 1 and 2 emissions - By 2025, reduce Scope 3 intensity by 25% - By 2025, reduce total energy consumption by 10% - By 2025, 100% renewable electricity consumption globally - By 2025, reduce waste by 10% - Aligned with 1.5°C target	- All people to have access to sustainable healthcare solutions, treatment and prevention - Demonstrate global leadership to manage environmental impact across all activities and products	- Life cycle assessments to assess environmental impacts of products - A cross-functional Governance Group implemented to execute climate strategy - Sustainability Advisory Board comprises SET members and external sustainability experts - The Senior Executive Team reviews internal sustainability scorecard	Scope 1, 2, and 3
BMW (BMW Group, 2020)	- By 2020, reduce CO2e emissions in European fleet by at least 50% - By 2021, 100% green power - Aligned with 1.5 °C target	- Premium can also be looked upon through sustainability - Have the best offers according to sustainability to customers world wide	- Life cycle assessment, ISO standard 14040/44 - The Sustainability and Mobility department is responsible for global sustainability management. They are under the direct oversight of the Chairman of the Board of Management within the Corporate Strategy division - Sustainability has been integrated at all corporate levels	Scope 1, 2, and 3

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Table E.1 – continued from previous page

Company	What	Why	How	GHG
Electrolux (Electrolux Group, 2021)	- By 2025, reduce carbon emissions in operations by 80% and by 25% in products - By 2030, climate neutral operations (scope 1 and 2) - By 2025, reduce scope 3 emissions from sold products by 25% - By 2050, climate neutral value chain - Aligned with the 1.5°C target - Awarded CDP climate A list and water A list	- Maintain sustainability leadership as a competitive advantage and driver of profitable growth - Have a sustainable strategy rather than a sustainability strategy	- Product energy efficiency - Application of LCA approach - Every Electrolux business area must have an environmental management system at each manufacturing site - Sustainability framework directly overseen by group management through sustainability board - KPI broken down and followed up at business area level	Scope 1, 2, and 3
General Motors (General Motors, 2020a) (General Motors, 2020b)	- By 2050, 50% sustainable materials in vehicles - 31% reduction in CO2e in scope 1 and 2 - 100% of suppliers reporting data to CDP Supply Chain - By 2040, 100% renewable electricity globally - Aligned with 2 °C target	- Take climate change seriously and see the role of the transportation sector in global GHG emissions contribution - Vision to have zero crashes, zero emissions and zero congestion in the future	- Board of Directors oversee the integration of ESG throughout General Motors - Sustainability office which use cross-functional teams - Target scope 3 emissions (account for 98% of emissions) - Green tariff agreement	Scope 1, 2, and 3
Husqvarna (Husqvarna Group, 2021)	- By 2025, reduction of CO2e emissions by 35% in value chain. - By 2025, launch 50 circular innovations - Implement renewable energy - Aligned with 1.5°C target	- Be an industry leader in the transition to a low-carbon, resource-smart economy - Feeling of urgency to address climate change	- Measure lifetime CO2e in products normalized to net sales - Each division delivers on their action plan - Sustainability efforts start at the top with the Board of Directors. People and Sustainability Committee inspect group efforts within sustainability - Have a Sustainability Core Team with persons from every division and core functions	Scope 1, 2, and 3

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Table E.1 – continued from previous page

Company	What	Why	How	GHG
IKEA (IKEA, 2021)	- By 2030, halve the climate footprint of the total IKEA value chain - By 2030, reduce GHG emissions by 15% - Aligned with 1.5°C target - 100% renewable energy in IKEA value chain	- It is perceived to be too expensive to live healthy and sustainable lives - People expect businesses to develop more affordable products and services that are good for people and the environment	- Transforming into a circular business - The total IKEA sustainability agenda is driven by the Strategic Sustainability Council - Each IKEA business within the IKEA franchise system organizes for their successes and contributes to the total IKEA sustainability agenda	Scope 1, 2, and 3
SKF (SKF, 2021)	- By 2025, reduction of CO2e emissions in manufacturing, -40% CO2e per ton of bearings sold - 40% reduction in CO2e from goods transportation per tonne of shipped products to end customer - By 2030, carbon Neutral - By 2030, 100% renewable electricity	- Feel a need to act on climate change - Reduce risk and increase resilience in operation - Reduce environmental impact and increase competitive advantage	- CO2e becoming a parameter in the supplier selection - The Director of Group Sustainability reports to the Chief executive Officer and assures that all relevant aspects of sustainability are addressed and integrated into operations and activities - The implementation of the sustainability program in the line organization is driven by the respective SKF areas	Scope 1, 2, and 3
SSAB (SSAB, 2021)	- By 2045, fossil free operations - Fossil free steel as a product - By 2032, reduce GHG emissions in scope 1 and 2 by 35% - Aligned with 2 °C target	- Managing business in a sustainable way strengthens the ability to deliver strong financial and operational results.	- Use of recycled materials - Pre-study on cost of CO2e - Board of Directors monitor sustainability performance - The Head of Sustainability responsible for strategy development and coordination	Scope 1, 2, and 3
Volkswagen (Volkswagen, 2021)	- By 2051, neutral carbon footprint - Aligned with 2°C target - By 2025, reduce DCI (decarbonization index) by 30% per vehicle	- Investors are looking for sustainable investment options - Build the future of mobility while secure it sustainably – for today and the future	- Electrifying vehicle fleet - By 2025, reduce energy, water and waste by 45% per vehicle - Internally steering decarbonization, 20€ per tonne of CO2e - Internal CO2e fund to finance projects that contributes to reduction of GHG emissions	Scope 1, 2, and 3

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Table E.1 – continued from previous page

Company	What	Why	How	GHG
Whirlpool (Whirlpool, 2021)	- By 2022, zero waste to landfill from manufacturing - By 2030, reduce GHG emissions from products in use by 20% - By 2030, Scope 1 and 2 GHG emission reduction by 50%, scope 3 (category 11) by 20% - By 2025, 18% recycled plastic content in EMEA - Aligned with 2 °C target	- To protect the environment, to assist employees' growth and ensure their safety, and to uplift the communities	- Sustainability team that uses LCA to assess environmental impact - Board of Directors overseeing integration of ESG throughout Whirlpool - Two ESG councils at management level, one for environmental impacts and one for social and governance	Scope 1, 2, and 3

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