The process of setting science-based supply chain greenhouse gas emission targets

- An exploratory study of IKEA Component's scope 3 target setting process

Faculty:	Lund University, Faculty of Engineering
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Authors:	Pernilla Agné and Caroline Vernet
Supervisor at IKEA:	Linda Wilkens
Supervisor at LTH:	Eva Berg
Examiner LTH:	Jan Olhager

Abstract

Title: The process of setting science-based supply chain greenhouse gas emission targets - An exploratory study of IKEA Component's scope 3 target setting process

Authors: Pernilla Agné and Caroline Vernet

Division: Faculty of Engineering Logistics

Supervisors: Linda Wilkens, Global Sustainability Leader, IKEA Components, and Eva Berg, Faculty of Engineering Logistics

Keywords: Science-based targets, green supply chain management, scope 3, greenhouse gas, carbon management

Background: The world is facing global warming because of excessive release of greenhouse gases. The Science Based Target Initiative encourages companies to do their fair share in limiting the temperature increase to 2 degrees above preindustrial temperatures. This is called setting science-based targets. Little research has been made on the target setting process and there are few practical examples of companies setting targets for their supply chain. Inter IKEA, including IKEA Components, need to go through this process and want to understand the best way to do it.

Purpose: The purpose of this master thesis is to, in cooperation with IKEA, determine how the process of setting supply chain (scope 3) GHG emission targets should be conducted and to help IKEA Components in doing this.

Method: This research has a pragmatic worldview and uses an overall qualitative approach to understand the target setting process for scope 3 emissions. The research questions are answered by a mixed research design using both a case study and mathematical modeling.

Conclusion: Setting targets for supply chain emissions is often complex since data availability and possibilities to impact rely on external entities. The general process should include; scoping, creating a GHG inventory, modeling, deciding on time horizons and commitment levels, communicating the targets and tracking progress. Companies can during this process choose to have a varying amount of stakeholder input. Using a bottom-up approach including more stakeholder input seems to be more appropriate for companies with less developed green supply chain management practices. A top-down approach better suits companies with well-developed sustainability practices. Following the, in this research proposed, process and insights will make setting supply chain science-based targets somewhat easier. The need for corporate climate action will only increase and more companies will need to set targets. Hopefully this research can be a small piece of the puzzle in helping these companies and contributing to a better planet.

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Acknowledgements

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Pernilla Agné

Caroline Vernet

Definitions and abbreviations

Absolute Target	Reduction in absolute emissions.
Baseline year	A year against which a company's emissions are tracked
Carbon footprint	The total amount of greenhouse gases produced to, directly and indirectly, support human activities, usually expressed in equivalent tons of carbon dioxide (CO_2).
Carbon management	The measurement and management of GHG emissions.
Category	Business category within IKEA Components (A&A, Electrical components, Chemicals and Packaging & handling)
CDP	Carbon Disclosure Project
CO_2e	Carbon dioxide equivalent, the effect from a GHG can be translated into how many grams of CO_2 which has the same effect.
CSR	Corporate Social Responsibility
Emission area	Supply chain area which releases emissions (e.g. Material, Production and Transport)
First-tier supplier	Supplier which supplies goods directly to IKEA Components and a retailer/company
GHG	Greenhouse gas
Green Supply Chain Management (GSCM)	How to combine sustainability work and supply chain management work within a company.
Global warming potential (GWP)	An index that measures how much global warming a gas causes.
HF supplier	Home furniture supplier
ICOMP	IKEA Components
IoS	IKEA of Sweden
IKEA R&S	IKEA Range & Supply
Material	Steel, wood, aluminum, plastic etc.
Relative target	Reduction of emissions compared to unit of output (e.g. sales, volume)

SBT	Science Based Targets
SBTi	Science Based Targets Initiative
Scope 3 emissions	Emissions resulting from the company's activities but occur from sources that the company do not own or control.
Supply chain management (SCM)	"Supply chain management is the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within the supply chain, with the purpose of improving the long-term performance of the individual companies and the supply chain as a whole." (Mentzner et al., 2001, p. 18)
SSI	Supplier Sustainability Index
Unit	IKEA companies (e.g. Components, Transport, Food and Industry)
WRI	World Resource Institute
WWF	World Wildlife Fund
X	X to represent numbers that are not publicly available

1. Introduction

This first chapter starts with a description of the background, followed by the problem, purpose and research questions of this master thesis. Further sections describe intended target group, contributions, delimitations, clarification of roles and of the research. The chapter is concluded with a section that outlines the report structure to guide the reader through the research.

1.1 Background

The corporate and research interest in sustainable supply chain management has increased throughout the 21st century (Corbett and Kleindorfer, 2003; Corbett and Klassen, 2006) and is now something all organizations must consider (Kleindorfer, Singha and Van Wassenhove, 2005; Corbett and Klassen, 2006). Since climate change is recognized as the most serious environmental threat facing our planet (Stern; 2007; IPCC, 2007) a significant part of sustainability work, or green supply chain management (GSCM), entails the management of corporate greenhouse gas (GHG) emissions, or carbon management.

The international, politically agreed-upon, government emission targets aim to limit global warming to a 2°C temperature increase above preindustrial levels, sometimes called the 2°C decarbonization pathway (Sullivan, 2009). Because of this policy makers will likely continue to strengthen policies to reduce GHG emissions for companies. (ibid.) Historically regulation has been the critical driver for GSCM, but this is changing (SBTi, 2015). Other drivers for GSCM in large companies include pressure from internal stakeholders, customers, competitors and society (Walker et. al., 2008).

Companies' GSCM tend to focus on relatively insignificant opportunities for carbon reduction (CDP, 2013). An increasing number of companies are however taking GHG emission reduction further than just complying to new policies or setting easy-to-achieve targets (SBTi, 2017). In 2014 80% of the world's 500 largest companies reported GHG emission targets to CDP (Climate Disclosure Project), but most of these were not in line with the 2°C decarbonization pathway (SBTi, 2015). The interest has increased since then and companies are taking action to align their emission targets with the scientific requirements. This is called setting Science Based Targets (SBT) (SBTi, 2015). One way companies are doing this is by signing up for the Science Based Targets Initiative (SBTi) and thereby assuring that their targets are science-based.

Company GHG emissions can, according to the GHG Protocol (2017), be categorized in three scopes. These scopes enable measurements and comparison between companies. The scopes are

- Scope 1 - Emissions from owned or controlled sources
- Scope 2 - Indirect emissions from the generation of purchased energy
- Scope 3 - Indirect emissions (not included in scope 2) that occur in the supply chain of the reporting company, including both upstream and downstream emissions (ibid.)

Companies have historically focused on managing their scope 1 and 2 emissions (CDP, 2013). Of the 500 largest public companies 97% report their scope 1 and 2 emissions. Even though most of these companies can identify the most carbon intense activities in their supply chain, only 47% of these are measuring them. Measuring is a necessary prerequisite of target setting. (ibid.)

Setting SBT is a relatively new phenomenon which few companies have attempted. Even fewer have set targets for supply chain (scope 3) emissions (SBTi, 2017). There are multiple methodologies for setting targets, but few documented practical examples of where it has been done (Rietbergen et al., 2015). The 2015 Accenture-UN Global Compact CEO study showed that 43% of the surveyed CEO saw SBT as one of the most important climate leadership behaviors for companies to adopt (SBTi, 2015).

IKEA Group is a large Swedish home furnishing company that signed up for the SBTi in 2016 (IKEA, 2017). Science-based targets for scope 1, 2 and 3 are being developed by the IKEA Group. After the commitment, IKEA underwent a reorganization and 90% of the scope 3 emissions ended up in another IKEA company group, Inter IKEA Holding. To not lower the ambitions from the initial commitment, a separate project was initiated at Inter IKEA Holding to capture this footprint. One of the IKEA units in this project is IKEA Components (ICOMP), an IKEA company under IKEA Range & Supply. In addition to developing science-based targets, this project will also continue to the climate targets for supply chain in IKEA sustainability strategy People & Planet Positive, which ended in 2015, as well as set the future ambition level in the current update of the sustainability strategy.

This project in general and ICOMP in particular was considered a relevant case for studying the process of setting SBT for scope 3 emissions. Setting targets for supply chain (scope 3) GHG emission is a relevant issue for both researchers and companies which has few documented empirical applications (Rietbergen et al., 2015). Looking into how to do this by working with ICOMP is therefore the focus of this master thesis.

1.2 Problem

To help reach the overall IKEA goals IKEA Components needed to assess their climate impact and create targets for emission reduction. ICOMP was therefore facing the problem of how they were going to set GHG emission targets for their organization in the best way. They also faced the problem of how to communicate targets and how to track progress.

1.3 Purpose

The purpose of this master thesis is to determine how the process of setting supply chain (scope 3) GHG emission targets should be conducted and to help IKEA Components in doing this.

1.4 Research questions

To achieve the purpose the following research questions were answered. The research questions were developed by studying the Science-based targets initiative (section 4.4.5-7) and the best practices (section 4.4.10).

1. How should the process of setting science-based supply chain (scope 3) GHG emission targets be performed?
    a. How should a GHG inventory be created?
    b. How can modeling be used to facilitate target setting?
    c. How should time horizons and commitment levels be determined?
    d. How should targets be communicated and how should progress be tracked?

1.5 Target group

The target group for this master thesis is people working at ICOMP, other companies wanting to implement Science Based Targets and researchers within similar areas.

1.6 Contributions

- **To IKEA**: Contributions to the sustainability work by creation of GHG emission targets and a methodology to build scenarios and to maintain them.
- **To research**: Showcasing a practical example of setting supply chain (scope 3) SBT, proposing insights that can be developed in further research.
- **To society**: Enabling long-term GHG emission reductions, contributing to reduced global warming.
- **To the researchers**: Learning to plan and execute a large supply chain project within a sustainability context. Learning to apply engineering skills in practice.

1.7 Focus and delimitations

The study is limited by the length of the thesis, which is 20 weeks. This naturally limits the available time and resources. When the thesis is published, the target setting process at ICOMP is not completely finished. This means that the results presented in the report are not final, but represent the state at the completion of the thesis.

The first delimitation is on emission scopes. This research focuses on how to set targets for supply chain (scope 3) targets. Some results could however be generalized to also setting scope 1 and 2 emission targets. Whereas results can be generalized to the other scopes is however not a point of discussion in this research.

The second delimitation is that the study aims to set targets for ICOMP. Results may therefore be more applicable to companies that are similar to ICOMP and less applicable to companies that are not similar to ICOMP. With this logic results may be less applicable for service companies and more applicable to producing companies with complex supply chains.

The final delimitation regards the emission scope which was predefined by IKEA. The three emission areas with the greatest impact at ICOMP were Material, Production and Transport.

Within the three supply chain emission areas the problem was further broken down into four business categories, Assembly and Accessories (A&A), Chemicals, Packaging and Handling material (Packaging & handling) and Electrical components.

1.8 Clarification of project roles

Inter IKEA (IKEA R&S + Industry) appointed a project group with the mission of setting science-based targets for IKEA Group´s scope 3 emissions. The project group consists of members from the different IKEA units; Food, Industry, Components, Transport and IKEA of Sweden (IoS). This study aims to look closer into IKEA Component's part of setting the targets. The researchers' roles were to help ICOMP in the process of setting their targets so that they were aligned with the targets of the project group, but also to contribute to the work of the overall project group. What steps of the process the researchers contributed is further described in section 6. Empirical findings from IKEA.

1.9 Report structure

The report consists of Introduction, Method, Frame of reference, Empirical findings (from benchmarking and from IKEA), Analysis, Conclusion and Contributions and further suggestions, described in Figure 1. The introduction provides a broad overview of the area to understand the problem and the underlying context. The Method section extensively describes how the research was performed and why methods were chosen. The chapter Frame of reference presents current knowledge within the research area, laying a foundation for answering the research questions. The Empirical findings sections describe the research results. The Analysis chapter aims to interpret the empirical data. The Conclusion summarizes the findings, answers the research questions and suggest an exploratory model of how to perform the science-based scope 3 target setting process. The report is concluded with Contributions and further suggestions to academia and practice. As seen in Figure 1, the report starts with a broad focus to gradually become more detailed and then aiming to generalize the findings into a conclusion.

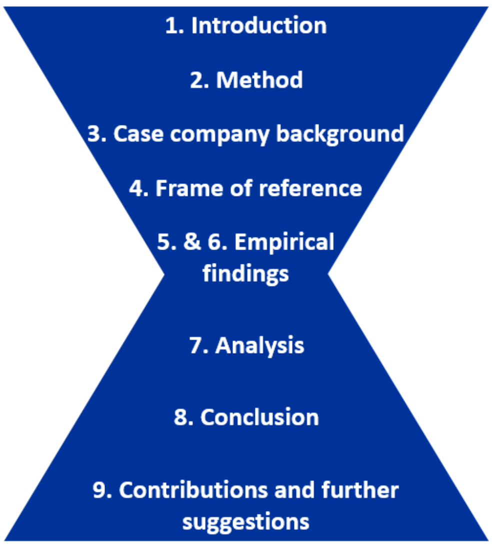

Figure 1. The structure of the report (authors' own figure).

2. Method

This chapter describes the methods applied in this thesis and motivates why the approaches are used. The first section describes the research approach and theoretical aspects on methodology. The second section discusses the quality of the study and its results. The method is then summarized in section three. The last section describes the research process and practical approach.

2.1 Research approach

When conducting research a systematic approach is needed. Creswell (2013) suggests four key areas to consider, these are presented in Table 1. The key areas need to be considered before the start of the research to ensure compatibility and structure. (ibid.)

Table 1. Key terms in research approaches (Creswell, 2013).

Key areas	Explanation
Research approach	Plans and procedures for conducting research and studying a topic.
Philosophical worldview	"A basic set of beliefs that guide action" (Guba, 1990, p. 17)
Research design	Procedures of inquiry.
Research method	Specific methods of data collection.

The relationship between the key areas are depicted in Figure 2. Figure 2. A framework for research showing how key elements of methodology are interrelated (Creswell, 2013, p. 36).Together with some choices that can be made within each area. When selecting a research approach the nature of the research problem at hand, the intended target group and the researchers' previous experiences should be taken into account (Creswell, 2013).

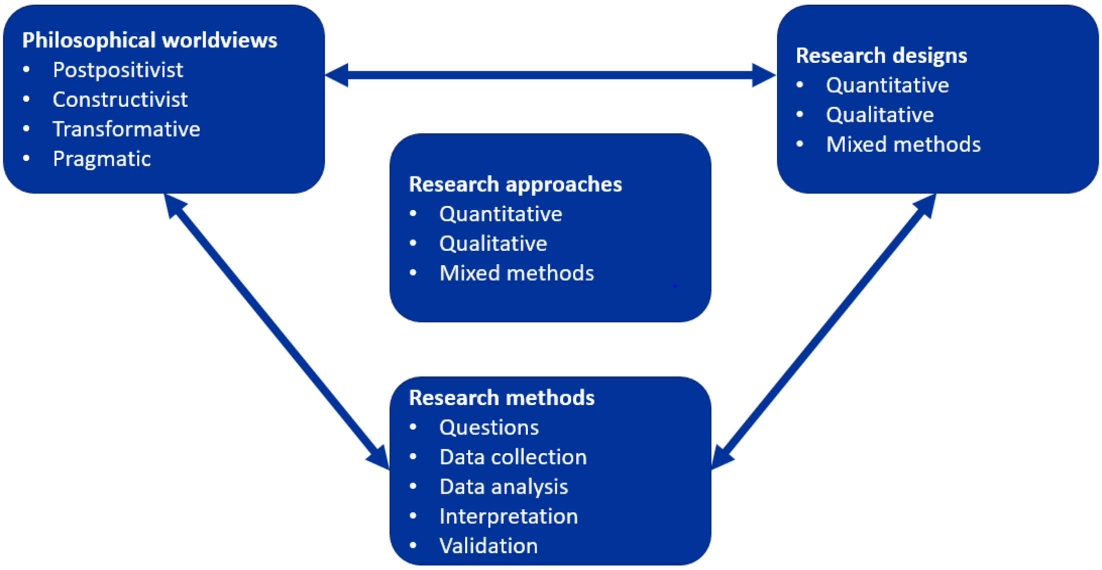

Figure 2. A framework for research showing how key elements of methodology are interrelated (Creswell, 2013, p. 36).

2.1.1 Philosophical worldview

Creswell (2013) proposes four general worldviews (see Figure 2). Postpositivism aims for theory verification by empirical measurements. Constructivism aims for theory generation by viewing the world as complex and subjective, in this view research should highlight complexity and should rely on participants' views of the situation. The transformative worldview focuses on political and social action by highlighting the needs of marginalized people. Pragmatism is problem-centered and real-world practice oriented and "arises out of actions, situations, and consequences rather than antecedent conditions (as in postpositivism)" (Creswell, 2013, p. 39). Pragmatism views truth as what works in a specific situation and is closely related to mixed method approaches (ibid.)

The researchers' worldview for this study was Pragmatic. This was an appropriate world view because it is problem-centered, oriented towards real-world practices and aims to find a solution that fits a specific situation. Since the purpose entailed finding a practical solution to setting SBT for ICOMP this philosophical worldview was suitable.

2.1.2 Research approach

In qualitative research, researchers interpret gathered data in some form (Creswell, 2013). It is an approach for evaluating phenomenons. This kind of research is often framed through words as opposed to numbers, and uses open-ended research questions. Quantitative research on the other hand, aims to test objective theories by evaluating the relationships between variables. Numerical data is usually gathered and analyzed using statistical methods. This kind of research is often framed in numbers and uses closed-ended questions. Mixed method research integrates the qualitative and quantitative approaches and uses both forms of data. The underlying assumption for using a mixed method approach is that combining the two will provide a more complete understanding of the studied phenomenon. These three approaches should not be viewed as discrete options but as a continuum where the mixed method lies in the middle.

The qualitative and quantitative approaches can also be described as inductive and deductive (Woodruff, 2003). Woodruff (2003) explains these as circular processes that can be used in combination, this is called using an abductive approach. The inductive approach consists of data collection, description, substantive theory and the phenomenon. The deductive approach consists of literature review, formal theory, field verification and the phenomenon. These processes are depicted in Figure 3. (ibid.) Dwivedi et al. (2009, p. 55) defines the difference between substantive and formal theory as follows, "A theoretical model that provides a "working theory" of action for a specific context. A substantive theory is considered transferable, rather than generalizable, in the sense that elements of the context can be transferred to contexts of action with similar characteristics to the context under study. This contrasts with formal theory, which is based upon validated, generalizable conclusions across multiple studies that represent the research population as a whole, or upon deductive logic that uses validated empirical theories as its basic axioms."

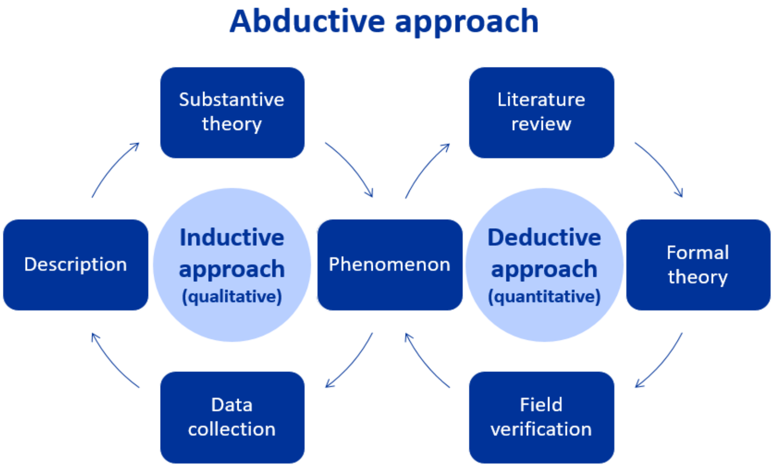

Figure 3. The inductive and deductive approaches. In combination, they are called an abductive approach (Woodruff, 2003).

The research approach used was qualitative (inductive). This was considered appropriate since the aim was to create substantive theory and no large amounts of quantitative data was available. Qualitative data was gathered from multiple sources to understand the situation. The research followed the circular process of the inductive approach. The phenomenon of study was the process of setting targets at ICOMP. It was studied by gathering data, describing the data and forming substantive theory. Then circling back to the phenomenon. The process is depicted in Figure 4.

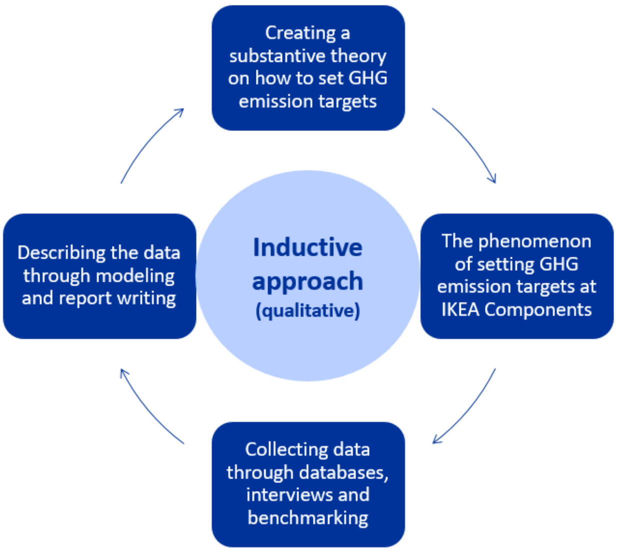

Figure 4. Applying the inductive approach to the phenomenon of how to set GHG emission targets (authors' own figure).

2.1.3 Research design

There are many possible ways to design research such as survey (Fink and Arlene, 2012), experiment (Campbell and Stanley, 2015), action research (Rearson and Bradbury, 2008), case study (Yin, 1994), mathematical modeling (Koole, 2010) and simulation (Bertrand and Fransoo, 2002). Research designs can also be combined to make use of their individual strengths (Denscombe, 2003). Using mixed research design enables comparing perspectives on the same situation and triangulates result. (ibid.)

This master thesis used a mixed method research design to study ICOMP, see Figure 5. Answering the research questions required both a qualitative understanding and mathematical calculations, hence it was assessed that a mixed method design was appropriate. The case study design was used as the overall approach to understand the qualitative aspects of setting GHG emission targets. Within the case study benchmarking was used to support the findings. Mathematical modeling was used to understand the quantitative aspects of setting GHG emission targets at ICOMP, such as constructing the as-is situation and understanding the impact of future actions. A mixed method design also triangulates results, increasing the validity. This can be done by comparing the results from the case study with the results from the mathematical modeling.

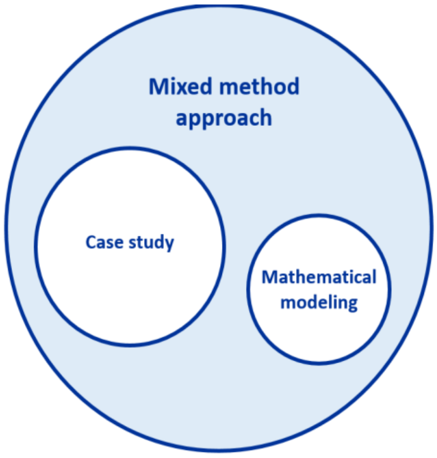

Figure 5. The mixed design approach applied in this research (authors' own figure).

Case study

The case study approach is appropriate when answering "how" and "why" questions, when the focus is on a contemporary phenomenon within a real-life context (Yin, 1994). The case study puts a greater influence on portraying the complexity of the situation than testing and generalizing theories, hence a more qualitative research strategy is appropriate (Creswell, 2013). All research questions are "how" questions, the research is mostly qualitative and the phenomenon to be studied is contemporary and placed in a real-life context (ICOMP). The case study is therefore appropriately used in this research.

The case study research design is appropriate when attempting to understand complex relations in a specific context (Denscombe, 2003). It focuses on a demarcated phenomenon and collects all possible input to describe it. A case study can e.g. collect data through direct observation, interviews and archives (Leonard-Barton, 1990). There are multiple purposes of using a case study approach, these are summarized in Table 2.

Table 2. Typical research questions for different case study purposes (Voss et al., 2002, p. 198).

Purpose	General research questions
Exploration	- Is there something interesting enough to justify research?
Theory building	- What are the key variables? - What are the patterns or linkages between variables? - Why should these relationships exist?
Theory testing	- Are the theories we have generated able to survive the test of empirical data? - Did we get the behavior that was predicted by the theory or did we observe another unanticipated behavior?
Theory extension/refinement	- How generalizable is the theory? - Where does the theory apply?

The case study approach is suitable when studying an area which has not been explored to any big extent (Meredith, 1998). Today the literature lacks research about setting GHG emission targets for scope 3 (Rietbergen et al., 2015). Comparing the research questions of this case study with the purposes in Table 2, they mostly resemble the general research questions for the Exploratory-purpose. It is also a suitable approach to provide a better understanding of practice. (ibid.) It is hence concluded that this research has an Exploratory purpose.

Case studies can be formed on single or multiple cases (Yin, 1994). In general, multiple case studies are preferred over single case studies because they provide stronger evidence for conclusions. Multiple case studies can however often require extensive time and resources. Single case studies can be appropriate for e.g. capturing a representative or typical case or for revelatory cases (investigating situations previously inaccessible to science). (ibid.)

The case study will focus on the single case of setting GHG emissions at ICOMP. The delimitation to a single case is made for two reasons. The first being the advantage of focusing on one system, allowing a greater depth of analysis, and the second being time and resource constraints. This choice limits the generalizability of conclusions. Due to the use of benchmarking, where three companies were interviewed concerning their target setting process, it could be argued that the research is a multiple case study. Still, it is desired to keep the main focus on IKEA and use the benchmarking to get more input. It will also increase the credibility and enable generalizations. Also, when only studying four companies in total it is seen as a too small number to use multiple case study as a method (Yin, 1994). Using a single-case study together with a benchmarking and applying a cross-case analysis to find patterns between IKEA and the three benchmarking cases, is by the researchers seen as the most suitable. This will enable keeping focus on IKEA and at the same time getting a quantitative input which together will generate contributions to the literature.

The unit of analysis for this case study is the process of setting emission targets for supply chains. The process includes the approach of setting targets and tracking performance. In other words, the unit of analysis is the way a company is working to set science-based targets.

According to Leonard-Barton (1990, p. 249), ”Any information relevant to the stream of events describing the phenomenon is a potential datum in a case study, since context is important”. This means that the case study tries to consider all variables related to a specific phenomenon. It is however impossible for researchers to observe all relevant situations, interview all stakeholders and gather all relevant archival data. Therefore, a selection of input needs to be made and a demarcated system to analyze needs to be defined (Merriam, 1994). The researchers hence need to clearly define the scope of the study.

Mathematical modeling

The method of using mathematical modeling is presented in this section and further background on modeling is presented in section 4.4 Modeling. Koole (2010, p. 89) defines mathematical modeling as “the process of solving real-world problems using mathematical techniques”. This is therefore an appropriate method to use for understanding ICOMP’s current emissions and building scenarios of future emissions. It is also used as a method to visualize results and to form a basis for decision making. Dym (2004) presents a structured approach for mathematical modeling, see Figure 6. The approach consists of principles formulated as questions. These are presented below.

- Why? Explaining the need for the model.
- Find? What information is needed? Listing desired data.
- Given? Identify available data and facts that are already known.
- Assume? What assumptions can be made and how will this affect the result.
- How? Define the governing physical principles.
- Predict? What will the model predict? Define the equations that will be used, calculations that will be made and questions that will be answered.
- Valid? Define tests that could be used to validate the model.
- Verified? Are the predictions good? Finding tests that could be used to verify the model. Is the model useful for the initial purpose it was created?
- Improve? How can the model be amended? Identify values not fully explored, variables that should, but have not been, included and assumptions that could be further discussed.
- Use? How will the model be used in practice? (ibid.)

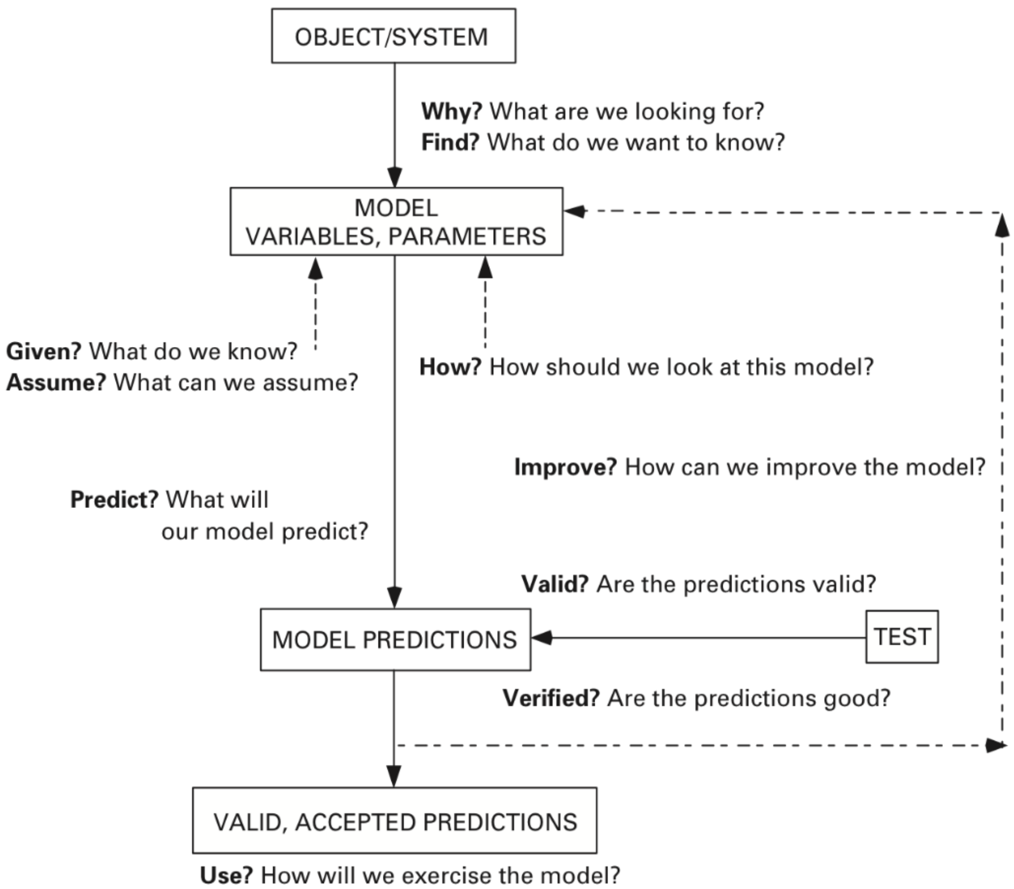

Figure 6. Overview of mathematical modeling and the principled approach (Dym, 2004, p. 7).

This approach to mathematical modeling (Dym, 2004) highlights defining the purpose of the model and working through an iterative process to improve and validate the model. The approach also includes considerations on usability (ibid.)

The research questions do to some extent include mathematical considerations. Creating a GHG inventory (1.a. How should a GHG inventory be created?) requires assumptions and mathematical calculations. Modeling and simulations (1.b. How can modeling be used to facilitate target setting?) requires mathematical modeling and simulations by definition. Setting time horizons and commitment levels (1.c. How should time horizons and commitment levels be determined?) will both need qualitative input from the case study and quantitative input from mathematical modeling. Communicating targets and tracking progress can also benefit from using mathematical modeling as well as qualitative input. It is therefore concluded that a mixed method approach using both the case study and mathematical modeling is appropriate in answering all research questions.

Building a mathematical model including scenarios aids in summarizing data, investigating and visualizing what ICOMP needs to do to reach the targets. Modeling can also be used in the future to measure progress. It can further contribute to a better understanding of the current state, which parameters that have the largest impact and what actions IKEA can take.

Scenario building can be useful in mathematical modeling to examine complex relationships (Bertrand and Fransoo, 2002). It is therefore good to use for exploration but has limited scientific quality of results. It also facilitates understanding and finding problems before they occur. (ibid.) Scenario building was used within the mathematical model to see what impact different actions would have on GHG emissions. The scenarios were developed by gathering stakeholder input on future developments. The purpose of using scenarios was to investigate possible future actions and internally communicate the impact of these. When creating scenarios, the approach proposed by ExtendSim (2008) was used. This meant starting with simple models and approximations and then adding requirements gradually. (ibid.)

The choice of modeling software was based on three criteria; facilitating easy use at ICOMP, enabling visualization and having enough computational power to handle the data. The software tool that fitted these criteria the best was Microsoft Excel (see section 4.4 Modeling for the investigated software programs). The program was available on all employee computers and most people in the organization had good knowledge of how to use the program, hence fulfilling criteria one. Excel also fulfils criteria two because it is possible to create diagrams that can be transferred to presentations, visualizing. The data and model was also assessed to be simple enough to work well in Excel, fulfilling criteria 3. The Excel model was built by using VBA, Microsoft's programming language (Microsoft, 2017).

2.1.4 Research methods

Creswell (2013) propose that research methods should be determined for Questions, Data collection, Data analysis, Interpretation and Validation. In addition to these research methods an additional one for the Literature review is added as recommended by Voss et al. (2002). All research methods are presented in this section except for Validation which is presented in 2.2 Quality of the study.

Questions

The research questions of this research were developed after an initial literature review and discussion with the focal company and supervisors at LTH. The purpose of the questions was to find answers that would serve as an aid for companies performing the process of setting targets. The findings also aimed to contribute to the theory where data was missing. These gaps in theory were found by the researchers during the literature review.

Literature review

Conducting a literature review serves the purpose of understanding the research area, placing the research into its academic context and supporting analysis (Rowley and Slack, 2004), it was therefore considered important for this study. The literature review was performed through the process presented in Figure 7, adapted from Rowley and Slack, 2004).

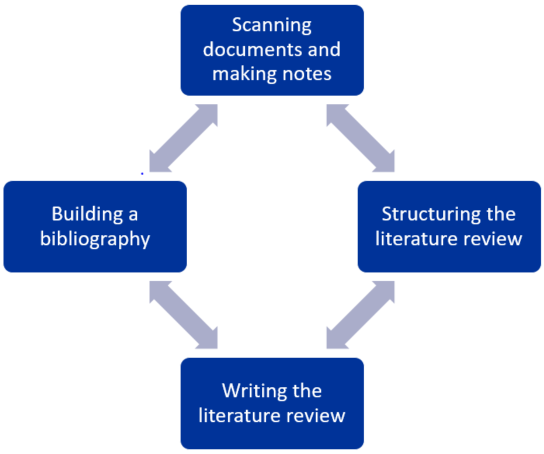

Figure 7. The iterative process of creating the Frame of reference (Rowley and Slack, 2004).

1. Scanning documents and making notes

Scanning documents and making notes was done simultaneously. Citation pearl growing (Rowley and Slack, 2004) was used as a search strategy for scanning documents. The citation pearl growing approach starts with a few sources and uses suitable terms and references in these to find other relevant literature. This was considered a suitable approach since there is little existing research on the specific topic (Rietbergen et al., 2015). The initial search terms in relation to the research questions are presented below.

- Initial search term: "green supply chain management"

This area lies in the intersection of supply chain management and carbon management. It creates a setting for the study and provides information on trends and general approaches to supply chain sustainability work. This is relevant to the research because it is within this overall area that supply chain GHG emission targets lie.

- Initial search term: "emission targets"

Target setting methodologies, processes and best practices were studied. This search term aimed in finding all relevant sources on how to set GHG emission targets. The search started by looking into target setting in general and then to emission targets setting in particular. Since there was little existing research within this area documented practical examples were also included.

- Initial search terms: "communicating targets" and "tracking progress"

This lays the foundation for answering the last research questions. This was an area that did not have much relevant literature. Analysis within this area therefore had to be more based on the empirical results.

This research project used two search engines for conducting the literature review, Google Scholar and LUBSearch Lund University Libraries. Since they can produce different results to the same search terms, two search engines were used to lower the risk of missing relevant sources. No limitations on publication years were used in the search. However, sources relating to global warming and best practices were assessed on their relevance in today's world before being used.

Since the topic is not very researched, the literature study also included other sources than journal articles and books. Reports and recommendations from NGOs and descriptions of best practices from other companies were collected from online sources. Before using any material, the sources were assessed on the basis of trustworthiness. This was done by checking if the source was mentioned by other trustworthy sources. Only sources passing this assessment were used.

Notes were taken using two approaches; by highlighting important passages in the text and by summarizing important concepts.

2. Structuring the literature review

The literature review should be logically organized in accordance with its content (Rowley and Slack, 2004). There is no general way of structuring a literature review. The structure should instead be developed according to the specific situation. (ibid.) The literature review was therefore structured so that concepts were presented from general to very specific, e.g. starting by looking at supply chain management and carbon management in general and continuing by examining GHG emission target setting in particular.

3. Writing the literature review

In accordance with recommendations from Rowley and Slack (2004) the writing started with setting headings and deciding what concepts would go under what heading.

4. Building a bibliography

The bibliography is a database of all the read sources. This was created continuously throughout the creating of the literature review.

Data collection

The most common data collection methods for case studies are interviews, observations and archival analysis (Höst et al., 2006). Interviews and archival analysis were together with benchmarking used in this research to enable triangulation of results. Observations were not considered relevant because data on the process of working with GHG emission targets could not be collected by observing people, but by talking to them.

Interviews

An interview is a conversation with a determined purpose structured by the interviewer (Silverman, 2016). To be able to gather valuable information during an interview and to draw conclusions preparation is crucial. Most often the interview is qualitative and therefore aims for in-depth understanding of a phenomenon. (ibid.) Interviews can be structured, where the interviewee responds to a pre-defined list of questions, semi-structured, where questions are prepared beforehand but structure and formulation can be adjusted during the interview, or unstructured where the interviewer lets the interviewee decide what should be discussed (Höst et al., 2006).

Interviewing was both used to collect internal data within IKEA and to collect external benchmarking data. Stakeholders within IKEA were asked to contribute with possible actions to reduce GHG emissions and to give input on targets. Semi-structured interviews within ICOMP were carried out to gain understanding of the business categories; A&A, Chemicals, Electrical components and Packaging & handling. Additionally, the transport manager and supply chain manager were interviewed. An interview guide was used and the same general questions were asked to every category manager, see appendix B. Some questions regarding areas concerning only a specific category were also added. The research questions and the research framework were the basis for the development of the interview guides. The questions aimed to answer the research questions and fill the gap in theory.

The interviews were performed according to the qualitative interview process described by Gubrium (2002) presented below.

1. Designing the research.

This included a literature review to understand how the interviews could contribute to research. Interviews guides were developed to include three types of questions; Main questions to guide the interview, probes that clarify statements or requests on further examples and lastly follow up questions.

2. Finding respondents.

The interviewer can try to minimize or maximize distances among respondents to either highlight or contrast patterns. To find patterns the interview usually must be carried out with several participants. Internal IKEA participants were found through the "snowball" process. One person interviewed helped to locate other potential participants through his or her network. The central person in this network was the global sustainability leader. Benchmarking participants were found through the SBTi website.

3. Setting up the interview.

After finding qualified candidates, they need to accept and confirm the content, time and place for the interview. This was done by contacting them through email and sending them the overall questions beforehand. (ibid.)

Benchmarking

Benchmarking is the process of systematically identifying, analyzing, and adapting industry best practices to improve an organization's performance (Boxwell, 1994). It is "the search for those best practices that will lead to the superior performance" (Camp, 1989, p. 12). By taking this external perspective on performance, benchmarking assists companies in gaining competitive advantage (Zairi, 1998). It is crucial to perform benchmarking in a structured way to ensure focus on the right areas and using the benchmarking results to improve actions (Camp, 1989). Figure 8 below presents the process proposed by Camp (1989) which was applied in this research.

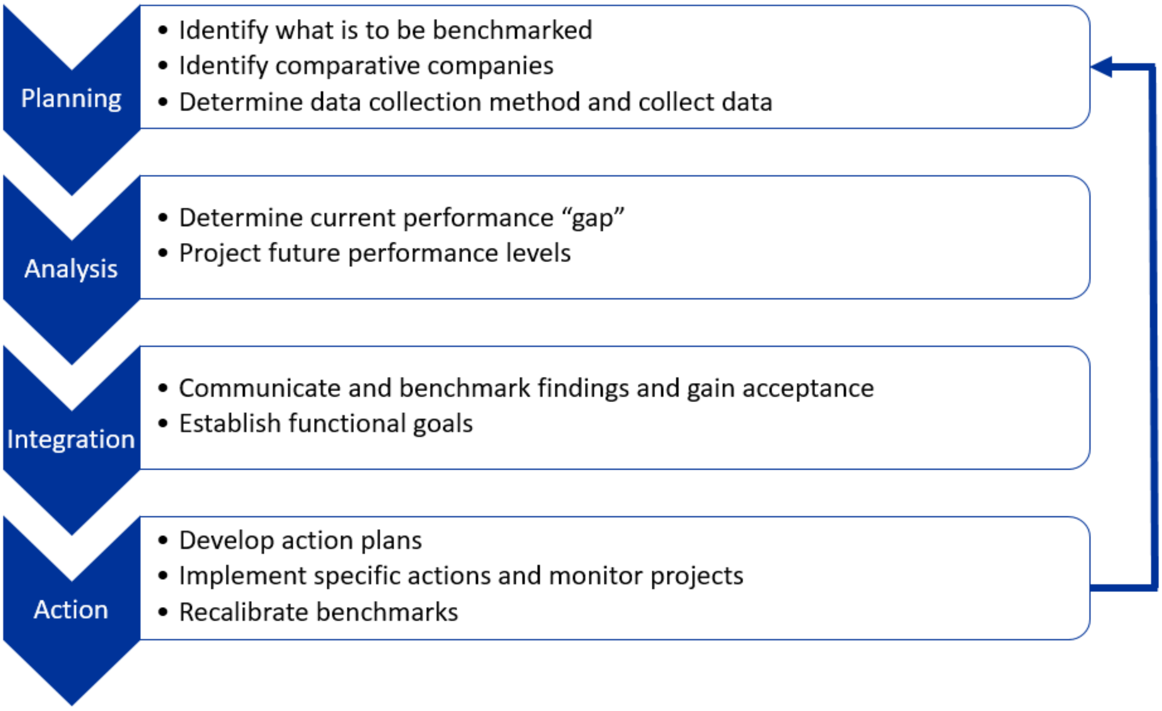

Figure 8. The general benchmarking process (Camp, 1989, p. 17).

Benchmarking was used to collect data on how companies with approved scope 3 targets are working. The data collected through benchmarking provided information and examples of how targets-setting can be performed. The benchmarking process proposed by Camp (1989), presented in Figure 8, was used. Since this is a research project only the first two phases, Planning and Analysis, were considered applicable. If ICOMP wants to implement the recommendations of this study they can then perform the steps in the remaining phases, Integration and Action.

Planning

1. Identifying what is to be benchmarked.

The research aimed to find best practices in how to set GHG emission targets for scope 3 emissions. This is therefore what was benchmarked in this study.

2. Identify comparative companies.

The number of companies that have approved targets for scope 3 emissions were few. Of these companies it was assessed that the ones based in Sweden or where the researchers already had contacts would be the most likely to participate. Contact was established with Tetra Pak, Husqvarna, Nestlé and Astra Zeneca. In-depth interviews were performed with Tetra Pak, Husqvarna and Nestlé. Astra Zeneca did not have time for an in-depth interview, but gave short answers.

3. Determine data collection method and collect data.

Since there is little documented information on how companies should work with GHG emission targets (Rietbergen et al., 2015) an explorative qualitative approach was considered appropriate. Loosely structured interviews serves this purpose well.

Analysis

4. Determine current performance “gap”.

Since IKEA has not done this type of target setting before the “gap” is merely differences in how IKEA plans to set targets and what the benchmarking companies have found is a good way of doing it.

5. Project future performance levels.

The future performance levels are considered in the final recommendation on how to work with GHG emission targets.

Data was collected through interviews with key people within the target setting process at the respective companies. Interviewees were all at the center of the target setting process at their respective companies. An interview guide based on the literature review was created to maximize the relevant output, see appendix A. The research questions and the research framework were the basis for the development of the interview guides. The questions aimed to answer the research questions and fill the gap in theory. To get a basic understanding the opening questions aimed at getting to know the company, the interviewee and their scope 3 targets. Further questions aimed at providing input into answering the research questions. The literature study was used to compare theory with real practice at the companies. Additional questions were created with a purpose to collect data that literature was lacking.

Archival analysis

Data collected for other use than the current research can be used as sources, this is called archival analysis (Höst et al., 2006). It is however important to remember the original purpose of the data so that it is not misinterpreted. (ibid.) Archival analysis was used in this research when gathering database information from IKEA to create the as-is GHG emission situation and to model future emission scenarios.

IKEA collected some archival data before the start of the project (ICOMP Global sustainability leader, 2017), the missing data was collected by the researchers. Data for the GHG inventory was collected within three areas; Material, Production and Transport (see 1.7 Focus and delimitations). Additional data for expected growth was also gathered as input to the modeling. The areas are presented in Table 3.

Table 3. The areas in which database information was gathered.

Area	Scope	Description
Material	Raw material purchased	Gathered in tons per year, converted to CO_2e by an external actor (External consulting company, 2017).
Production	First-tier suppliers and P&D units	Gathered in CO_2e per supplier through the Supplier Sustainability Index (SSI, 2016).
Transport	First-tier suppliers to HF suppliers	Because of the lack of data GHG emissions were estimated through a series of approximations.
Growth	Sales for ICOMP	Expected growth within the respective business areas. Estimations were made for years where no forecasts existed.

Data analysis

To analyze the data cross-case analysis was employed. This technique is commonly used in multiple case designs (Yin, 1994), but is considered appropriate here to analyze similarities and differences between the IKEA case and the three benchmarking cases. Cross-case analysis is a suitable method to see the results through different lenses and to go beyond the initial impressions (Eisenhardt, 1989). There are three ways to perform cross-case analysis; by looking for similarities and differences in select categories between cases, by looking at cases in pairs and identifying similarities and differences and by finding similarities and differences through looking at one data source at a time. (ibid.) Since the unit of analysis is the process of setting targets the first approach is considered the most appropriate because each step of the process can serve as an analyzing category.

Qualitative research in general and case studies in particular are advantageously analyzed through pattern matching and explanation building (Yin, 2009). These were therefore used as tools within the cross-case analysis. Pattern matching compares predicted patterns with observed empirical patterns. Pattern matching is used in this research to compare the cases with each other. Explanation building is a form of pattern matching which aims to explain empirical case results by answering how and why something happened. Explanation building is used to analyze why the studied companies have used different processes, how their processes have aided them and (ibid.) The data analysis is presented in chapter 7. Analysis.

Interpretation

Interpretation of results can in qualitative research take many forms and be adapted to specific situations (Creswell, 2013). Interpretation of results is used to answer the question "What were the lessons learned?" (Creswell, 2013, p. 200). In this research interpretations are made from the comparison between cases combined with information from literature. The interpretations conclude whether findings are consistent with theory or if they diverge. (ibid.) The interpretations are presented in the section 7. Analysis and are thereafter summarized in an exploratory model. The interpretation can also raise new questions that should be answered. Since this is an exploratory study the overall conclusions should be investigated further to be validated into theory. Suggestions for future research is presented in section 9.3.

2.2 Quality of the study

For research to contribute to academia and practice the study needs to be credible. This means that the study has trustworthiness, rigor and quality (Golafshani, 2003). Credibility can be broken down into validity (construct, internal and external), reliability (Gibbert et al., 2008) and objectivity (Björklund and Paulsson, 2003). Höst et al. (2006) also add transferability as a part of quality, specifically relevant to master theses. These concepts in relation to the study are discussed further below.

2.2.1 Validity

Validity concerns whether the research actually measures what it is intended to measure (Golafshani, 2003; Lekvall and Wahlbin, 2007). There are three types of validity relevant for case study approaches; construct, internal and external validity (Gibbert et al., 2008). The types of validity often correlate, meaning that good validity in one area often implies good validity in another (ibid.)

Construct validity of research is the initial concept, notion, question or hypothesis that determines what data to gather and how to gather it (Golafshani, 2003). It refers to whether a study examines what it claims to examine (Gibbert et al, 2008). To enhance construct validity in case studies researchers should

- Using multiple sources of evidence (Gibbert et al, 2008)
- Establish a clear chain of evidence - allowing reconstruction by others (Yin, 1994, p. 102)
- Use triangulation - looking at the same phenomenon from different angles by using different data sources and collection methods (Gibbert et al., 2008). Triangulation is a way of ensuring credible results (Golafshani, 2003). Triangulation is defined as “a validity procedure where researchers search for convergence among multiple and different sources of information to form themes or categories in a study” (Creswell and Miller, 2000, p. 126).

Internal validity (also called logical validity) concerns the causal relationship between variables and results (Gibbert et al, 2008). Researcher need to provide a compelling logical argument explaining the research conclusions. Three ways of enhancing internal validity are

- Formulating a clear research framework - demonstrating relationships between variables and outcomes
- Performing pattern matching - observed patterns should be compared with results from previous research or expected patterns (described in section 2.1.4 Research method, under Data analysis)
- Using theory triangulation - using multiple perspectives to verify findings (ibid.)

A study has high external validity if results are generalizable. This means that results and theories should be applicable not only to the specific situation of the study, but also to similar situations (Gibbert et al, 2008). Case studies can be analytically generalizable whilst quantitative studies can be statistically generalizable. Analytical generalization refers to generalization from empirical observation to theory. Researchers can create case studies with high external validity by

- Cross-case analysis - using 4-10 cases (can be analysis between and within companies)
- Providing a clear rationale of the case study selection and context - described further in section 2.1.4 Research method. (ibid.)

Multiple measures have been taken aiming to ensure validity of this study. Construct and internal validity are considered relatively high, whilst external validity is lower because of the single case study approach. The measures taken are presented below together with what type of validity they aim to address.

- Using multiple sources of evidence; namely IKEA internal databases, internal interviews and external benchmarking – construct validity
- Simple triangulation by looking at the same situation from different angles using the two internal sources and a mixed research design approach – construct validity
- Establishing a clear chain of evidence by explicitly motivating choices made and describing relevant circumstances – construct validity
- Pattern matching by comparing the processes of different companies and with existing research – internal validity
- Supporting the research by a clearly structured research framework – internal validity
- Benchmarking – external validity
- Describing the case study selection and context – external validity

Transferability refers to the extent to which results can be generalized, in some sense it is the same thing as external validity (Höst et al., 2006). The transferability of case studies is generally low. In the case of this study the single case of setting targets at ICOMP has low transferability because of the limitation to one case. Actions taken to increase transferability was performing the benchmarking, being part of the overall target setting project group at IKEA and reading available case studies online. The main contributor to an increased transferability was the benchmarking. This was believed to make the transferability better than a single case study, but not as good as a multiple case study.

Since the study is exploratory the results should be viewed as ideas on what to consider when setting science-based supply chain emission targets. In this sense, the transferability of results is relatively high. If results were to be viewed as new formal theory, transferability would be very low.

2.2.2 Reliability

The reliability of a study refers to the extent of which results are replicable or repeatable, meaning absence of random error. If the study can be reproduced under a similar methodology it is considered reliable (Golafshani, 2003; Lekvall and Wahlbin, 2007; Gibbert et al, 2008). Transparency can be enhanced by the use of

- A case study protocol - a report specifying how the case study has been conducted

- A case study database - notes, documents, narratives and other relevant data (Gibbert et al, 2008)

General reliability can also be enhanced by using

- Triangulation
- Control questions - examining the same thing twice (Yin, 2003)

This study aims to have high reliability by clearly describing the process, context and motivating decisions made. A simplified case study protocol is presented in the chapter 2.4 Research process. All notes, documents, narratives and other relevant data was saved in the same place to be easily shared with anyone wanting to use it.

2.2.3 Objectivity

Objectivity refers to whether researchers have performed the study in an objective manner (Björklund and Paulsson, 2003). This means that researchers have no personal gains in obtaining certain results and no personal opinions have affected the study. To ensure objectivity researchers should

- Display and motivate all choices made
- Clearly show when own opinion is stated
- Reproduce sourced content correctly
- Use credible sources (ibid.)

This study is considered to be objectively performed since credible sources are used, personal opinions are clearly stated and choices are motivated. One thing that lowers the objectivity of the study is that the researchers performed some of the process steps at ICOMP. This can however also be seen as a strength of the research since it gave the researchers more insights and understanding of the process.

2.3 Summary of method

The overall research approach is summarized in Figure 9. This research has a pragmatic worldview and uses an overall qualitative approach to understand the process of setting GHG emission targets for scope 3 emissions. To answer the research questions a mixed design including both a case study approach and mathematical modeling is used. Research methods included strategies for developing the questions, conducting the literature review, collecting data, analyzing data, interpretation and validation.

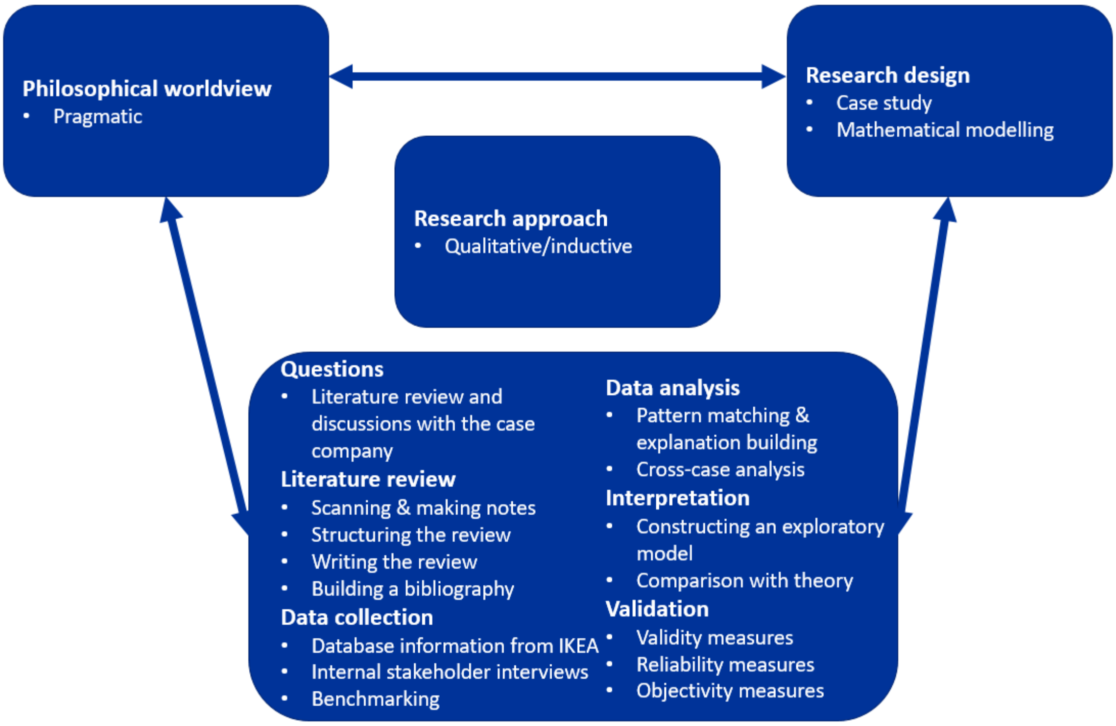

Figure 9. The research approach of this master thesis (the authors' own creation based on Creswell, (2013, p. 36)).

2.4 Research process

The practical research process was based on the research approach and was further broken down into planning, literature review, data collection, data analysis, methodology development, drawing conclusions and presenting results (adjustment of Höst et al., 2006). The overall steps are presented in Figure 10 and described further below.

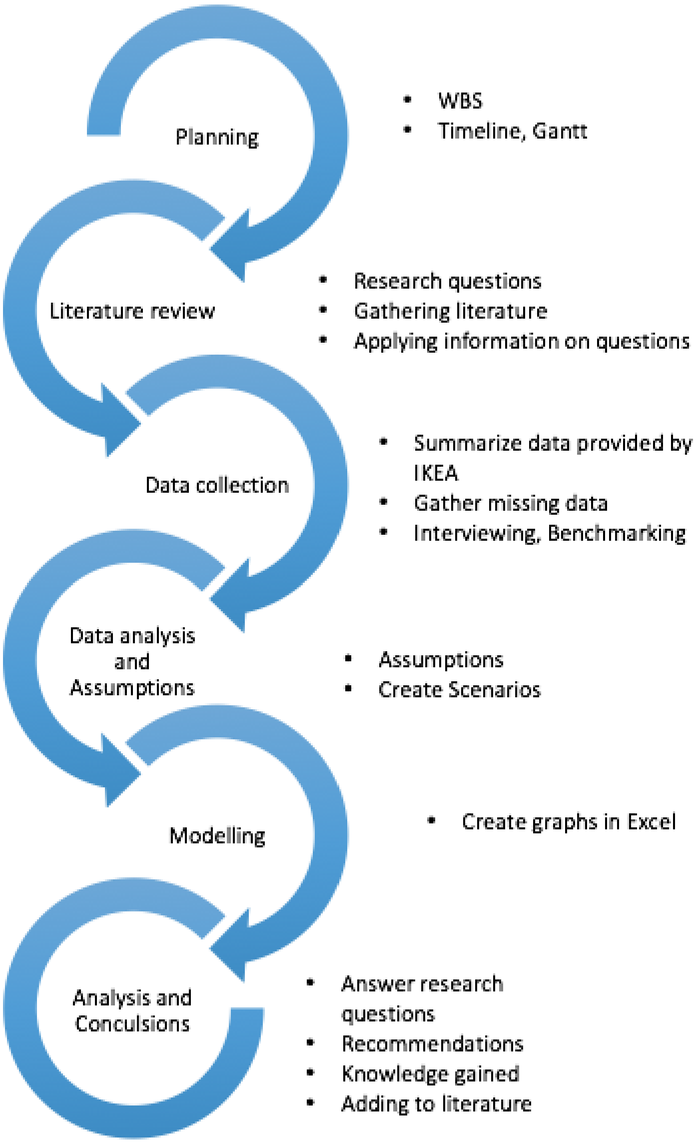

Figure 10. The overall research process of this master thesis (the authors' own creation).

2.3.1 Planning

The project commenced with a planning period. This consisted of scoping the project, choosing research methods and planning the realization of these. In accordance with Höst et al. (2006) it also included a work breakdown structure to get a detailed overview of the work and a detailed timeline (Gantt chart) including sub targets. Throughout the project continuous follow-up on the timeline was done to ensure on-time project completion.

2.3.2 Literature review

To lay a foundation for results a literature review on existing research was conducted. The focus of the literature review lay in the intersection of supply chain management, carbon management and target setting. The literature study aimed to explore previous research relating to the research questions. The literature consisted of journal articles, other articles and reports, books and internet sources.

2.3.3 Data collection

The data collection was divided into three main sources; database information from IKEA (archival analysis), interviews within IKEA and benchmarking data. The means for collecting these data have been further described in section 2.1.4 Research methods, under Data collection.

2.3.4 Methodology and model development

The methodology and model for setting GHG emission targets was developed using Excel. IKEA Component's as-is situation, targets and scenarios were developed and visually presented. The Excel model includes short-, mid- and long-term targets. The model was built to enable visualization of scenarios, targets and progress. Excel was used as modeling tool since it is simple, everyone can open it on their own computers and it enables visualization. The drawback with using Excel is that it limits the amount of data that can be handled. The model development has been further described in section 2.1.3 Research design, under Mathematical modeling.

2.3.5 Drawing conclusions and presenting the result

The study aims to answer the research questions described in section 1.4 Research questions. Empirical data gathered in the case study and the modeling were analyzed in relation to the frame of reference and the research questions and conclusions are drawn. The results were presented in an academic report and through oral presentations at LTH and at ICOMP. The academic report aims to present all relevant details for inquiry and analysis, while the presentations aimed to summarize the most important findings relevant to the audience.

3. Case company background

This section presents the case company and the scope of the study at ICOMP.

IKEA is a Swedish group of companies that sells ready-to-assemble furniture, appliances and home accessories globally. It is the world's largest furniture retailer (Forbes, 2012). In 2016 IKEA Group signed up for the SBTi (SBTi, 2017).

IKEA has a relatively developed sustainability approach in many areas. An example of this is that the corporate top management team includes a sustainability manager (IKEA, 2017). Another example is the yearly sustainability report which in 2016 won the prize for Best Sustainability report within the Big Companies category (Aktuell Hållbarhet, 2016). The Global Reporting Initiative (GRI) guidelines are used to support the reporting, but IKEA doesn't report entirely according to the guidelines (IKEA Sustainability Report, 2016). They have instead chosen to focus on how they are achieving their People and Planet Positive strategy (IKEA Sustainability Report, 2016). Figure 11 shows IKEA Group's GHG emissions in 2015, where Scope 3 emission comprise the majority of total emissions.

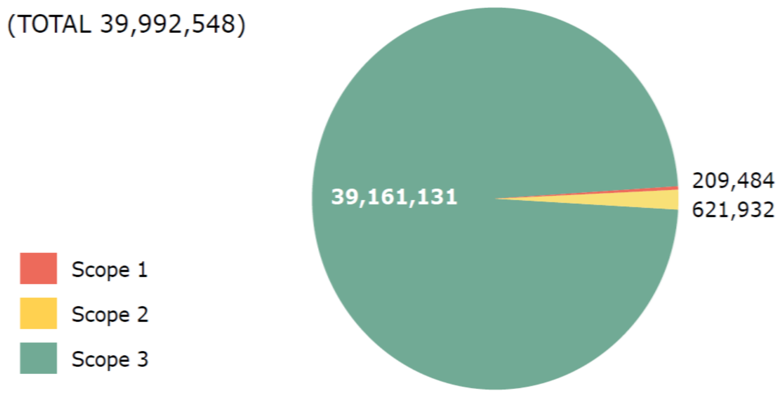

Figure 11. IKEA's total GHG emissions in FY 2016 (tons) (IKEA Sustainability report, 2016, p. 42).

3.1 Organizational structure

There are multiple companies within IKEA, however, the main focus of this case research lies within the Inter IKEA group, presented in Figure 12 (Inter IKEA group, 2017). IKEA Range and Supply develops and supplies IKEA products by working within the entire value chain from product design and sourcing to customer requirements and end-of-life (IKEA, 2017). IKEA Industry produces wood furniture for sales in IKEA stores. Furniture not provided by IKEA Industry is bought from external suppliers (called Home Furnishing supplier, HF suppliers). IKEA Supply AG is responsible for supply including distribution, cross-border flows and goods to various IKEA Retail Companies (Inter IKEA Group, 2017). Several other functions/units and legal companies operate under IKEA Range and Supply. One of these are ICOMP. (ibid.)

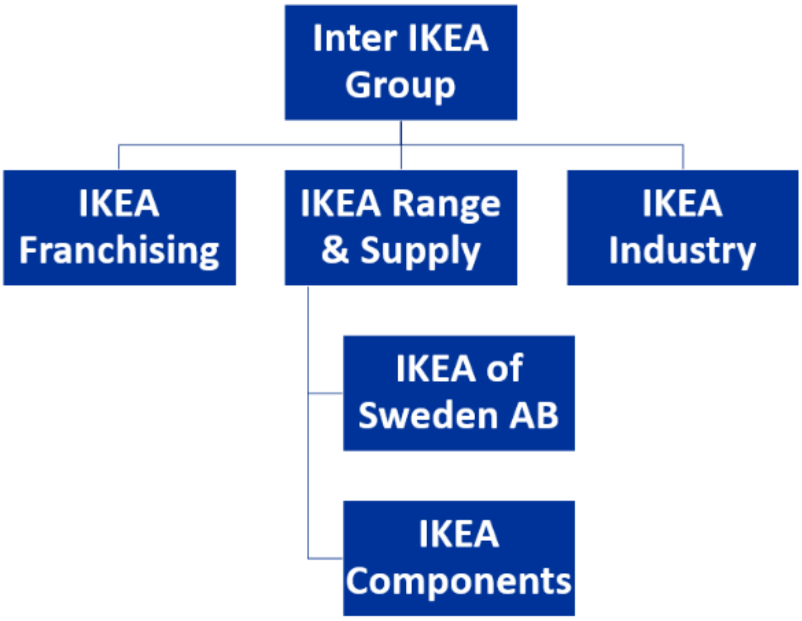

Figure 12. Organizational structure of Inter IKEA Group. IKEA Components is one of multiple subdivisions of IKEA R&S (Inter IKEA Group, 2017; ICOMP Global sustainability leader, 2017; ICOMP Supply chain manager, 2017).

3.2 IKEA Components

ICOMP develops, purchases and sells components and other material for IKEA furniture (ICOMP Global sustainability leader, 2017). Figure 13 presents an organizational with details on the scope of this project. A&A develops and purchases all components that go into the fitting bags that accompany IKEA furniture packages. The components are purchased from external suppliers, packed at the packaging factories (P&D-units) and then transported HF suppliers. ICOMP owns the two main P&D units, one in Slovakia, and one in China. In Europe five external packaging units are also used for small shares of the packaging. Electrical components also develop components and then sources them. Packaging & handling and Chemicals only source materials. These components and materials are never physically owned by ICOMP, only purchased and directly delivered to HF suppliers. ICOMP is also responsible for development of Float glass and mirrors and Open and close-products, this is excluded from ICOMP scope but included in R&S scope. (ibid.)

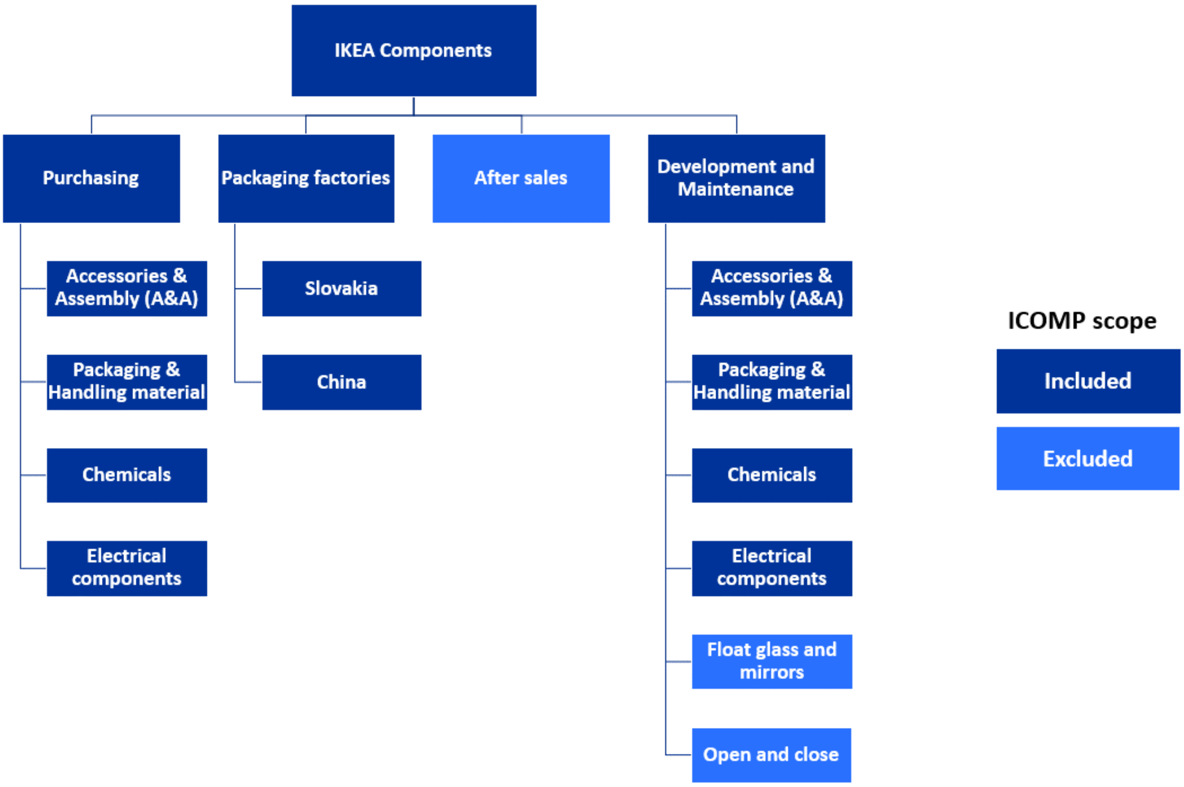

Figure 13. Organizational structure of ICOMP and scope of the project (authors' own creation from input by ICOMP Global sustainability leader (2017) and ICOMP Supply chain manager (2017)).

4. Frame of reference

Chapter three presents the theoretical frame of reference in which this research lies. Three main areas are explored; supply chain management, carbon management and target setting. The chapter starts by looking at carbon management (section 4.1 Carbon management) and then looks at the intersection of carbon management and supply chain management (sections 4.2 Carbon management within the supply chain and 4.3 Supply chain GHG emissions). The Frame of reference then explores setting targets in general and GHG emission targets in particular (section 4.4 Setting company GHG emission targets).

This study lies in the intersection of supply chain management, carbon management and target setting. To lay a foundation the literature study therefore explores previous research in these areas. The literature review supports the research by building an understanding of theory, creating the basis for analyzing results and showing where in research this study will contribute. In Figure 14 the examined areas are illustrated.

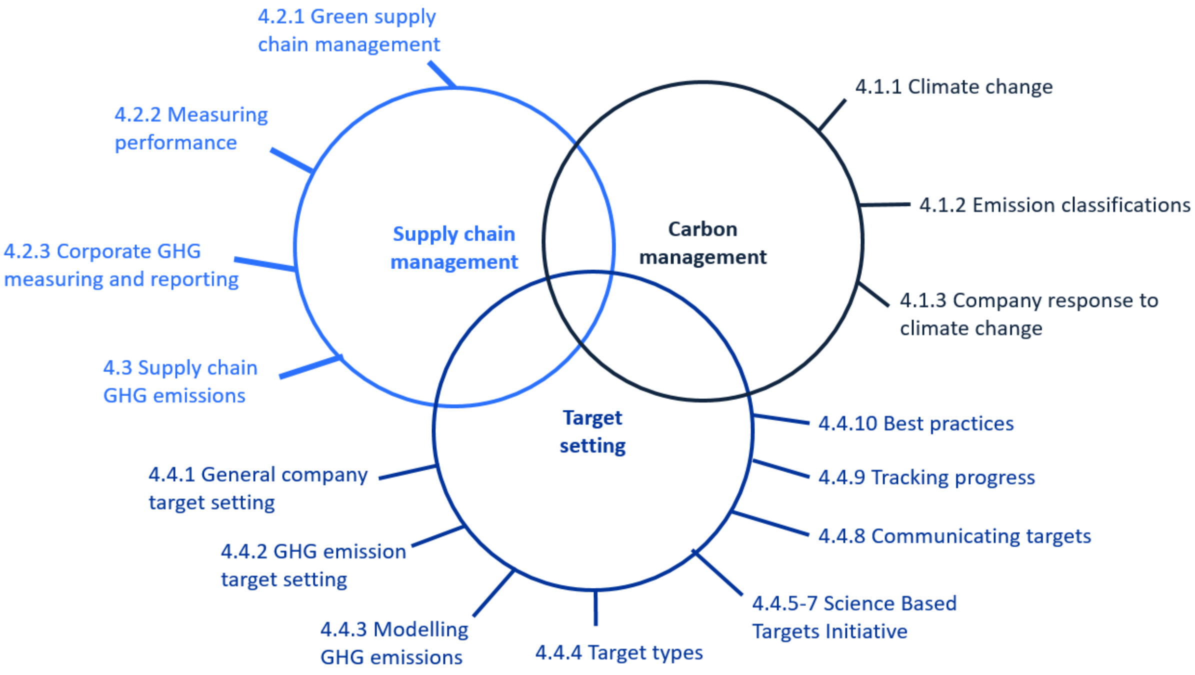

Figure 14. Overview of the frame of reference which focuses on the intersection of supply chain management, carbon management and target setting (authors' own creation).

4.1 Carbon management

Carbon management relates to corporate climate strategy and actions. It therefore includes both knowledge of climate change and how companies are to reduce their impact on climate change. (Okereke, 2007).

4.1.1 Climate Change

A greenhouse gas is defined a gas in the atmosphere that absorbs and re-emits heat (Brander, 2012). Gases have different life times and absorb different amounts of heat. To be able to compare the gases and to summarize the gases global warming potential (GWP) and carbon dioxide equivalents (CO_2e) are often used. GWP and CO_2e are indexes which rate gases in relation to how much global warming they cause compared to CO_2. As seen in Figure 15, GHG levels in the atmosphere have never been higher. (ibid.)

Figure 15. A graph showing the increase of CO_2 levels in the atmosphere since the Industrial Revolution (NASA, 2017).

The increase of greenhouse gases in the atmosphere is causing global warming (NASA, 2017). The earth is responding to the increased GHG levels by; temperature rise, sea level rise, warming oceans and melting ice sheets. Greenhouse gases block the heat in the atmosphere, capturing it, causing temperatures to rise. The gases that contribute to global warming are; water vapor, carbon dioxide (CO_2), methane, nitrous oxide and chlorofluorocarbons. Carbon dioxide is a natural component of the atmosphere, but in relatively small amounts. The gas is released through burning of fossil fuels, respiration, volcano eruptions, deforestation and land use. Some of these sources come from human activity. The Intergovernmental Panel of Climate change (IPCC), a group consisting of 1,300 experts from all over the world, have concluded that human activity is warming our planet. These activities have raised carbon dioxide levels from 280 ppm to 400 ppm in the last 150 years. (ibid.)

4.1.2 GHG emission classifications

Carbon dioxide emissions can be classified into three scopes (GHG Protocol, 2017). These scopes are depicted in Figure 16.

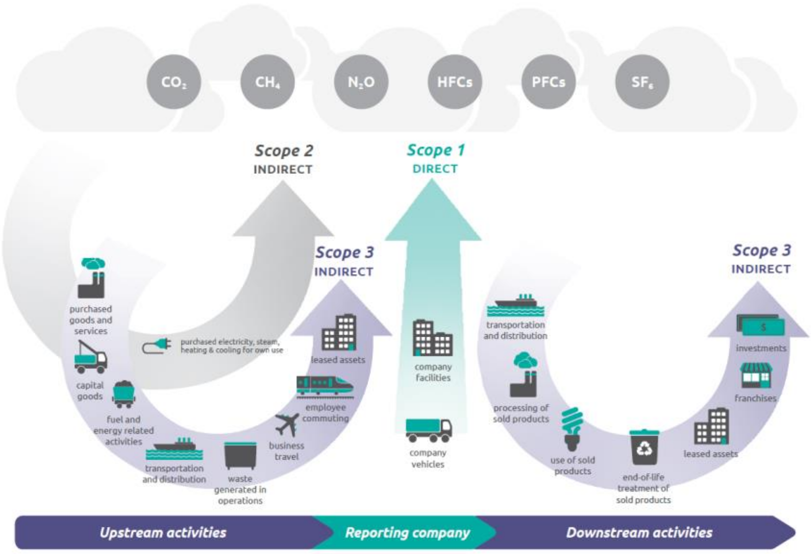

Figure 16. The three scopes in the GHG Protocol (GHG Protocol, 2011, p. 5).

The GHG Protocol breaks down scope 3 emission into fifteen categories, see Table 4, appendix C contains more detailed descriptions and explanations of the scopes. These fifteen categories have been defined by the GHG Protocol to enable reporting and comparison between companies. The categories can be used as guidelines for companies wanting to understand their GHG emissions. (ibid.)

Table 4. Scope 3 categories as defined by GHG Protocol (2013, p. 7).

Scope	Category	Description
1	Company facilities	Company owned facilities
1	Company vehicles	Company owned vehicles
2	Purchased electricity, steam, heating and cooling for own use	Electricity, steam, heating and cooling for own use purchased for own use
3	Purchased goods and services	Extraction, production, and transportation of goods and services purchased or acquired not otherwise included in Categories 2 - 8.
3	Capital goods	Extraction, production, and transportation of capital goods purchased or acquired
3	Fuel- and energy-related activities	Extraction, production, and transportation of fuels and energy, not already accounted for in scope 1 or scope 2.
3	Upstream transportation and distribution	Transportation and distribution between a company's tier 1 suppliers and its own operations. Transportation and distribution services purchased
3	Waste generated in operations	Disposal and treatment of waste generated
3	Business travel	Transportation of employees for business-related activities
3	Employee commuting	Transportation of employees between their homes and their worksites
3	Upstream leased assets	Operation of assets leased by the reporting company
3	Downstream transportation and distribution	Transportation and distribution of products sold from the company's operations to the end consumer
3	Processing of sold products	Processing of intermediate products sold by downstream companies
3	Use of sold products	End use of goods and services sold
3	End-of-life treatment of sold products	Waste disposal and treatment of products sold
3	Downstream leased assets	Operation of assets owned by the reporting company (lessor) and leased to other entities
3	Franchises	Operation of franchises, reported by franchisor
3	Investments	Operation of investments (including equity and debt investments and project finance)

4.1.3 Company response to climate change

Companies and researchers are increasingly starting to understand the importance of climate change as a critical factor of consideration in supply chain management (Seuring, 2013). Drivers for energy and carbon management include reducing costs, preparing for compliance to new governmental regulations, enhancing corporate reputation and increasing eligibility for using financial incentives or other company advantages (Rietbergen et al., 2015). Today most studies focus on producers and manufacturer-related aspects, while the supplier aspects often have been left uncharted. However, there is a shift towards greater focus on the indirect impact of the supply chain, both upstream and downstream. World business Council for Sustainable Development (WBCSD) and World Resources Institute (WRI) (2009) report that a minimum of 80% of carbon emissions are released as scope 3 emissions. (ibid.)

4.2 Carbon management within the supply chain

There are multiple factors to consider when wanting to manage GHG emission output in the supply chain. The most important ones according to literature seem to be green supply chain management, supply chain performance measurement and corporate GHG measuring and reporting.

4.2.1 Green supply chain management

One way of considering GHG emissions within supply chain management is by applying the perspective of GSCM (Hervani and Helms, 2005). This approach empathizes the sharing of environmental responsibility with the overall aim to reduce environmental impact across industries. There are many possible ways to measure supply chain environmental impact, whereas GHG emissions is one of them. (ibid.) The concept is defined and broken down as

GSCM = Green purchasing + Green Manufacturing/Material management + Green distribution/Marketing + Reverse logistics (Hervani and Helms, 2005, p. 334)

The aim of GSCM is to combine environmental management with supply chain management (Laari, 2017). Many companies are today reliant on their suppliers and thereby also responsible for not only their own but also their suppliers' environmental impact. There are also strategic motivations for GSCM such as positive corporate image, increased efficiency and innovation leadership. Sustainability can be a competitive advantage and at the same time lower product cost and improve value. GSCM is often seen as difficult to implement due to complexity of supply chains, the longtime horizons and the interrelation with traditional business objectives. The benefits and effects of the relationship between competitive strategy and GSCM need to be highlighted. In many cases, standard strategies such as the cost leadership and differentiation, could be used to extend the GSCM theory. (ibid.)

4.2.2 Supply chain performance measurement

Measuring performance in supply chains is harder than measuring performance within companies because of system complexity (Beamon, 1999). Selecting what to measure and evaluate in a supply chain can also be difficult. Effective supply chain performance measurements are characterized by inclusiveness (measuring all relevant aspects), universality (enabling comparison), measurability and consistency with company objectives. (ibid.)

Using a single performance measure is attractive for simplicity reasons. If a single performance measure is applied, one must ensure that this measurement is actually measuring the performance of the whole system (Beamon, 1999). Many companies choose cost as a single supply chain performance measure, relying fully on cost does not include all relevant aspects and strategic goals. (ibid.)

Measuring performance aims to give companies the necessary information for making decisions and taking action (Holmberg, 2000). Measuring supply chain performance has been shown to create greater understanding, improve behavior of supply chain members and increase overall performance (Shepherd and Günter, 2006). To successfully manage supply chain performance measurements companies need to adopt a systematic approach, align performance measurements with strategy, balance cost and non-cost measurements and adhere to the supply chain context, minimizing local optimization (Holmberg, 2002; Shepherd and Günter, 2006).

A difficulty with measuring across multiple entities is comparability of figures and differences in how measurements are made (Holmberg, 2000). Creating standards and ensuring compliance can reduce this problem. Other potential issues are poor technological integration, geographical and cultural differences, differences in organizational policy, lack of agreed upon metrics, or poor understanding of the need for inter-organizational performance measurement (Hervani and Helms, 2005).

4.2.3 Corporate GHG measuring and reporting

Traditional supply chain performance measurements have a short-term outlook while green supply chains require a more long-term focus (McIntyre et al., 1998). McIntyre et al. (1998) suggest that approaches can be blended by representing long-term views with short-term performance measurements. Measuring environmental performance is essential for companies that want to manage their emissions (Young and Welford, 1998). Carbon accounting measures GHG emissions at different levels of the organization such as corporate, project and factory level (Rietbergen et al., 2015). Having a structured approach to measuring and target setting enables decision-making by comparing measurements over time to analyze trends, using measurements to set objectives and assess if targets have been met and benchmarking results to understand where improvements can be made (ibid.)

Companies have generally focused their efforts on measuring and reducing scope 1 and 2 emissions but are increasingly understanding the relevance of measuring scope 3 emissions as well (GHG Protocol, 2011). To construct a supply chain GHG analysis there are two main approaches (West coast climate forum, 2016). The first is to ask suppliers about their emissions. This method is accurate but time consuming. It could be useful for large companies that purchase large amounts from a relatively small number of suppliers. The biggest problem here is that suppliers often don’t have available data. The second option is to estimate emissions for different product types. There are several tools available for doing this, some free of charge and some that requires payment. (ibid.)

One of the tools is the Greenhouse Gas Protocol-Scope 3 Evaluator (Greenhouse gas protocol, 2017). This tool was created by the GHG Protocol in cooperation with the External consulting company. The tool allows companies to make a rough first approximation of their scope 3 footprint. This is done by answering some questions about structure, activities, fuel use, transportation etc. The outcome is a report the company could use as a starting point in identifying action areas before developing a more GHG inventory. (ibid.)

4.3 Supply chain GHG emissions

The supply chain setup impacts scope 3 GHG emissions, considering emission costs can change the optimal configuration of the supply chain (Elhedhli and Merrick, 2012). Companies apply different methods for breaking down targets within the organization and the supply chain. Targets can be set by bottom-up and top-down approaches. Possible further breakdowns can be made on organizational, geographical, functional and hierarchical dimensions (McKinnon and Piecyk, 2012). Timelines also differ widely between companies. (ibid.)

4.3.1 Material

Many aspects of material choice need to be considered in product design; quality and cost are of large importance (Kou et al., 2014). Carbon footprint has however in recent years received increased attention in the product design process. Still, GHG emissions are often only taken into account late in the development process, making changes for lower emissions very difficult and expensive. Hence, to be able to impact GHG emissions in a cost-effective way consideration needs to be taken in the initial design stage. This consequently means that lowering the carbon footprint of an entire product range would take a very long time. (ibid.)

WSP (2017) and Roy (2000) suggest areas which impact the carbon footprint and environmental impact of products. Some of these would take very long for companies to change while others could be changed faster. The areas are:

- The supply chain and their materials and processes (e.g. where materials are sources from)
- Raw materials/full bill of materials (e.g. selecting renewable and/or recycled materials)
- Design specifications (e.g. reducing the weight or volume of materials in the product)
- Production processes (e.g. using cleaner techniques for product manufacture)
- Packaging (e.g. using less packaging material)
- Consumer usage (optimizing the life of the product)
- End of life disposal and reuse (reuse, remanufacture, recycling or disposal at the end of the product's life) (ibid.)

4.3.2 Production

Low carbon manufacturing (LCM) is the process of emitting low CO_2 intensity from system sources and the manufacturing process (Tridech and Cheng, 2011). It can be further described with four main characteristics;

- Low CO_2 from source; Today a big percentage of equipment used in the manufacturing is powered by electricity. If the machines can be improved and thereby use less energy, the release of carbon dioxide will decrease.
- Energy efficiency; The percentage of output of energy divided by the input energy, should in the LCM concept be higher than the conventional process.
- Minimization of waste; Optimizing the process when it comes to reducing the waste
- Resource Utilization; This can be observed by looking at raw material usage and waiting time in the process. These factors can then be used as constraints to create an optimal production algorithm. The carbon dioxide will decrease when the resource utilization increases. (ibid.)

As seen in Figure 17. Share (%) of renewables in gross energy consumption 2014 (bars) and projected shares in 2020 (marks) (Eurostat 2016)., the percentage of renewable energy used in different countries varies a lot (Eurostat 2016). In the top with the highest percentage are Iceland, Norway and Sweden. A result of this is that the amount of CO_2 released is impacted by where the production is located. (ibid.)

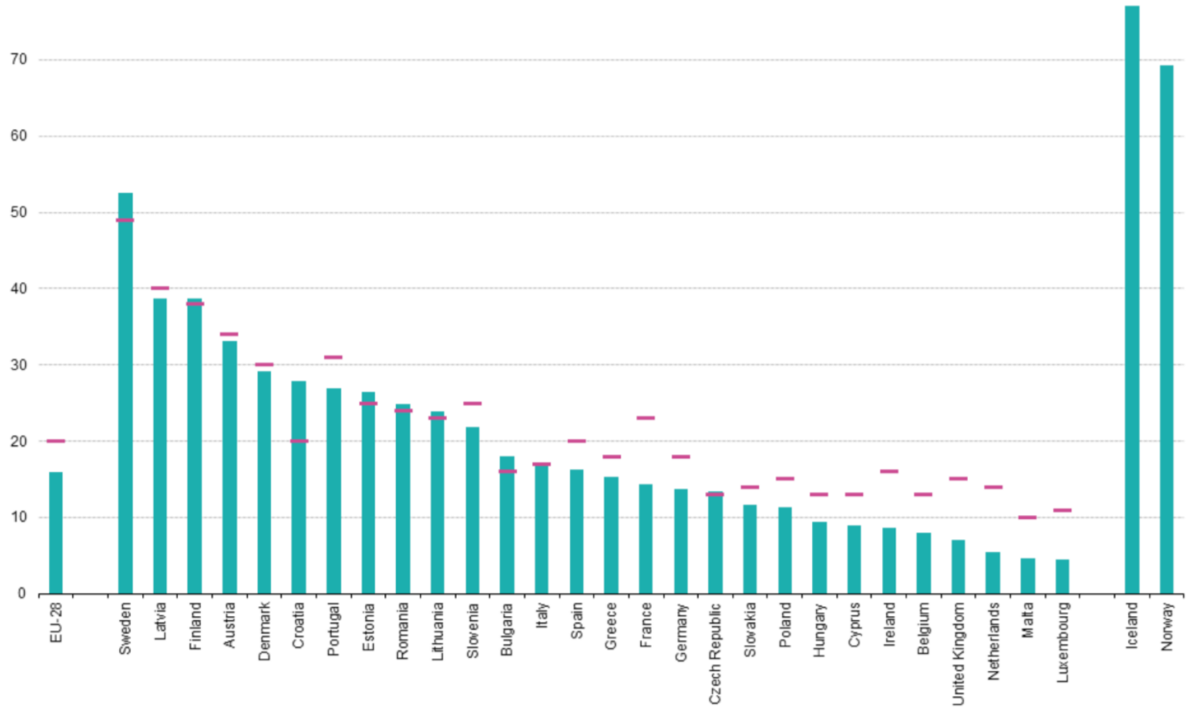

Figure 17. Share (%) of renewables in gross energy consumption 2014 (bars) and projected shares in 2020 (marks) (Eurostat 2016).

Emissions from production varies with what suppliers are chosen, all the way up-stream in the supply chain. Companies have in general not gotten far in considering environmental issues within purchasing (Tate et al., 2012). However, Christensen et al. (2008) argue that the traditional sourcing process quite easily can be adjusted towards green sourcing. Hsu et al. (2011) propose 14 criteria for supplier selection with regards to carbon management, these are presented in Table 5. Switching supplier base and changing supply chain structure takes very long time.

Table 5. GHG emission criteria for supplier selection (Hsu et al., 2011).

Dimension	Criteria
Planning	• Carbon governance • Carbon policy • Carbon reduction targets • Carbon risk assessment • Training related to carbon management • Life cycle cost management
Implementation	• Measures of carbon management • Involvement in initiatives for carbon management • Management systems of carbon information • Supplier collaboration
Management	• Carbon accounting and inventory • Carbon verification • Carbon disclosure and report

4.3.3 Transport

Transport in a supply chain is the physical flow of goods from one point to another (Brand et al., 2012). Modes of transport can be divided into air, water and land where land includes road and rail. These modes affect GHG emissions differently. Transport is often perceived as the hardest sector to decarbonize since it is the most difficult and expensive sector in which to reduce GHG emissions. (ibid.)

GHG emissions from different freight modes depend on multiple variables. Taking other objectives into consideration, like delivery reliability and lead time, the decision becomes complex. This can be exemplified by the choice between road and intermodal freight. For land transport, the first factor influencing GHG emission is the split between road (truck) and intermodal (rail and truck) (McKinnon and Piecyk, 2010). Within rail the emissions are highly dependent on what type of electricity the trains are running on, this is depended on the mix of fuels used in electricity generation and the average thermal efficiency of power plants (McKinnon, 2007). For example, diesel-hauled rail freight operations have twice the CO_2-intensity of electric-hauled operations (McKinnon, 2007). This implies that rail will have different emission factors depending on the country. However, intermodal transport generally has a lower carbon footprint than road transport (Nam Seok and Bert Van, 2009). In road transport emissions depend on the handling factor (frequency of ton transportation in the origin to destination supply chain), the average length of the haul, loading factor, the amount of empty running, fuel efficiency and carbon intensity of fuel (McKinnon and Piecyk, 2010).

4.4 Setting company GHG emission targets

The literature review of setting GHG emission targets firstly considers general company target setting and then GHG emission target setting and target types. The SBTi is presented together with approaches to setting science-based targets and how targets are approved. The review further looks at communicating targets and tracking performance. Lastly best practices of other companies that have set scope 3 targets are presented.

4.4.1 General company target setting

"Setting performance targets and managing to achieve them is fundamental to business success. Targets provide explicit direction to the organization and motivate management to strive for ever higher levels of performance." (McTaggart and Gillis, 1998, p. 18). Targets enable both monitoring and improvements (Walsh, 2000). Setting ambitious targets can enhance motivation, performance and creative problem solving (Thompson et al., 1997; Gunasekaran et al., 2004). Using targets is a common way of achieving these outcomes and it can be done on many different levels of the company (Walsh, 2000). Historically company targets have focused on financial performance, but companies are increasingly extending their objectives and including targets for more aspects of performance (Bourne et al., 2003). Companies generally benefit from setting targets for different time horizons, short-term, mid-term and long-term (Grant, 2003). This is because the time horizons fulfil different purposes within the organization. Short-term targets are good for creating action plans and following up on performance while long-term goals can be used more as strategic visions. Mid-term goals are the link in between the two and help set companies on the right trajectory for the long-term goals. (ibid.)

Common mistakes when setting targets include:

- Only setting one target (Doyle, 1994; Meekings, 2011)
- Setting too many targets (McTaggart and Gills, 1998)
- Setting conflicting targets (McTaggart and Gills, 1998; Doyle, 1994)
- Short-term focus, forgetting long-term implications (Doyle, 1994)

Setting targets in the right way is however essential to achieve benefits. Some important factors to consider are presented below.

- Realistic and motivational targets should be based on knowledge and best practices to ease internal acceptance (Walsh, 2000).
- Ambitious targets need to be accompanied by leadership, resources (Walsh, 2000), changes in culture and work processes (Thompson et al., 1997).
- Set performance indicators at every relevant level (Meekings et al., 2011)
- Present performance in charts instead of tables (Meekings et al., 2011)
- Have a clear structure for why, when and how performance should be reviewed and by whom (Meekings et al., 2011)

McTaggart and Gills (1998) empathize the importance of involving subdivisions in the target setting process and propose the following three steps to do it.

- Setting a corporate level overall governing objective and performance goal
- Translating the goal into a single, overriding, measure of performance
- Establishing a decentralized strategy development process that empowers each sub unit to define their own approach for achieving the governing objective and thereby produce bottom-up, customized performance targets (ibid.)

4.4.2 GHG emission target setting

Company GHG emission reduction targets are by Rietbergen et al. (2015, p. 550) defined as “detailed and quantifiable requirements for improving the GHG performance of (parts of) the company”. Targets serve multiple purposes, including to explore, to guide, to motivate and to regulate work within the organization (Rietbergen and Blok, 2010). Targets have a specific role in performance assessment (Rietbergen et al., 2015). In general, it is important that targets are SMART; Specific, Measurable, Appropriate, Realistic and Timed (Drucker, 1954). Rietbergen and Blok (2010, p. 4341) say that the purpose of measurable targets is to “motivate and regulate the target group, by giving feedback on the goal achievement or checking compliance.”.

Scope 3 emissions may be the largest part of company emissions (GHG Protocol, 2011). Setting targets for scope 3 emissions is more complex because less information is available and because available information might be less reliable (SBTi, 2015). For this reason, scope 3 emission calculations often hold greater uncertainties. (ibid.)

The main types of GHG emission reduction targets discussed in literature are absolute or relative targets, economic intensity targets, physical efficiency targets, and economic targets (Rietbergen et al., 2015). Multiple papers and standards propose processes for setting GHG emission targets. These processes generally consist of the same elements, the general process is presented in Figure 18 (Rietbergen et al., 2015).

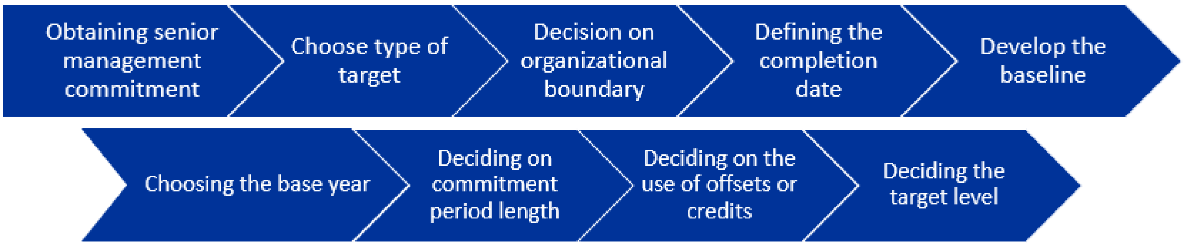

Figure 18. The general process of setting corporate GHG emission reduction targets (Rietbergen et al., 2015).

There are many ways companies can set GHG emission targets, ranging from unilateral decisions by policy makers, collaborative approaches using consumer feedback or expert opinions, benchmarking and a wide variety of modeling approaches (e.g. theoretical limits, past performance analysis, business-as-usual projections, cost-benefit and economic analysis) (Rietbergen et al., 2015). Another aspect of target setting is whether to use a top-down or a bottom-up approach (Margolick and Russell, 2001; Rietbergen et al., 2015). If a top-down approach is used the target is first set on a company level and then broken down throughout the organization. The bottom-up approach starts further down in the organizational structure by assessing emission reductions potential in different areas and the aggregating the reductions to a company level. (ibid.) There is in literature little insight in how companies should set GHG emission targets and especially on methodologies for setting the targets levels (Rietbergen et al., 2015).

4.4.3 Modeling GHG emissions

A model is a representation of how we believe that the world functions (Lawson and Marion, 2008). Mathematical modeling translates this world view into mathematics. Real world systems are often very complex. Therefore, the first step in mathematical modeling is to identify the most important parts of the system and exclude the rest. The second consideration concerns the level of mathematical manipulations that should be used, sometimes a simple model might be sufficient while other problems might require very complex equations. (ibid.) Models should be as simple as possible yet as detailed as necessary (Barbarossa, 2011). How well a model mimics reality depends both on the available knowledge of the system and how well the modeling is performed (Lawson and Marion, 2008). Modeling can be used for multiple purposes including developing scientific understanding, testing the effect of changes in a system and aiding in decision making. (ibid.)

Models can be categorized by different dimensions, one important distinction is made between deterministic or statistical models (Lawson and Marion, 2008; Barbarossa, 2011). Deterministic models always give the same outcome for given input variables while statistical models predict a distribution of different outcomes. (ibid.) Models can also be either mechanistic or empirical. Mechanistic models take into account how changes by looking at lower levels in the system (Lawson and Marion, 2008; Hinrichsen and Pritchard, 2005). In empirical models, changes are merely noted and underlying mechanism are not taken into account. Another important type of model is the systems model which is built up of sub-models and is appropriate to use to model how components interact. (ibid.)

Modeling can be made using many different tools which all have different strengths and weaknesses, e.g. Excel (Microsoft, 2017), MatLab (MathWorks, 2017) and ExtendSim (ExtendSim, 2017). Even though measuring and controlling carbon emissions is a challenge for many companies today supply chain and operations management there exists very little literature on how to model carbon emissions (Sundarakani et al., 2010).

4.4.4 Target types

Companies can choose to set absolute or relative targets, or both (SBTi, 2015). Absolute targets aim to reduce emissions a specific quantity in the target year compared to the base year. Relative targets, also called intensity or normalized targets, are instead based on emissions per unit of output (e.g. tons, cubic meters, value add). The climate is affected by absolute emissions, making absolute targets the most meaningful from a climate perspective. Another advantage of absolute targets is that they are simple and easy to communicate. When considering absolute and relative targets the company’s projected growth should be taken into consideration. Absolute targets will be more challenging for growing companies whilst they may not minimize environmental impact for shrinking companies. Intensity targets do not guarantee a total reduction in company emissions to the atmosphere. It is also possible to use absolute and intensity targets in combination. (ibid.)

4.4.5 The Science based targets initiative

Many carbon accounting and energy management schemes, e.g. ISO-14001, CO_2 Performance Ladder and SBTi, require companies to set GHG emission reduction targets (Rietbergen et al., 2015). These schemes range from letting companies set target levels any way they want, to minimum level requirements, to negotiations for ambitious targets. (ibid.)

After setting targets within these initiatives, they must be audited and approved. Little research has been done on this subject (Rietbergen et al., 2015). However, one study in Japan indicated that the evaluation process and auditing was lacking structure (Dusek and Fukada, 2012). It has also been shown that evaluation criteria were poorly defined and interpreted differently by auditors (Ammenberg et al., 2001; Rietbergen et al., 2015). Corporate GHG targets certifications also do not always guarantee ambitious targets (Rietbergen et al., 2015).

The SBTi is a partnership between CDP, UN Global Compact, WRI and WWF. The initiative aims to advise businesses on the level of emissions reductions necessary to accomplish the 2ºC decarbonization pathway and how this can inform organization GHG reduction targets (SBTi, 2015). Currently (May 3, 2017) 262 companies have signed up to the initiative, 42 companies have approved targets and approximately two new companies are signing up each week. (ibid.)

The SBTi defines science-based targets as "Targets adopted by companies to reduce GHG emissions are considered "science-based" if they are in line with the level of decarbonization required to keep global temperature increase below 2°C compared to preindustrial temperatures, as described in the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC)." (Science Based Targets Initiative, 2015, p. 7).

4.4.6 Science-based target setting methodologies

There are multiple methodologies for setting these targets, most of which are designed for setting scope 1 and 2 targets. The most significant ones are the Absolute Contraction Approach, Sectoral Decarbonization Approach (SDA), Corporate Finance Approach to Climate Stabilizing Targets (C-fact), Greenhouse gas emissions per unit of GDP (GEVA), Center for Sustainable Organization's (CSO) context-based carbon metric and the 3%-solution (Faria and Labutong, 2015; Sciencebasedtargets.org, 2017). These methodologies are more or less suitable for different industries and companies, "There is not one 'best' method but there will be one that will work best for your company." (SBTi, 2016).

"A science-based target approach refers to the way the carbon budget in a chosen emissions scenario is allocated among companies with the same level of disaggregation (e.g. in a region, in a sector, or
globally)." (SBTi, 2016, p. 28) There are multiple science-based approaches that attempt to disaggregate emission budgets to company levels. Faria and Labutong (2015) categorize methods into compression methods or convergence methods. Compression methods define

absolute emission reductions to companies based on generic 2-degree pathway. A convergence approach establishes convergence intensity pathways as a preliminary step in determining absolute emission targets. (ibid.) Contraction approaches say that companies within the same sector, region or globally should reduce emissions at the same rate (SBTi, 2016). Figure 19 exemplifies the difference between convergence, compression and contraction approaches.

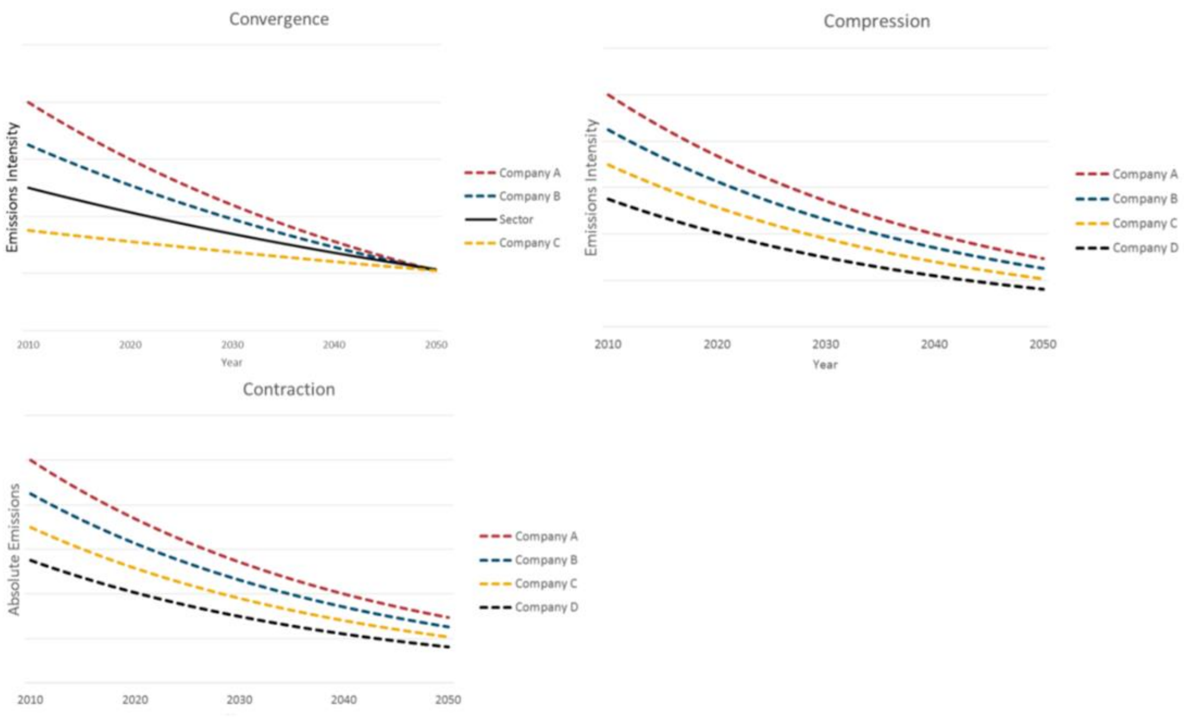

Figure 19. Convergence, compression and contraction approaches (SBTi, 2015, p. 19).

Figure 20 presents existing science-based methodologies, their level of disaggregation and what allocation method they use. Geographic methodologies take into account differences in how easy it is to decarbonize different geographical areas while Global do not. Sector methodologies take sector-specific consideration into account, this means that sectors which are easier to decarbonize will get tougher targets. The All economy-methodologies do not consider these differences. The horizontal axis categorizes the methodologies into convergence, compression and contraction approaches, as described above. The most relevant methodologies are also described further below. Methodologies have been developed by different actors, showcasing an interest from both academics, NGOs and companies.

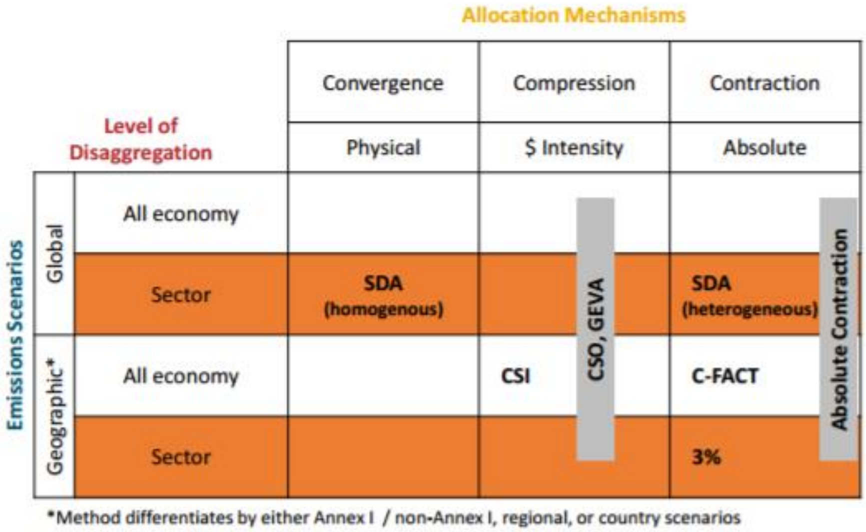

Figure 20. Science-based methodologies (SBTi, 2016, p. 23).

Absolute contraction approach

The absolute contraction methodology is based on emission scenarios from IPCC and allocates emissions proportionally to historical emissions in the base year. The approach is not developed by any specific entity, but Mars used a similar approach for setting their targets in 2009 (SBTi, 2016). To keep the temperature-rise below 2 degrees compared to pre-industrial levels, global emissions in 2050 need to be 41-72% lower than in 2010 (SBT Workshop, 2015). Using the lower end of the range is however not recommended (SBTi, 2016). The procedure of getting these numbers can be shown using a trajectory, illustrated in Figure 21. Furthermore, if all companies in the world reduce their emissions with around 2 % per year from 2010 to 2050, the total corporate emissions will follow the 2 degree decarbonization pathway (SBT Workshop, 2015).

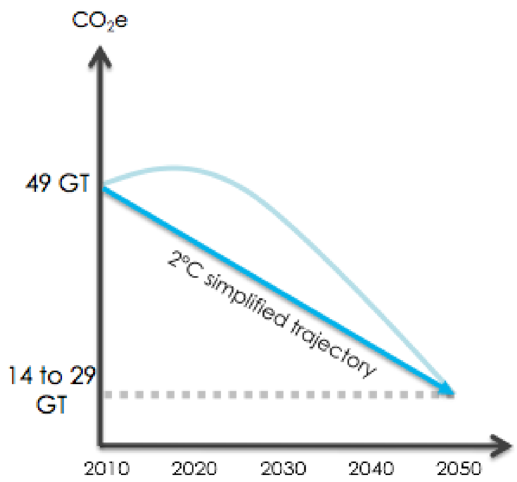

Figure 21. Showing the 2-degree trajectory of the absolute contraction approach (Science Based Targets Workshop, 2015).

This method has the advantage of being easy to use and follow (SBTi, 2016). The method can also be used for any scope. Companies can use multiple paths in reaching the overall 41-72%

reduction, these are linear decline (as in the simplified trajectory in figure X), peak and decline (light blue in figure X) and compound annual growth rate. Different paths are suitable for different companies, but in general the peak and decline path would be easiest for companies to achieve. (ibid.)

Greenhouse gas emissions per unit of GDP (GEVA)

To reach 50% lower global GHG emissions in 2050 compared to 2010 countries will need to reduce their GHG emissions per unit of GDP by 5 % per year (assuming the global economy continues to grow at 3,5% per year) (Tuppen, 2012). This can be translated to companies by reducing their GHG emissions per unit of value added (GEVA) by 5% per year. This can be used as a guideline for setting company GHG emission targets. (ibid.)

The Sectoral Decarbonization Approach (SDA)

The SDA is a methodology that allocates the GHG emission budget for the 2-degree decarbonization pathway into sectors (SBTi, 2015). The sectors and their respective current shares are presented in Figure 22. According to the SDA, carbon intensity reductions need to be more than 50% for most sectors (SBTi, 2015). The aluminum, air travel and cement sectors will need a lesser intensity reduction. (ibid.)

In comparison to other methods it considers inherent differences among sectors. These differences include mitigation potential and projected growth relative to population growth. (ibid.) From the sectoral budgets companies can derive their own budgets based on their relative contribution to the total sector activity and their carbon intensity relative to the average sector intensity in the base year (Krabbe et al., 2015). Depending on the industry, activity is measured in different units, e.g. tons or value add (SBTi, 2015).

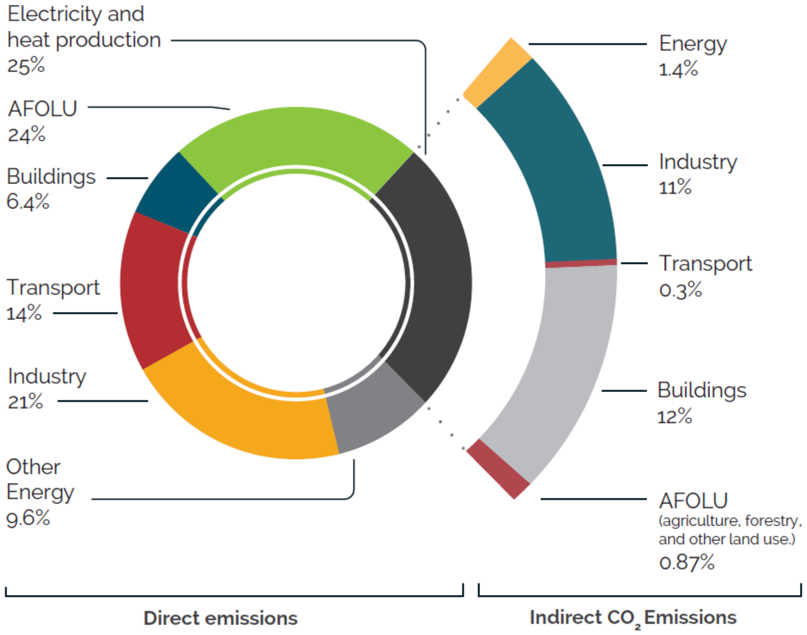

Figure 22. The share of direct and indirect GHG emissions in 2010 by economic sector (SBTi, 2015, p. 13).

SBTi provides a tool which enables target setting for scope 1, 2 and 3 emissions. But because of the complexity of scope 3 emissions it is currently only available for the light road vehicles manufacturing. The SDA for scope 1 and 2 emissions can however be of used for identifying carbon "hot spots" the company's supply chains (SBTi, 2015).

The 3% solution

This method was developed for US-based companies by WWF in cooperation with CDP, McKinsey & Company and Point380. The method shows how companies can achieve collective cost-savings of $780 billion USD between 2010 and 2020 by aligning targets with IPCC's 2-degree pathway by energy-efficiency measures and transitions to low-carbon energy sources (WWF and CDP, 2013). The method is called the 3%-solution because it builds on the US corporate sector reducing their GHG emissions by on average 3% annually. The tool called The Carbon Target and Profit Calculator breaks down the target for companies, taking sector-specific opportunities into account. The tool is not intended as a replacement for other target setting approaches but as an indicator of potential reductions and financial savings. (ibid.)

Center for Sustainable Organization's (CSO) context-based carbon metric

CSO was the first ever methodology for setting corporate science-based targets. It was developed by the Center for Sustainable Organisations (CSO) in cooperation with Ben and Jerry's in 2006 and is still continually improved. The methodology can be used for all emission scopes (Center for Sustainable Organizations, 2015; SciencebasedTargets.org, 2017). The methodology relates corporate emissions to science-based climate stabilization scenarios. The choice of scenario is treated as a variable. Organization-specific factors such as growth are also taken into account. Targets are continuously updated with regards to company size, changes in the population of emitters and global emission budgets. Performance is measured through absolute, relative and context-based emissions. (ibid.)

Corporate Finance Approach to Climate-Stabilizing Targets (C-fact)

C-fact, developed by the company Autodesk, is an open source approach to setting science-based targets (Stewart and Deodhar, 2009). The methodology is built upon the IPCC research saying that industrialized countries will need to reduce their GHG emissions by approximately 85% by 2050. C-fact has three important principles; verifiability (it only uses publicly available data to calculate targets), flexibility (it adapts to business and economy changes) and fairness (company commitments should be proportional to their contribution to the economy). (ibid.)

4.4.7 Scope 3 target approval

Targets need to fulfill multiple requirements to be approved by SBTi (SBTi, 2016). Most of these requirements are however only applied to scope 1 and 2 targets. If companies have significant (generally at least 40% of total emissions) scope 3 emissions targets should be set for these as well. The main requirement for setting scope 3 targets is that they must be ambitious. (ibid.)

To understand if scope 3 targets should be set, companies should perform a value chain mapping (SBTi, 2016). Scope 3 target can include all identified emissions categories, a few categories, or just one category, but in general the scope of the targets should align with the scope of the GHG inventory. It has to be explicitly specified which categories are included and excluded categories need to be justified. Guidelines for identifying relevant scope 3 targets are presented in Table 6. (ibid.)

Table 6. Criteria for identifying relevant scope 3 categories (SBTi, 2016, p. 47).

Criteria	Description
Size	They contribute significantly to the company's total anticipated scope 3 emissions.
Influence	There are potential emission reductions that could be undertaken or influenced by the company.
Risk	They contribute to the company's risk exposure (e.g., climate change related risks such as financial, regulatory, supply chain, product and customer, litigation, and reputational risks).
Stakeholders	They are deemed critical by key stakeholders (e.g., customers, suppliers, employees, investors, or civil society).
Outsourcing	They are outsourced activities previously performed in-house or activities outsourced by the reporting company that are typically performed in-house by other companies in the reporting company's sector.
Sector guidance	They have been identified as significant by sector-specific guidance.
Other	They meet any additional criteria for determining relevance developed.

An important distinction that SBTi makes is that "While scope 3 targets could be "science-based" in the sense that they follow a specific SBT approach/method, other approaches may also be appropriate to set credible scope 3 targets." (SBTi, 2016, p. 48). SBTi prefers absolute targets to ensure environmental integrity of a company's GHG performance (SBTi, 2016). Companies are however encouraged to set both relative and absolute targets. SBTi recommends setting long-term targets through 2050 with interim milestones at five year intervals and publicly committing to targets that are at least five years into the future. Setting a combination of short-term and long-term targets is a good way of making target visionary as well as actionable. It is also recommended to align base year and target years to the scope 1 and 2 targets. (ibid.)

4.4.8 Communicating targets

Large changes and new strategic targets need to be communicated both internally and externally (Piercy and Morgan, 1991). From an internal perspective, Corporate Social Responsibility (CSR) needs to be implemented in structural, instrumental and behavioral patterns. To be successful, initiatives need to be implemented across all business units (Kleine and Von Hauff, 2009). To reap the benefits from CSR in general and GHG emission reduction work in particular companies need to effectively communicate their efforts to stakeholders (Du, Bhattacharya and Sen, 2010). Including indicators, benchmarks, targets and trends into the communication increases credibility. Internal and external outcomes of effective communication is presented in Table 7. This shows that the right communication about science-based targets can create multiple benefits to the company. (ibid.)

Table 7. Outcomes of effective CSR communication (Du, Bhattacharya and Sen, 2010, p. 11).

Internal	External
• Awareness • Attributions • Attitudes, identification • Trust	• Customers: purchase, loyalty, advocacy • Employees: productivity, loyalty, citizenship behavior, advocacy • Investors: amount of invested capital, loyalty

4.4.9 Tracking progress

The company approach to sustainability needs to be dynamic, adapting to changes in internal and external conditions (Searcy, 2011). Companies should investigate compliance with their targets and revise them if necessary (SBTi, 2015). Progress towards reaching GHG targets can be tracked through key performance indicators (KPIs). Ownership and governance is essential for successful use of KPIs (Parameter, 2015). KPIs are the responsibility of a team and serve the purpose of assisting and helping the team improve their performance. Maintaining a team's sense of ownership is dependent on the information being valuable, useful and worthwhile. (ibid.)

To track progress of scope 3 targets companies will need to measure performance within their supply chain, it is therefore closely linked to the theory of supply chain performance measurement, presented in section 4.2.2.

4.4.10 Best practices of GHG emission target setting

SBTi provides a few interviews and case studies from companies that have had their targets approved. Companies signing up for the SBTi have done so for multiple reasons, some of these are presented in Table 8. Companies that sign up for setting targets want to be leading within sustainability to be able to secure their long-term survival. The first reason in this table, getting recognition from external stakeholders is also reported as one of the outcomes after having the targets approved.

Table 8. Reason for signing up for the Science Based Targets Initiative (SBT Case study: PostNord, 2017; SBT Case study: Kellogg Company, 2017; SBT Case study: NRG Energy, 2017; Husqvarna Group, 2017; Astra Zeneca Environmental specialist, 2017).

Reason	Examples of companies
Getting recognition and verifying that targets are on the right track.	PostNord, Kellogg Company
Wanting to be ambitious and aiming to be sustainability leaders	NRG Energy, Kellogg Company, Husqvarna, Astra Zeneca
The business case for long-term survival is strong	Kellogg company

The examination of targets of approved companies show that there are many different ways of setting targets. Breaking down targets into sub targets and creating targets for different time horizons are techniques used by many of the companies. Both absolute and relative targets are used. A summary is presented in Table 9.

Table 9. Types of targets used. (SBT Case study: Coca-cola, 2017; SBT Case study: Kellogg Company, 2017; SBT Case study: Pfizer, 2017; SBT Case study: Sony, 2017; SBT Case study: Thalys, 2017; Astra Zeneca, 2015; SBT Case study: NRG Energy, 2017; SBT Case study: ICP, 2017; Astra Zeneca Environmental specialist, 2017).

Types of targets	Examples of companies
Breaking down the target into multiple sub targets	Coca cola, Kellogg, Pfizer, Sony, Thalys, Mars, Astra Zeneca
Using different time horizons to create targets on short-, mid- and/or long-term intervals	NRG Energy, Kellogg Company
Using a combination of absolute and relative targets	Astra Zeneca, Kellogg
Absolute targets only	NRG Energy, PostNord, Pfizer, Sony
Relative targets only	Coca cola, ICP, Thalys

Valuable insights from approved companies include challenges and success factors when setting and implementing SBT. In general management support, clear communication and having a structured approach to tracking progress seems to be important. An interesting challenge is the needed shift from a short-term to a long-term perspective. Pfizer found it hard to set a target for such a long horizon as to 2050. They chose to face this challenge by creating a long-term vision and targets for shorter horizons. The short-term targets were set to place them on the right trajectory to reach the long-term vision. Success factors are presented in Table 10. The three insights presented last in the table are specifically connected to setting science-based targets for scope 3 emissions. Companies that have approved targets for scope 3 emissions include Coca Cola, Kellogg Company, IPC, Pfizer, Sony, Thalys, NRG Energy and Astra Zeneca. It was hard for most companies to gather data on the GHG emissions, a lot of data is still missing. It seems to be important to have a clear focus within the company. These insights are both connected to the complexity of the supply chain.

Table 10. Critical success factors for setting SBT (SBT Case study: PostNord, 2017; SBT Case study: Coca-cola, 2017; SBT Case study: Kellogg Company, 2017; SBT Case study: Pfizer, 2017; SBT Case study: Sony, 2017; SBT Case study: Thalys, 2017; SBT Case study: IPC, 2017; Astra Zeneca, 2015; SBT Case study: NRG Energy, 2017; Putt del Pino, 2016; H&M, 2015; Husqvarna Group, 2017; Astra Zeneca Environmental specialist, 2017).

Success factors	Examples of companies
Clear and thought-through internal and external communication	Coca cola, Pfizer
Having targets and visions on different time frames	Pfizer
Using benchmarking to learn from other companies	Sony, Astra Zeneca
Management support	Coca cola, Sony, Mars
Working with key internal and external stakeholders	Kellogg Company, Sony, Thalys
Continuously reviewing and updating targets	Astra Zeneca
Incorporating targets in KPIs	Thalys
Breaking down targets within the organization	Astra Zeneca
Shifting focus to a more long-term orientation (a challenge)	Kellogg Company, Pfizer
Working with suppliers to make them change (a challenge)	Sony
Knowing what methodology to use orientation (a challenge)	Thalys
Having clear supply chain focus areas of where to improve	PostNord, Astra Zeneca, Pfizer, Husqvarna
Working with stakeholders to understand what can be influenced	Kellogg Company, Astra Zeneca, IPC,
Data availability is often low and needs to be improved	Astra Zeneca, H&M

Approved companies report multiple positive outcomes, these are presented in Table 11. These outcomes show that using science-based targets can create benefits for companies in multiple ways. The most important outcomes seem to be creating a clear focus of what the company is aiming for and boosting internal pride.

Table 11. Companies have reported many positive outcomes from setting SBT (SBT Case study: Coca-cola, 2017; SBT Case study: Kellogg Company, 2017; SBT Case study: Pfizer, 2017; SBT Case study: Sony, 2017; SBT Case study: Thalys, 2017; Husqvarna Group, 2017)

Outcomes	Examples of companies
Bringing the company together, focusing on the same issues and creating a structured internal approach	Kellogg Company, Pfizer, Coca cola, Sony
Recognition from external stakeholders	Kellogg Company, Husqvarna
Easier communication	Coca cola
Creating company pride, confidence and authority	Kellogg Company, Pfizer, Sony, Thalys, Husqvarna
Increased brand value and competitiveness	Sony

5. Research framework

This section presents the overall research framework used as a foundation for studying the process of setting targets.

The research framework, depicted in Figure 23, was firstly developed as a hypothesis by synthesizing the literature study and then validated by the empirical findings. It could be concluded that all the studied companies followed a process similar to the one presented below.

Figure 23. The research framework employed in this project (the authors' own creation).

The research framework's connection to the theoretical process of setting GHG emission targets (Rietbergen et al., 2015) is presented in Figure 24. The steps of the theoretical process are included in the steps of the research framework. Some theoretical steps did however not receive any focus by the studied companies and are therefore not mentioned in the empirical findings, one such step was Deciding on the use of offsets or credits. Obtaining senior management commitment and Defining the completion date were both considered prerequisites to the process, and were hence not. The theoretical steps were reorganized in accordance with how the studied companies worked.

The research framework also includes steps which are not included in theory, these are Modeling, Communicating targets and Tracking progress. Modeling was added because it was by theory suggested to be useful for visualizing data, understanding the impact of actions and supporting decision making (Bertrand and Fransoo, 2002) and it was used at some of the studied companies. Communicating targets was added to the research framework because it was suggested to be important by theory (Piercy and Morgan, 1991) and because it was also considered important to the studied companies. The same thing goes for Tracking progress, it was suggested by theory (Searcy, 2013; SBTi, 2015) and it was of importance in practice. Hence it was added to the research framework. The research framework will be discussed further throughout the report.

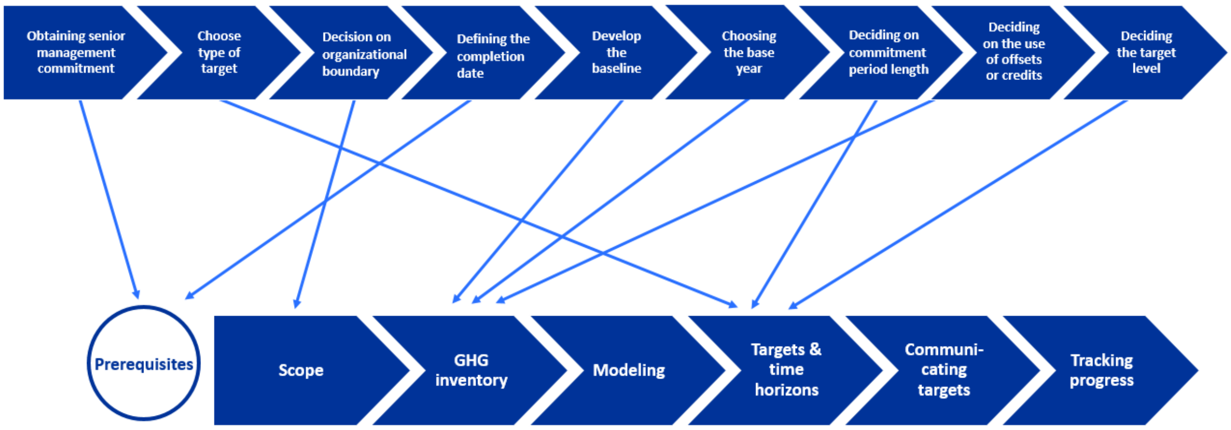

Figure 24. The connections between Rietbergen et al. (2015) process of setting GHG emission reduction targets and the research framework for this study (the authors' own creation).

7. Empirical findings from IKEA

This chapter presents the findings of the study at ICOMP, structured according to the research framework. Figure 25 presents what was done by the researchers and what was done by ICOMP.

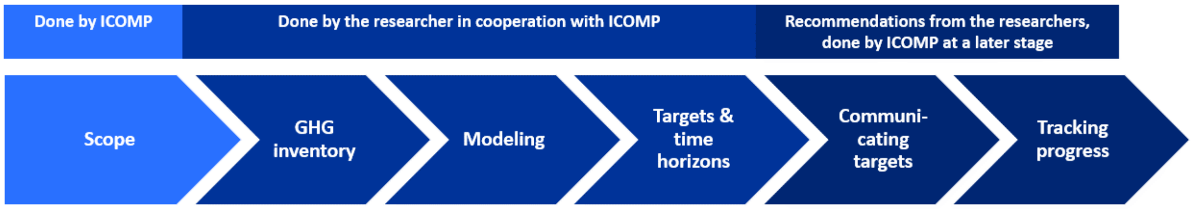

Figure 25. The target setting process and how the researchers contributed to the process (the authors' own figure).

7.1 General approach

Within Inter IKEA a project group consisting of representatives from Range & Supply and Industry worked together to set the targets. This project group consisted of employees from the different IKEA units and a project support team. The goal of the project was to set ambitious scope 3 targets to be accepted by SBTi. This was done by following the overall process presented as the research framework. The project group met biweekly to ensure overall alignment among the different units. Functional working groups for the major emission areas Material, Production and Transportation made sure that the same methodology was used throughout the supply chain. Aligning on assumptions and scope to avoid overlaps was also a key activity.

At ICOMP the process followed the overall project group process, starting by mapping the emissions and defining the scope. The gathering of data for the GHG inventory was started by ICOMP Global sustainability leader (2017) and finished by the researchers. Gathering input from stakeholders was done continuously. Modeling was performed by the researchers. Time horizons and commitment levels were set in cooperation with ICOMP and the Inter IKEA project group. Communicating targets and tracking progress at ICOMP was to be done after the completion of this master thesis. The conclusions from the benchmarking and the frame of reference serve as recommendations for how IKEA in general and ICOMP in particular are to work with these two final steps.

7.2 Defining the scope and mapping the supply chain

Since it is IKEA Group that signed up for the SBTi, emissions from all IKEA units which are currently not part of IKEA Group (such as ICOMP) are considered scope 3. This means that ICOMP scope 1, 2 and 3 emissions are all scope 3 emissions from an IKEA Group perspective.

The GHG inventory is a presentation of the as-is emissions of the largest emission areas. Small emissions were, in accordance with recommendations from SBTi, excluded from the scope. This had to be done to ensure a time efficient process. The Inter IKEA project group categorized the relevant emissions into five categories; Material, Production, Transport, Food ingredients and Product use. The first three ones were relevant to ICOMP while the other were not part of the scope. The three emission areas are described below and connected to the ICOMP supply chain in Figure 26.

- Material - Emissions from cradle to first-tier supplier or P&D unit
- Production - Emissions from first-tier suppliers, the two P&D units and the external packaging units
- Transport - Emissions from transport from first-tier suppliers to HF suppliers (for A&A with interim stops at packing units).

Production was assessed as a separate category since specific data was available in this area. There was no detailed data available further upstream in the supply chain and therefore all these emissions were aggregated in the Material emission area.

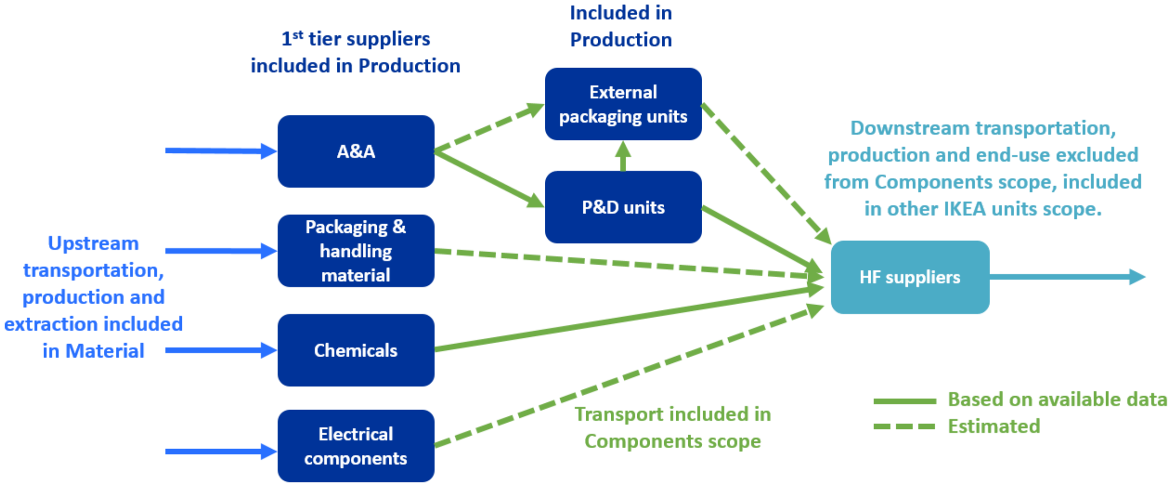

Figure 26. The ICOMP supply chain and what emissions are included in what emission area (the authors' own figure with input from ICOMP Global sustainability leader (2017) and ICOMP Supply chain manager (2017)).

The three areas constitute ICOMP's largest GHG emissions. Table 12 describes what GHG protocol emission categories are included in what project emission area (Material, Production and Transport) and what emissions that are out of scope. Some emission categories are not considered at all and some belong to the scope of another IKEA unit.

Table 12. A description of what scope 1,2,3 categories are included in the ICOMP scope (the authors' own creation with input from ICOMP Global sustainability leader (2017) and Ahrens (2017)).

Scope	Category	The ICOMP scope
1	Company facilities	P&D units included in Production emission area, office space excluded
1	Company vehicles	Not applicable
2	Purchased electricity, steam, heating and cooling for own use	P&D units included, office space excluded
3	1. Purchased goods and services	Included in Material and Production emission area
3	2. Capital goods	Excluded, non-significant share of emissions
3	3. Fuel- and energy-related activities (not included in scope 1 or scope 2)	Included in Production (first-tier suppliers) and Material (further upstream)
3	4. Upstream transportation and distribution	Included in Transport (from first-tier supplier to HF supplier) and Material (further upstream).
3	5. Waste generated in operations	Included in Production
3	6. Business travel	Excluded, non-significant share of emissions
3	7. Employee commuting	Excluded, non-significant share of emissions
3	8. Upstream leased assets	Not applicable
3	9. Downstream transportation and distribution	Included until HF supplier (the rest is the scope of other IKEA units)
3	10. Processing of sold products	Covered by other IKEA units
3	11. Use of sold products	Covered by other IKEA units
3	12. End-of-life treatment of sold products	Excluded, non-significant share of emissions
3	13. Downstream leased assets	Not applicable
3	14. Franchises	Not applicable
3	15. Investments	Excluded, non-significant share of emissions

7.3 Creating a GHG inventory

Data was gathered for emissions released in financial year 2016 or calendar year 2015 (depending on the available data). This as-is situation is called the GHG inventory. This data served as the starting point for calculations. The GHG emissions released during this year were then used as a base to determine targets, called baseline. Creating the GHG inventory involved collecting data covering the entire scope. Some emission areas had good data availability and reliability, see Figure 27. This was the case for Production since ICOMP has been gathering this information in their supplier assessment tool. For other emission areas, such as Transport, data availability and reliability was very low. Lack of data was mostly due to the fact that operations were outsourced and no attempts to gather data had been made before.

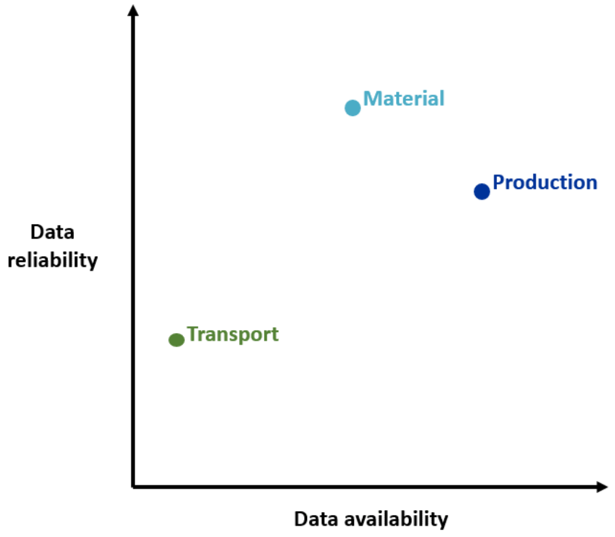

Figure 27. The data availability and reliability in ICOMP's emission areas (authors' own figure).

When data was lacking, assumptions were made. These are described in each section below. Assumptions were also verified by stakeholders to ensure that they were reasonable. The data gathering process included identification of areas where data was lacking. For the Material emission area data was gathered in volume and then converted into carbon dioxide equivalents (CO_2e) by a consulting company. A GHG inventory for Production emission area was created by gathering GHG emissions from first-tier suppliers and P&D units through the existing Supplier Sustainability Index (SSI) tool. Transport data was gathered through volumes and distances and then converted to GHG emissions by the researchers. The total share of GHG emissions from Material, Production and Transport are presented in Figure 28 below.

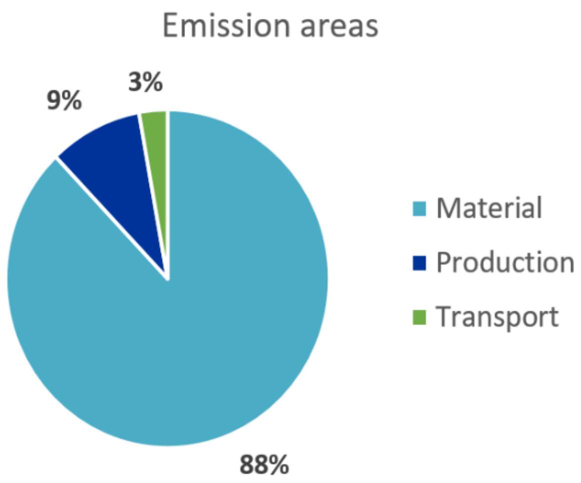

Figure 28. The share of GHG emissions for each emission area (authors' creation).

7.3.1 Material

Raw material volumes purchased 2015 for the four categories; A&A, Packaging & handling, Electrical components and Chemicals, were gathered in cooperation with ICOMP. The data on raw material included

- Name of material
- Material specification (if applicable)
- Material form (if applicable)
- Business category
- Fossil/renewable: fossil, renewable or not applicable
- Virgin/recycled: virgin, recycled or not applicable
- Country were first-tier supplier is located
- Supplier (if data was available)
- Volume in tons

Materials were then organized into material categories, see Table 13. This was done to be able to see differences among and within categories. Material volumes were also categorized as virgin/recycled and fossil/renewable. This was done because the GHG emissions depend heavily on these variables. All relevant combinations of virgin/recycled and fossil/renewable were included in the inventory, even if current volumes were zero. This was done so that emission factors for all alternatives could be provided by the consulting company to be able to use them for modeling future scenarios.

Table 13. The overall material categories (by the authors').

Material category	**Business categories**
Plastics	A&A, Electrical components
Metal	A&A, Electrical components
Wood	A&A, Packaging & handling
Other	A&A, Electrical components
Corrugated cardboard	Packaging & handling
Polyols	Chemicals
Additives	Chemicals
Isocyanates	Chemicals
Chem. systems	Chemicals

The data was summarized and handed over to an external consultancy that provided emission factors and converted the material volumes to GHG emissions. These emissions were calculated from cradle to first-tier supplier/P&D unit. Figure 29 shows the share of GHG emissions from the different material categories.

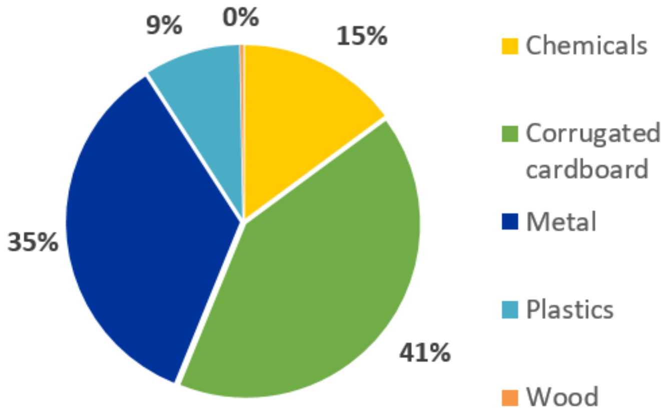

Figure 29. The Material GHG inventory (authors' creation).

Some materials were excluded from the scope because they either had very insignificant volumes or were planned to be discontinued. This was e.g. the case for loading ledged in the Packaging & handling category.

A significant assumption made in the Material GHG inventory was that only 100% renewable or recycled material was categorized as renewable/recycled. This assumption was made because of lacking data on recycled/renewable shares in materials and because most suppliers use small shares of renewable/recycled sources (ICOMP Global sustainability leader, 2017). Many suppliers mix in amounts of recycled material, but if there was no reliable data they were categorized as virgin. (ibid.)

7.3.2 Production

Current GHG emissions for internal and external P&D units and first-tier suppliers were gathered through the supplier evaluation tool called Supplier Sustainability Index (SSI) for 2015. The SSI is a tool, developed by IKEA, used to assess suppliers' sustainability performance. The total GHG emissions from a supplier includes emissions from electricity, other fuels for production, fuels for internal transport and refrigerants and other GHG emissions (including waste).

There was available data for 171 first-tier suppliers, both of the P&D units and the five external P&D units. Based on internal stakeholder input, it was estimated that 26 suppliers had not reported through SSI in 2015 (ICOMP Global sustainability leader, 2017). This was a guess, the number of supplier that hadn't reported was hard to determine because of a change in IKEA organizational structure. The 26 missing suppliers were assumed to have the same split between categories and continents as the existing data. These are presented in Table 14.

Table 14. The split of the 26 missing suppliers were estimations had to be made (authors' creation).

Number of missing suppliers	Continent	Category
4	Asia	A&A
10	Europe	A&A
1	Europe	Chemicals
3	Asia	Electrical components
4	Europe	Packaging & handling
4	Asia	Packaging & handling

Based on internal stakeholder input, it was assumed that GHG emissions for missing suppliers was on average the GHG emissions per kg produced within a specific category and continent. This was done in accordance with the SSI standard which states "Any data that is not covered during the reporting (e.g. phase-out, supplier failing to report, etc.) is estimated by dividing the collected figures of a category with the response rate within that category (in terms of % m^3 for IKEA of Sweden and % kg for ICOMP)." (SSI, 2017). The logic is presented in Equation 1.

Equation 1. Calculation of GHG emissions for suppliers with missing SSI data.

$$Estimated\ GHG\ footprint\ of\ category = \frac{Measures\ footprint\ of\ category\ (kg\ CO_2e)}{Repsonse\ rate\ in\ category\ (\%)}$$

When calculations for the suppliers with missing data had been made the GHG inventory was summarized and results were validated with internal stakeholders. The split between categories is shown in Figure 30.

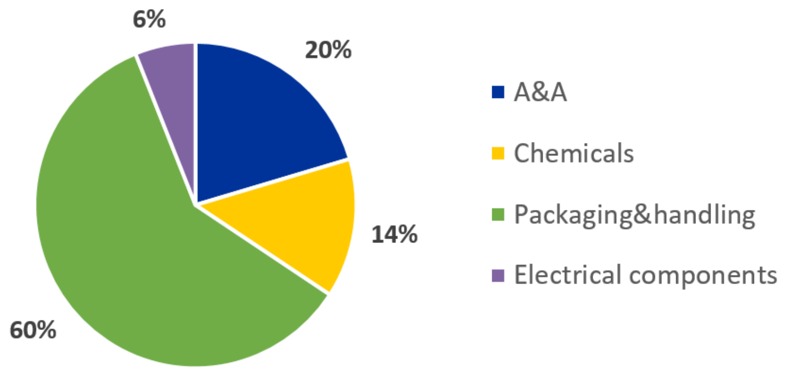

Figure 30. Production GHG inventory (authors' creation).

7.3.3 Transport

Transport was the area where the least amount of data was available. Due to that, several assumptions had to be made. The first assumption was that all transport was done by truck. This assumption was made since truck was the only freight mode with any available data and because truck is the most used transportation mode, only Chemicals use intermodal transport (ICOMP Transport manager, 2017). The transport was mapped to understand the flows and determine for what parts there was available data and where assumptions had to be made. The overall approach was to use the available data to estimate the missing data.

GHG emissions from Transport were calculated by applying Equation 2. The parameter of CO_2e per tkm was provided by the transportation unit at IKEA (IKEA Transport Global sustainability developer, 2017).

Equation 2. Calculation of GHG emissions from Transport.

$$CO_2e = Distance\ (Km) \times Weight\ (ton) \times (\mathrm{X}\ g\ CO_2\mathrm{e}/km \times ton)$$

A&A (Europe and China) and Chemicals were the categories were the most data was available. Emissions from these categories were based on a sample of the largest known suppliers and HF suppliers, here called a sample supply chain. It was assumed that transport for the largest known suppliers could be used to estimate all transport within that category. Figure 31 explains the calculation logic for these categories. Equation 2 was used to calculate emissions for the sample supply chains. Emissions for the sample supply chains were then used to estimate total emission in each category. A value named "other" was created to represent the transport of the missing volumes.

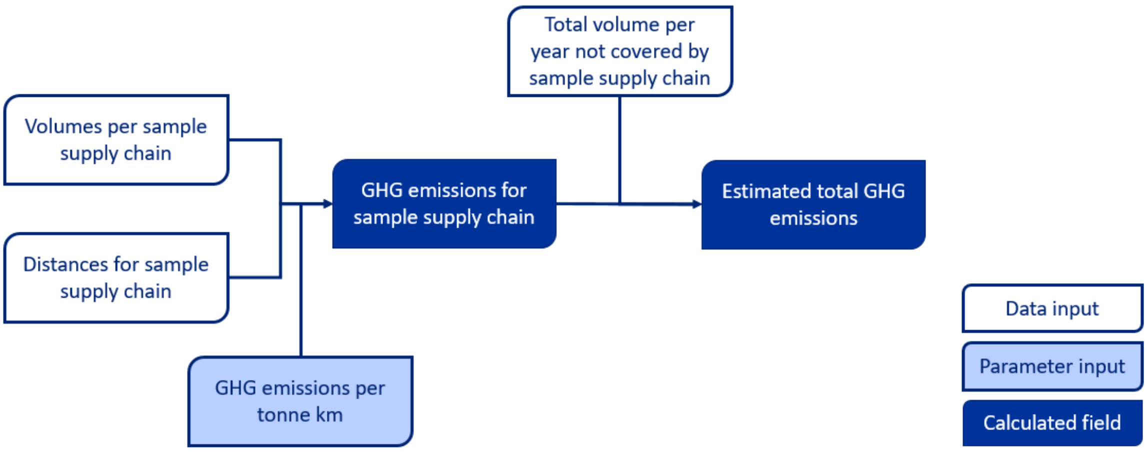

Figure 31. The methodology for calculating transport GHG emissions for A&A and Chemicals (authors' creation).

For Electrical components there was no available data. A&A Asia (inbound to P&D units) was therefore used to estimate these emissions. This was used as a proxy because they are both situated in Asia and are both transporting components. Equation 3 was used to do this.

Equation 3. Calculation of GHG emissions from Electrical components Transport.

$$\frac{Total\ Emissions\ from\ A\&A\ Asia\ Inbound\ * Share\ of\ Electrical\ out\ of\ total\ weigth\ for\ materials\ (\%)}{Share\ of\ A\&A\ Asia\ inbound\ out\ of\ total\ weigth\ Materials\ (\%)}$$

Detailed transportation data within Packaging & handling was also lacking. Packaging & handling includes many different suppliers and is always sourced locally (ICOMP Global sustainability leader, 2017). The transportation within this emission area was based on the information that routes had a maximum length of X km. (ibid.)

Table 15. Transport emissions. A&A transport goes through a P&D center (resulting in two transportation routes), while the other categories go directly to the HF suppliers.

Category	Share of total CO2e from Transportation
A&A EU inbound	13%
A&A EU outbound	15%
A&A Asia inbound	6%
A&A Asia outbound	5%
Electrical	1%
Packaging & handling	49%
Chemicals	11%

As shown in Table 15 the total amount of CO_2e for the different categories were calculated. Figure 32 presents the shares of GHG emissions for transport. Results were validated by ICOMP Transport manager (2017).

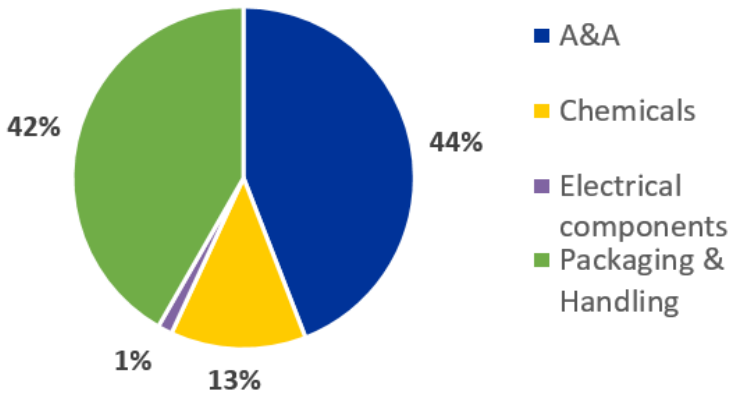

Figure 32. Transport GHG inventory.

7.4 Modeling

The developed model was deterministic and mechanistic. The deterministic approach was suitable since internal stakeholder input showed that actions lowering GHG emissions would have an deterministic impact and not be affected by statistical variables. A mechanistic model was created in the sense that smaller units of analysis built up the whole picture. An example of this is that emissions from Production was documented by supplier. A scenario could then change emissions for a specific supplier which then impacts ICOMP's total emissions. (ibid.)

The modeling approach by Dym (2004) was used to create an emission scenario model, Figure 33 summarizes the approach. The modeled phenomenon was GHG emissions at ICOMP. The aim was to see impacts of possible actions and to visualize target levels. Data gathering and assumptions are to some extent already presented in the 7.3 Creating a GHG inventory section. They are further developed in the section below. Validation and verification was done iteratively throughout the model development. Recommendations on how to use the model were developed by the researchers. The questions Why? and Find? are discussed in section 7.4.1 Purpose, Given? in 7.4.2 Data collection and 7.3 Creating a GHG inventory, Assume? in all relevant sections, How? in 7.4.5 Scenarios, Valid?, Verified? and Improve? in 7.4.3 Stakeholder input and Use? in 7.4.6 Using the model in the future.

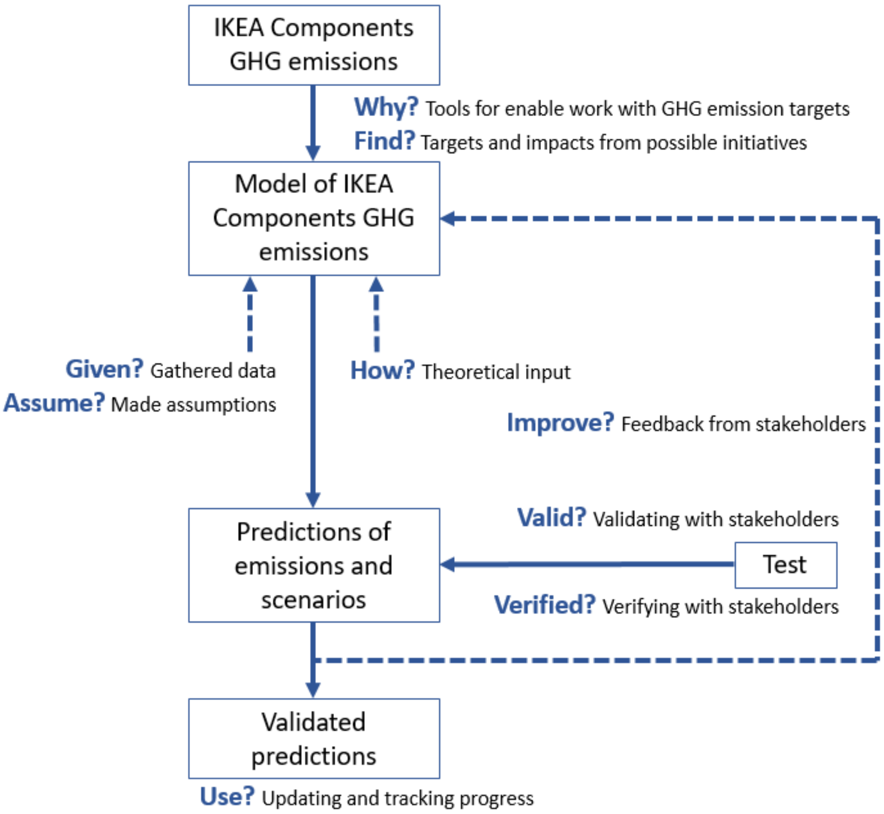

Figure 33. The modeling approach which was applied when building the GHG model at ICOMP (author's figure adjusted from Dym, 2004).

7.4.1 Purpose

Why?

The model was created to gain a better understanding of the as-is situation and how different future scenarios would affect the total release of greenhouse gases. Another motive for creating the model was to increase management's interest in GHG reduction in a concrete and simple way. The model enables showing how different factors affects the total release of CO which can be used as input to creating action plans to reduce GHG emissions.

Find?
The main purpose of the model was to assist in setting short-, medium- and long-term science-based targets. The model helped to get a better understanding of which factors that affected the result and how actions would contribute to decreasing emissions.

7.4.2 Data collection

The data needed for the modeling was the GHG inventory and forecasts on future sales. The collection of the GHG inventory is described in 4.3 Creating a GHG inventory. The collection of data on sales was gathered in different ways depending on the year. For the four business categories the following data on sales was gathered.

- For years 2010-2016 total sales
- For years 2017-2050 total projected sales

The sales data and projected growth was then applied to the GHG emission inventory for Material, Production and Transport to estimate GHG emissions from 2010 to 2015 by assuming that GHG emission per euro of sales has been constant. To create a scenario of what would happen if the current trajectory will continue it was assumed that GHG emissions per euro would stay the same until 2050.

7.4.3 Internal stakeholder input to the model

The internal stakeholder input was gathered for multiple purposes. The first one was to get an overall understanding of the emission areas and categories and how they affect each other. The second purpose was to understand what stakeholders would appreciate getting out of the model and what scenarios were relevant. The third purpose was to prepare stakeholders for setting GHG emission targets and engaging them to start thinking more about what they can do to achieve the targets. The last purpose was to validate and verify the model. The general stakeholder input on the emission areas is presented below.

For most materials, the best alternative to reduce GHG emissions is to increase the share of renewable and recycled material (ICOMP Global sustainability leader, 2017). This is at least the best solution on a short and medium time horizon. In the longer run considering product development changes will be possible. The product could then be designed with the most sustainable material without decreasing quality. The limitation of sourcing more sustainable material is often market availability. Another limitation is ICOMP's purchasing priorities. Today price weighs heavier than sustainability. This makes sourcing of new materials and suppliers more focused on price. Switching in between materials is very complex and can only be done on very long time horizons. This will therefore not be considered in the model. Focus will instead be on the shares of recycled and renewable materials and how these affect emissions. (ibid.)

A&A and Electrical components both purchase components (ICOMP Global sustainability leader, 2017). If suppliers are to change to more recycled metals ICOMP needs to put pressure on them to do so. This is something which is possible for ICOMP to do in the future. Packaging & handling is already a quite sustainable category with regards material because most suppliers use high shares of recycled cardboard. ICOMP could however put pressure on the ones that are not using high shares of recycled material to do so. (ibid.) The chemicals category is quite special compared to the other categories. Chemicals are the main ingredients in producing mattresses for beds and sofas (ICOMP Chemicals supply planner, 2017). This material is therefore difficult to substitute. There are few available suppliers available on the market, giving the existing suppliers large power. ICOMP is a small customer and it is therefore hard for them to influence sustainability in chemical production. Innovations on the market are mostly driven by the suppliers themselves, meaning that the main thing ICOMP can do is to be updated on what is happening on the market. (ibid.)

ICOMP has a relatively large influence on the P&D units and first-tier suppliers in the Production emission area (ICOMP Global sustainability leader, 2017). This is the case because they are already gathering GHG data and because ICOMP is quite an important customer to most suppliers (excluding Chemical suppliers). ICOMP has people working internally as Sustainability developers with the sole purpose of helping the supplier become more sustainable. The easiest ways to influence suppliers are when the suppliers also save money by doing the change. An example of this is energy efficiency, if suppliers use less energy they will save money. Another example of where ICOMP can influence production is the percentage of renewable electricity used. In countries with high availability of renewable electricity it is quite easy for suppliers to switch. There are however still countries where availability is low. (ibid.)

Transportation was the area with the least amount of data available and therefore many assumptions were made. Transportation stands for a small amount of total emissions (ICOMP Global sustainability leader, 2017). The limited data availability together with the small impact the transportation has on the total emissions were the two main reasons why scenarios regarding the transportation were omitted.

7.4.4 Model configuration

The model consists of five major parts which are presented in Figure 34, the size of the sections represents how large the components are in the Excel model. The category and emission area menu's lets the user choose what they want to see in the graphs. The overall graph shows emissions on a yearly basis with the impact of selected scenarios. The detailed charts show additional parameters such as volumes and share of emissions within different categories. In the scenario menu the users can choose what scenarios they want to look into. When a scenario is activated the user can also adjust parameters for that scenario in the scenario user input section.

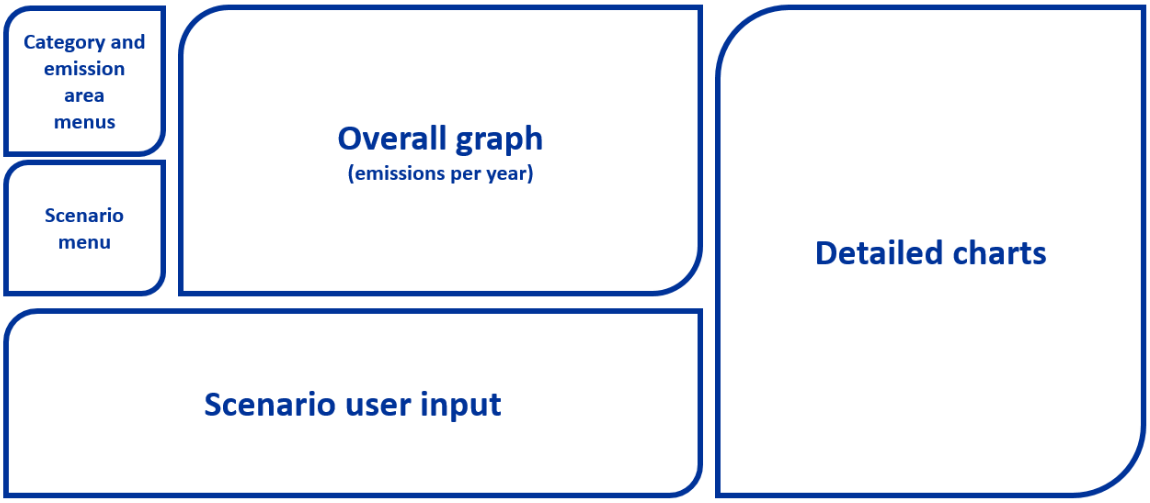

Figure 34. The overall user interface of the model (authors' creation).

The overall graph shows GHG emissions from year 2010 to 2050. The graph extrapolates the current GHG inventory to future years by the use of sales forecasts. One line in the graph shows how emissions will likely evolve if no further actions are taken. The model also shows the target levels for different time horizons. Comparing the projections of emissions with the current trajectory (with no new actions) with the targets levels shows the gap for which initiatives and action plans are needed. An example of the overall graph in of the model is shown in Figure 35.

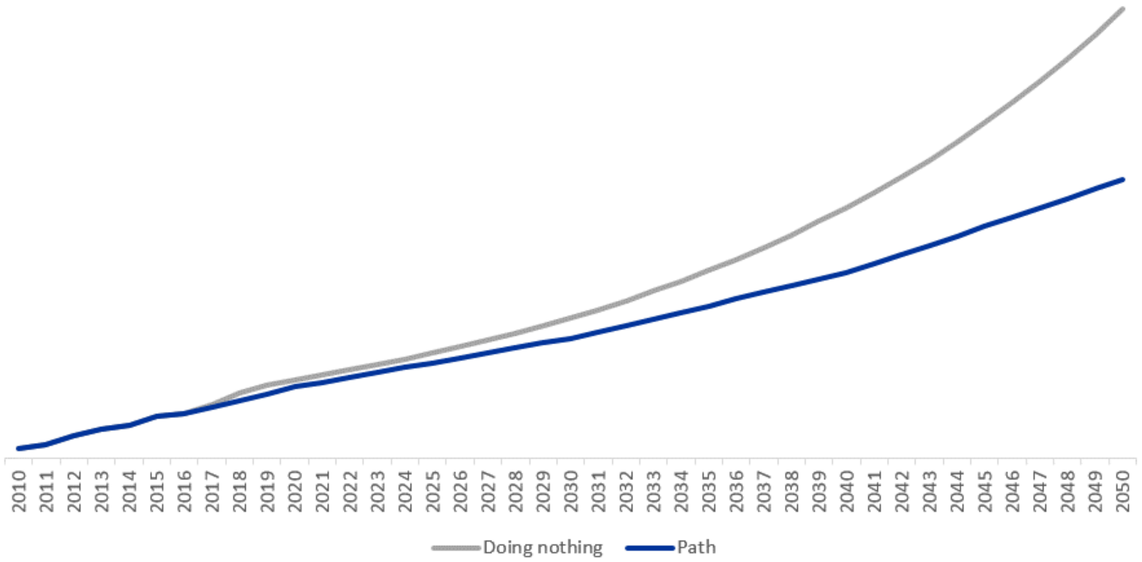

Figure 35. The overall graph. Here a standard growth is used, not ICOMP's projected growth and the targets are removed (authors' creation).

The model also includes detailed charts on all emission areas and categories. The detailed charts update depending on what selections the user makes in the menus. Figure 36 provides an example of the detailed charts showing when the user has all emission areas selected.

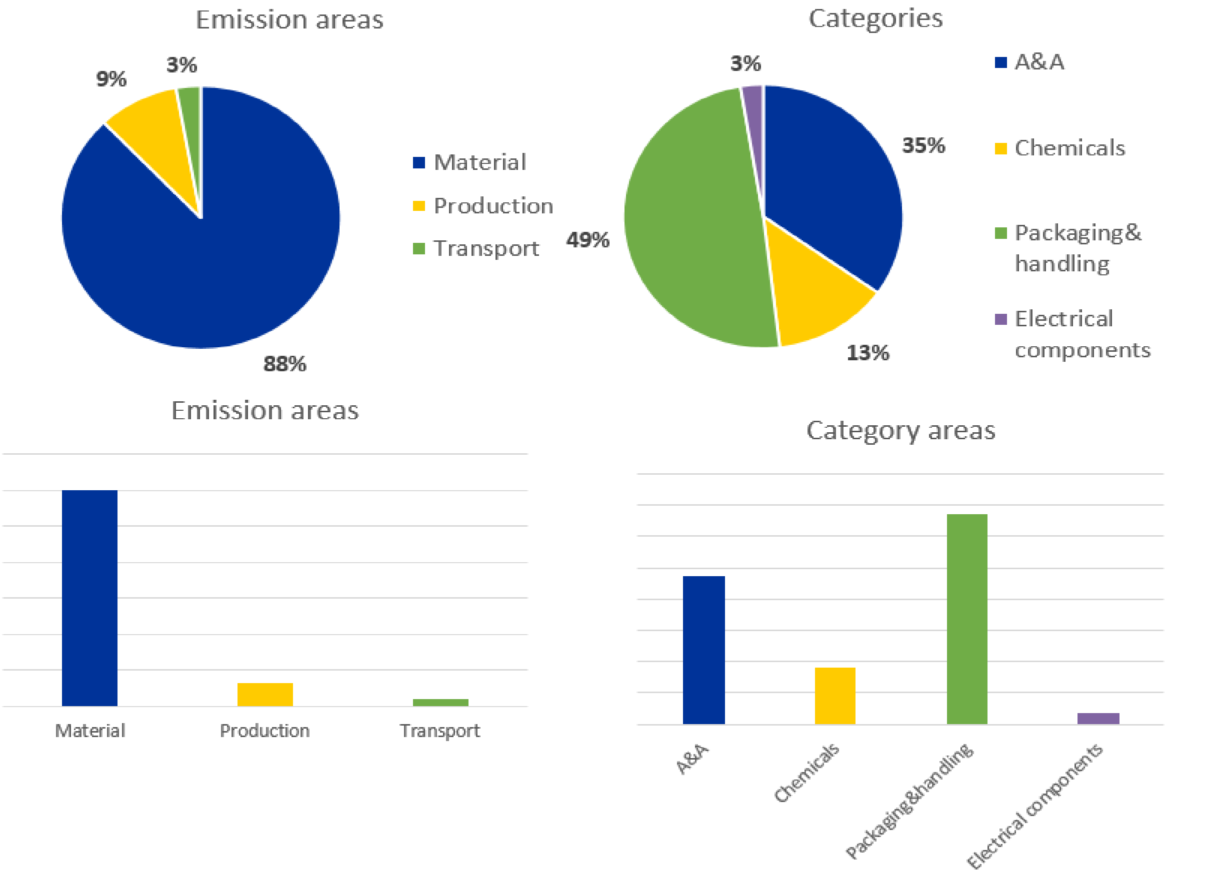

Figure 36. An example of the detailed charts shown when user want to look at all categories and all emission areas (authors' creation).

The user can choose to look at a specific emission area and category by clicking in the different menus, which are presented in Figure 37. When choosing area and category the overall graph adjusts to show only this area and detailed charts are updated to show relevant charts. The user can chose what scenarios they want to apply and see the effect of them. When the user chooses a scenario the overall graph and detailed charts adjust to show the impact. The menu selections enable managers to look specifically at their emissions and how scenarios affect them. The category and emission area menus can also be used in combination to e.g. show Material emissions for A&A.

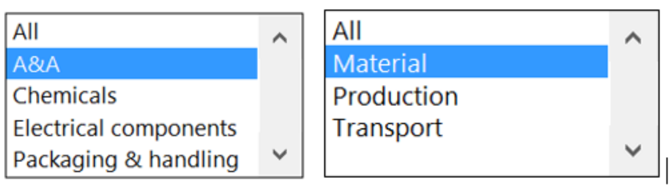

Figure 37. The menus (with A&A and Material selected) where the user can choose category (to the left) and emission area (to the right) (authors' creation).

7.4.5 Scenarios

Scenarios were identified through internal stakeholder’s input. The user can see the impact from a scenario or for multiple scenarios in combination by checking the checkboxes for the scenarios they want to apply. The scenario menu is presented in Figure 38. There are two scenarios in Production and five scenarios in Materials.

- ☑ Renewable electricity
- ☐ Energy efficiency
- ☐ Renewable polyols
- ☐ Recycled cardboard
- ☐ Recycled metals
- ☐ Recycled plastic
- ☐ Recycled wood

Figure 38. The scenario menu with the Renewable electricity scenario applied (authors' creation).

Renewable electricity in Production was identified by internal stakeholders as an area which ICOMP can influence. A scenario was built to show the impact of improving the share of renewable electricity in Production on different time horizons (2030, 2040 and 2050). The overall graph adjusts to the user input, e.g. "Make all first-tier supplier use at least 70% renewable electricity by 2030". Figure 39 shows an example of the scenario user input interface where users can input what shares of renewable electricity they want to look at.

Renewable electricity	
Year	**Share**
2030	50%
2040	90%
2050	100%

Figure 39. User input on the share of renewable electricity in Production (authors' creation).

The other scenario created for Production is Energy efficiency. This scenario shows the impact of using less energy per volume output, which results in less GHG emissions. There was no data on the potential to increase efficiency at specific suppliers so all suppliers were treated the same.

Input from Material stakeholders resulted in scenarios of a couple of combinations on virgin/recycled and fossil/renewable materials, these can be seen in Figure 38.

All scenarios were connected to the Scenario user input panel so that parameters could be adjusted as the user wants. When a scenario is not active (checked in the Scenario menu) the scenario user input table is not shown for that specific scenario. The model was created this way to not confuse users as to what scenarios are currently applied. Figure 40 shows an example of what the Scenario user input panel can look like.

Renewable electricity		Energy efficiency		Recycled Wood		Recycled Metals		Recycled plastic	
Year	Renewable s	Year	Better efficie	Year	Share	Year	Share	Year	Share
2030	50%	2030	40%					2030	70%
2040	90%	2040	50%					2040	80%
2050	100%	2050	50%					2050	90%

Figure 40. The Scenario user input panel with three applied scenarios (authors' creation).

7.4.6 Using the model in the future

The model includes a manual which describes how it is built and structured, what assumptions have been made and how data should be updated. This enables future users to update with more accurate data and to make improvements and add parameters which does not exist today or is lacking data.

7.5 Setting time horizons and commitment levels

Time horizons and commitment levels for ICOMP were set in cooperation with the entire Inter IKEA project group. Targets were to be set on a top level for the main emission areas; Production, Material, Transport, Product use and Food ingredients. The overall targets for Inter IKEA were then to be broken down and adapted to ICOMP. Since the Inter IKEA project group consisted of participants from all the different units they came with input iteratively on the situation for their respective units. The actual targets cannot be presented in this master thesis since they will be publicly released after the completion of the study.

ICOMP decided to set targets on three time horizons; short-, mid- and long-term. They chose to do this because the time horizons serve different purposes. The short-term targets will be a part of the short-term action plans (3-5 years ahead). The midterm targets have a strategic focus (10 years) and can be included into the strategic plans. The long-term targets are instead used to set a vision. Having targets on multiple time horizons is also believed to make tracking of progress easier, ensuring that the company is on the right trajectory for reaching the long-term targets.

ICOMP chose to set both relative and absolute targets. This was done because the targets contribute with different perspectives on emissions. During the benchmarking the researchers found that one obstacle when setting SBT was to fully understand the demand from SBTi. One company wanted to set a relative goal, but then SBTi required an absolute target. For another company it was the other way around. With this input in combination with their own ambitions ICOMP decided to set both relative and absolute targets. The absolute targets were set by using the chosen method and input from the many sources described in this chapter. The absolute targets were then translated into relative targets by forecasting sales in the target years. This was done by dividing the absolute GHG target by estimated sales in EUR.

The absolute target aims to limit the total amount of GHG that the company releases. The absolute emissions of a company are what in the end affects the climate. Setting absolute targets through a science-based methodology is therefore important. An absolute target does however not consider growth or buyouts. Such factors are considered in a relative target, for example GHG emissions per value add.

Scope 3 targets do not need to calculate by a science-based methodology, the only need to be ambitious (SBTi, 2015). To ensure credibility and ambition ICOMP decided to use a science-based methodology anyways. Absolute long-term targets were set using the Absolute contraction approach. This method was used because ICOMP thought this suited the company and their ambition the best. They wanted to be very ambitious and therefore they aimed for the 72 % reduction. SDA is a common method to use and ICOMP also considered this alternative. The main reason as to why they chose not to use this approach was that the company fits into the very general category “Other industries”. On very long time horizons it is not possible to forecast what will be possible to achieve since technology advances rapidly. Using a strictly science-based, top-down, approach for setting long-term targets was therefore considered the only appropriate method.

The short-term targets were set to 2020 using more of a bottom-up approach. Since the time frame for these targets was very short the targets focused on what would be achievable. One goal here was to quantify the exiting action plans and what reductions they would lead to. Aligning the targets to already existing strategies and action plans was essential to make the targets credible internally. The other important objective was to incorporate actions that would enable reaching the mid-term targets. It was during this process important to identify what needed to be done now to enable large GHG reductions to 2030. An example of these kind of actions was to communicate the targets to all suppliers and help them understand what they need to do to achieve them.

Setting targets for the mid-term time horizon required the most time and resources. Targets were set through an iterative process of establishing what was thought to be possible and what needed to be done from a science-based perspective. To understand the impact of different actions simulations were used. The iterative process for setting the mid-term targets was considered helpful to understand what kind of actions would be needed to reach targets. Having an idea of how to reach targets was considered important to make targets credible internally.

Targets were set by looking at the emission areas separately and then looking at the entire picture. Some emission areas that were considered easier to impact got more ambitious targets on shorter time frames while the ones considered harder to impact had more ambitious targets on a longer time frame. Targets were set on an overall level for the entire ICOMP supply chain. Target were then to be broken down in the organization by creating a dialogue with all units and a discussion on how much they could contribute. By doing this the units are easier to impact will probably get more ambitious targets while the units which are harder to impact will get smaller reduction targets. In this way the project group intends to create buy-in from the different units and make the organization feel like they are a part of the target setting process. Each unit will also create their own action plans, serving the same purpose.

7.6 Synthesis

The target setting process for ICOMP was described in the previous sections. In Table 16, the components used by ICOMP have been marked with an X. Firstly, all components that were conducted at the benchmarking companies were added to the table, then new components found at ICOMP were added (the added ones are marked with the text “new” in the description). The table aims to give an overview of components used in the target setting process. It also includes the results from the benchmarking to enable comparison. Connections and patterns between the four companies will be further discussed in chapter 7. Analysis.

Table 16. Observed components of the ICOMP target setting process (authors' creation).

Components of the process	ICOMP	Husqvarna	Nestlé	Tetra Pak
General approach				
Management support	X	X	X	X
Project group	X	X	X	X
A lot of input from stakeholders		X		
Defining the scope				
Focus on a few large emission areas which are possible to impact	X	X	X	X
Creating a GHG inventory				
High data availability	X		X	X
Needing to make assumptions	X	X	X	X
Clearly defining methodology (new)	X			
Aligning on what scope belongs to what business unit (new)	X			
Modeling				
Use of modeling and simulations	X	X		X
Aiding visualization	X	X		X
Aiding decision making	X	X		X
Needing to make assumptions	X	X		X
Setting time horizons and commitment levels				
Short-term target	X	X	X	X
Mid-term target	X	X		
Long-term target	X			
Aligned time frame with existing strategic horizons	X		X	X
Absolute target	X	X	X	X
Relative target	X	X		X
Top-down approach	X		X	X
Bottom-up approach	X	X		
Varying approaches to setting targets on different time frames (new)	X			

8. Analysis

This chapter presents analysis on the process of successfully setting supply chain GHG emission targets. It is structured according to the research framework. A cross-case analysis is used, where the target setting process for Husqvarna, Nestlé, Tetra Pak and IKEA are compared and related to theory. By finding patterns and connections, conclusions on how to perform the process can be found. Key findings of this exploratory study are then summarized and contributions to theory are suggested.

Many large companies are signing up to the Science based targets initiative. During the spring of 2017 about two companies a week were signing up (SBTi, 2017). This shows that the interest in setting SBT is increasing. This means that the companies are doing their fair share in working towards reducing global climate change. The climate development will most likely increase the pressure on companies to take serious climate action (Corbett and Kleindorfer, 2003; Corbett and Klassen, 2006; Sullivan 2009). This will probably lead to more companies signing up for SBTi (including scope 3 targets), including companies that do not have a developed GSCM practices today. This implies that many companies will be interested in how to set targets. It can therefore be concluded that the results of this research have the possibility of contributing to many other companies.

A lot of the companies that have signed up for scope 3 targets already seem to have well developed green supply chain management practices. This implies that they have most likely worked with some form of emission targets before. The research showed that the main reason companies wanted to sign up was to ensure that their targets had the right ambition level and to validate targets to internal and external stakeholders. This supports Walsh's (2000) theory that targets need to be based on knowledge and best practices to be internally acceptable. It is also consistent with the companies studied in the Frame of reference.

Supply chains can be very large and complex, including many actors spread across the world (Beamon, 1999). This complexity makes setting targets for the supply chain hard. Both to collect data and to influence actors within the chain can be hard due to no ownership, this is consistent with Holmberg's (2000) theories. Now, when more companies are signing up, the chance of two target-setting companies being within the same supply chain increases. An example in this study is Tetra Pak and Nestlé. This is beneficial for both the companies and the climate since they can work together towards similar targets.

8.1 General approach

The studied companies did in general follow the process presented as the research framework. Following a process ensures that companies don't miss any important aspects and works in a logical order (Rietbergen et al., 2015). The most time-consuming step in the process seems to be creating the GHG inventory and modeling emission. Setting the targets themselves seems to have been done relatively quickly when the other steps have been completed.

ICOMP followed the process presented in this research, but not all companies performed all the steps. Some companies did not use modeling to determine their targets. In one way, it could be argued that target should be science-based and therefore the results of modeling shouldn't have an impact. On the other hand, modeling gives the company a clear picture of what actions could help them to reach the goal and how large the gap between targets and outcomes of potential actions are. Modeling can also help companies to understand how targets should be set on different time horizons and when it is reasonable for emissions to peak and start declining. Insights gained from the modeling may also support the internal communication. In this research, the companies which used modeling thought this was very helpful. This is consistent with the theory of Lawson and Marion (2008).

The only major SBTi scope 3 requirement is that targets need to be ambitious (SBTi, 2016). This was shown to be interpreted in various ways. This is consistent with theory which says that companies can any approach that suits them (SBTi, 2015). The time spent on the process and the commitment level also varied. Husqvarna set up a project group and spent around one year on the process of creating the targets. This could be compared to Nestlé who only spent one week of effective time. This did not include the GHG inventory but it is still considered a relatively short time. The time it took to set targets was also highly dependent on previous work within data collection and sustainability initiatives.

In this research, the companies created a project group to set targets. Most project groups consisted of people with different sustainability roles. Involving people from multiple areas in the process enables more varied input. It also gives business units a chance to affect decisions and increases ownership of targets and engagement in sustainability. Another positive effect is that it is easier to set accurate targets on a unit level which in turn improves tracking of progress. This approach is in line with the theory of McTaggart and Gills (1998) which suggests that involving subdivisions in the target setting is of great importance. Using a project group consisting mostly of central sustainability people does on the other hand have the advantage of making the process smoother and faster. Nestlé used this approach and were able to set targets very quickly.

A similar decision as to what people to include in the project group is how much input the project group should take from internal stakeholders. The benefits and drawbacks to this are similar to the ones described above. Taking in a lot of input means using a bottom-up approach while not doing it means using a top-down approach (Margolick and Russell, 2001; Rietbergen et al., 2015). The amount of input taken also varied among the companies. Tetra Pak used a top-down approach, while Husqvarna developed their scope 3 targets using a more bottom-up procedure. Using a top-down approach supports the strictly science-based view of target setting. Having this view means that targets should be set only considering what the company's fair share of emissions is. Nestlé had this approach and therefore thought that targets did not need much internal stakeholder input.

Setting targets through a strictly science-based view means that there might be a gap between what companies think they can achieve and their target levels. This can be positive since it can encourage action and innovations to close the gap (Thompson et al., 1997; Gunasekaran et al., 2004). If the gap is too large targets might be seen as impossible to reach, which might be counterproductive. Using a top-down strictly science-based approach where there is a gap between targets and what the company knows they can achieve likely makes the targets more ambitious, see Figure 41. It is also possible that companies would be able to reach even more ambitious targets than what is required from a science-based perspective, see Figure 42, this has however not been seen in this research. Setting more ambitious targets is beneficial from a sustainability and publicity perspective.

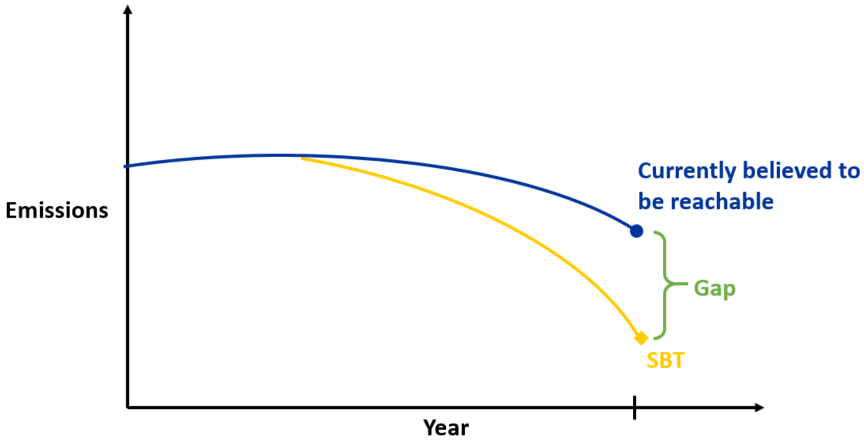

Figure 41. SBT is more ambitious company outlook (authors' creation).

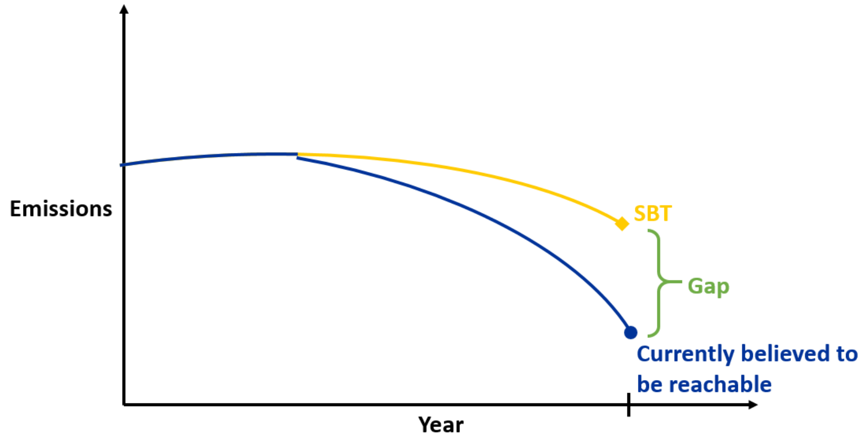

Figure 42. SBT is less ambitious company outlook (authors' creation).

As suggested by McKinnon and Piecyk (2012) this research indicates that both setting scope 3 SBT with a more bottom-up approach including more stakeholder input and using a more top-down approach has benefits and drawbacks. However, each approach might be more suitable depending on company characteristics. Using a top-down approach with little internal stakeholder input on targets and only sustainability people in the project group is probably more suitable for companies with already well established GSCM practices and companies that usually set targets in this way. Companies that have very developed GSCM practices most likely already have internal consensus on how to work with reducing GHG emissions. This makes gaining acceptance and ensuring ownership of developed targets easier. Companies with well-developed GSCM can therefore beneficially use a more top-down approach to save time and resources. A bottom-up approach with a lot of internal stakeholder input seems to be more appropriate for companies with less developed GSCM because they really need to anchor the targets within the organization to catalyze action. This idea is presented in Figure 43 below.

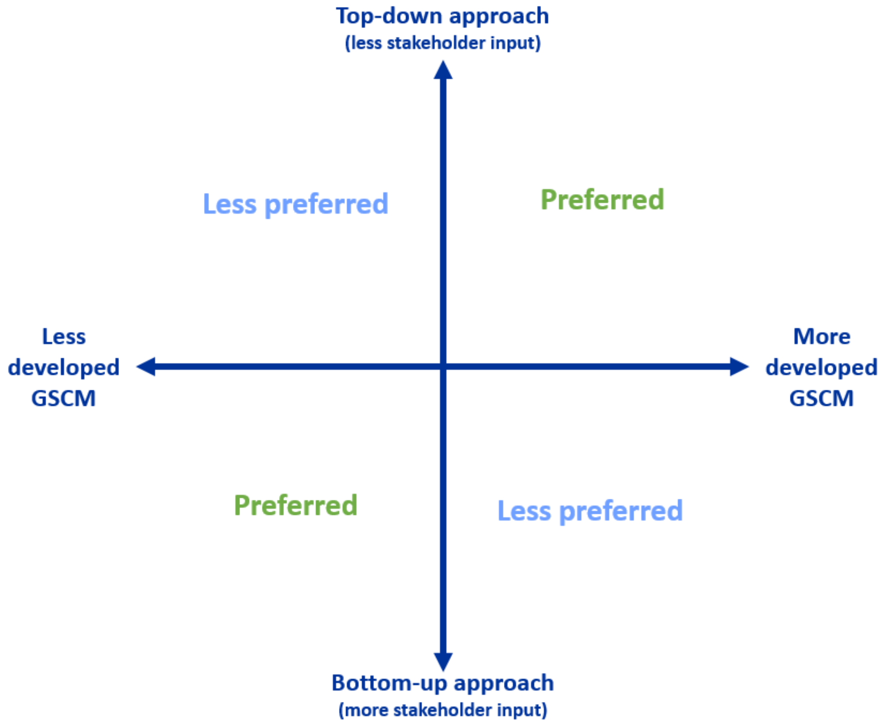

Figure 43. The most suitable project approach may vary on how developed the company's sustainability work is (authors' creation).

Having well developed SCM in general and GSCM in particular seems to make target setting process for scope 3 easier since a lot of data already is available and connections with other players in the supply chain are already established (Hervani and Helms, 2005). GSCM practices will probably also make achieving targets easier.

8.2 Defining the scope

The research shows that deciding what emission areas that should be included in the scope has not been very hard for the studied companies. This is the case because companies already have a good idea of what areas in their supply chain are emission hotspots and what areas they are able to impact. SBTi does however require an investigation of all fifteen scope 3 emission area categories to ensure that the major emission areas make it into the scope (SBTi, 2017).

What emissions are included in which emission scopes is defined by the GHG Protocol. What scope 3 categories to include in the target scope is partly decided by SBTi but companies can also influence the decision by motivating their decisions well. It could be seen that all the companies put a lot of focus on a few main areas with the large emissions. These were also the areas were the most time was spent on data collection and data quality assurance. All studied companies highlighted that it is important to not spend time on emission areas with very little effect. To exemplify, Husqvarna performed a very simple survey regarding business travel due to the small effect on the total emission.

This research shows that when choosing how many emission areas to include in the scope several factors are important to consider, these are presented in Figure 44. These correlate quite well with the theoretical considerations advised by SBTi (size, influence, risk, stakeholders, outsourcing, sector guidance and other). Requirements by SBTi for target approval are of course the most important factors to consider. Other than requirement, the first factor to consider is how large the emission area is today and how large it will be in the future.

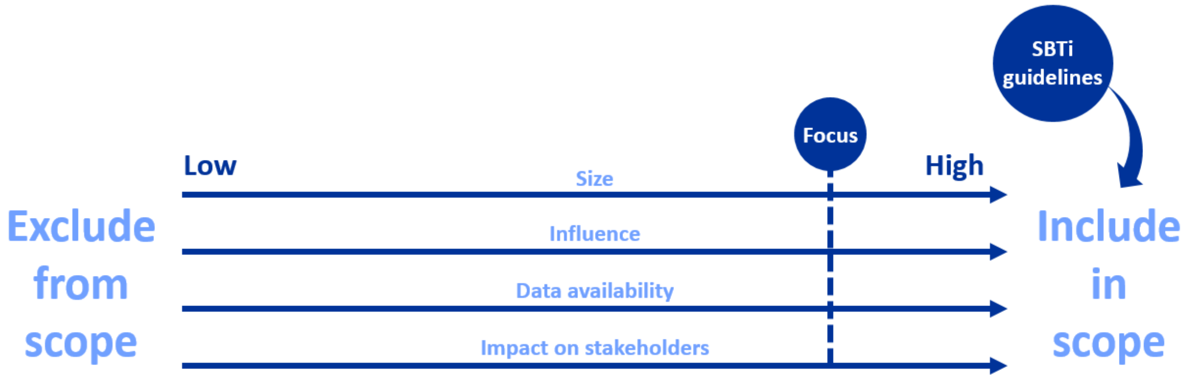

Figure 44. Factors to consider when deciding on the scope of the GHG emission targets (authors' creation).

The second factor to consider is the company's ability to influence the emission area. Since scope 3 emissions regard indirect emissions some areas are probably hard for companies to impact. If supplier power is high, e.g. if the company has a very small share of the supplier's business, it is usually very hard to influence these supplier's production. This was e.g. the case for the Chemicals category at ICOMP. This factor is highly dependent on the supply chain structure, how and if supply chain links are working together. If a large emission area has low influence possibilities an outcome of setting targets might also be recommendations to company management to work on increasing this influence.

The third important factor to consider is data availability within the emission area. If data availability is very low it might be hard to include the emissions in the scope. If data availability is low and the area is included companies should be aware that the emissions in this area are likely to change when data availability increases. It might then be beneficial to establish a procedure for how to revise the scope and the targets if this should happen. Many of the companies struggled with low data availability in some areas. Within ICOMP there was very limited data on transportation, this was also the case for Husqvarna and Nestlé. The main reason for this was that transport was handled by a third party. The transportation within large supply chains is often complex and few have such developed supply chain management so that they can track transport on a detailed level. Even though transport was a small part of ICOMP's total scope it was included because it was an area which they believed they could influence. This contradicts the statement of Brand et al. (2012) that the transportation sector is often seen as the hardest sector to decarbonize. Another reason for including it in the scope was that the data availability would increase within the near future.

A fourth factor to consider when scoping is the area's impact on internal and external stakeholders. Even though an emission area is relatively small it might still be beneficial to set targets for this area because it will contribute to engaging employees and other stakeholders (Meekings et al., 2011). Husqvarna used this approach when they decided to set targets for their own production even though it was a very small emission area. Another example of when this logic could be beneficial is emission areas that are small but directly in contact with customers, e.g. even if electricity in stores is a small part of total emissions companies could benefit from setting targets here as well to be able to use the targets for marketing purposes.

When deciding on scope it is lastly important to consider the proposed factors in combination. When scoping it is generally also important to not include too many areas (McTaggart and Gills, 1998). Doing this can easily cause confusion as to where efforts should be focused. This is shown in the figure as "Focus" and can be seen as a test emission areas should pass to be included in the scope.

8.3 Creating a GHG inventory

When the scope of the targets has been determined, it is time to create a GHG inventory. The research shows that four most important factors to consider here are data availability, data accuracy, methodology and internal scope. These are presented in Figure 45 below. Creating a GHG inventory was for most companies the most time-consuming part of the target setting process. Companies which already were gathering data on their largest supply chain emissions, like Nestlé and Tetra Pak, could create an inventory much quicker.

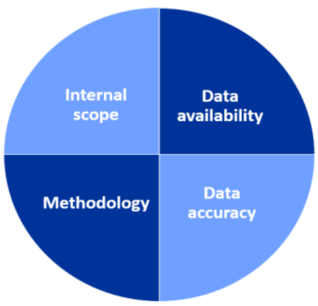

Figure 45. The most important factors to consider when creating the GHG inventory (authors' creation).

The research showed that companies' data availability regarding GHG emissions in their supply chains still is relatively low. Activities which the company govern themselves or are highly engaged in seems to have higher data available. This is consistent with the conclusions from Holmberg (2000) that measuring across supply chain entities is hard. This is also consistent with theory that companies have worked much more on reducing scope 1 and 2 emissions than scope 3 emissions (SBTi, 2017). Gathering data further away in the supply chain, upstream or downstream, was harder for the companies because they did not have established links to these entities.

When it comes to data accuracy this also varied between emission areas. An example where data accuracy can be discussed is within ICOMP's production emission area. The data available at ICOMP's own data system, SSI was filled out by the suppliers and the productions units themselves, hence using the first approach suggested by West coast climate forum (2016). The accuracy of the data therefore has some uncertainty. The level of detail of the underlying data could vary considerably. To the extent of which it is possible, uncertain data should be verified by internal experts. In the case of the SSI this could mean that the people who work the most with each supplier, e.g. the supplier developer, should check that the provided numbers are reasonable.

Deciding on what methodology to use for creating the GHG inventory is of great importance. To ensure consistency on assumptions and how emissions are measured and calculated it is important that the methodology is clear to everyone involved. The IKEA project group spent a considerable amount of time on methodology and internal scoping of the GHG inventory. When supply chains are large and complex there are most likely multiple people working with gathering the data. In this case, it is important to align on what methodology to use so GHG will be measured the same across the organization (Meekings et al., 2011).

It seems like it is not until companies start collecting data that they fully realize the extent to which assumptions needed to be made. A conclusion is that all companies had to make assumptions to some extent. This may indicate that it is practically impossible to have fully accurate data in all areas. Still, companies should be aware of the uncertainties pertaining to making assumptions. This goes hand in hand with the fact that the companies wanted to get their biggest emission areas as accurate as possible. An assumption made within an area with large emissions increases the uncertainty of the total inventory more than an area with low emissions. In ICOMP's case a lot of estimations had to be made within transport. This was considered acceptable due to the small impact transport has on ICOMP's total emissions.

When making estimations companies should document which assumptions have been made and explain the logic behind these (Dym, 2004). This is important since targets often are set on very long time horizons, making it plausible that the people currently working on this will be replaced in the future. Assumptions should, to the extent possible, be verified by experts. In this project, this was done for the Transportation emission area by getting input on the assumptions, calculation methodology and final emissions from the transport manager at ICOMP and the sustainability responsible at IKEA Transport.

When creating a GHG inventory it is also important to consider the internal scoping, meaning what emissions should belong to what business areas or parts of the company. When data is requested from different parts of the organization it should be made clear what this data covers and what it doesn't cover. A good way of doing this is mapping the supply chain and visually drawing what emissions belong to what entity. The mapping approach was used in this project to visualize to stakeholders what emissions belonged to what business unit. This helped to avoid double counting emissions and ensuring that set targets could be broken down into business unit levels fairly. A general rule for assigning emissions to different business units successfully can be that the emissions should belong to the business unit which has the largest possibility to impact emissions. Large companies and complex supply chains increases the difficulty of doing this, the IKEA project group spent a considerable amount of time on this.

When creating the GHG inventory companies should simultaneously document where data availability and accuracy needs to become better in the future. If something is not measured it is according to theory (Holmberg, 2000) it is hard to make decisions and design actions for improvement. Areas that needed better data in the future was therefore one of the deliverables from the IKEA project group.

8.4 Gathering input from stakeholders

Gathering input from stakeholders was during the research identified as an important aspect to consider in the target setting process. It was therefore added as a separate point of empirical findings and analysis.

There are two main types of stakeholders, internal and external. Gathering input from stakeholders is a good way of aligning the targets with other business objectives, creating ownership of targets within the organization, understanding where there are opportunities and getting input on time horizons and ambition levels. In this project input from internal stakeholders was gathered at ICOMP and external input was gathered by the IKEA project group. At ICOMP the researchers gathered internal stakeholder input by talking to both business unit leaders (such as Chemicals) and functional unit leaders (the transport manager). It was beneficial to get input from both of these perspectives.

When it comes to external stakeholders, organizations leading the SBTi seemed to be the only ones that were asked to give input on targets. These organizations, mainly WWF and WRI, were very important in securing that the targets actually were science-based. External consultancies were also for establishing emission factors. A common approach was to get help from one of the organizations during the process and have the other one approve the targets.

Gathering input from internal stakeholders relates back to the decision of whether to use a bottom-up or top-down process discussed in section 7.1 General approach and presented in Figure 43. Using a bottom-up approach implies much more input from internal stakeholders. Companies using a top-down approach do however not require any stakeholder input. Management is however an internal stakeholder that always needs to be included in the process. Management support is essential successful launch of targets. This confirmed by theory through the process presented y Rietbergen et al. (2015).

The research showed that the extent of input from internal stakeholders varied. The pros with not taking in any input would be that the process most likely becomes faster and smoother. This was one of the main reasons why Nestlé did not want to involve the business units during the target setting process. On the other hand, the engagement may increase by letting unit managers influence the process. When letting internal stakeholders be a part of the target setting it may be more likely that the target gets a separate KPI and therefore can be followed up in a better way. At Husqvarna, the unit managers had to iteratively set the targets for their units by themselves with support from the project group. This resulted in new ways of working and in a new GHG emission KPI. At Nestlé were the units were informed first after the targets were set, no new KPIs or new working process was implemented. The same sustainability KPIs as used before, where GHG emissions were a part, were instead used for tracking progress. The risk with this is that these only tracks sustainability work in general and not the specific progress for GHG emissions in particular (Meekings et al., 2011).

Gathering internal stakeholder input can help to understand within what emission areas and business categories there are opportunities to reduce emissions. This input can be used to understand what the organization thinks they can achieve and as an input for modeling future emissions. Internal stakeholder input on supply chain emissions can for instance reveal what suppliers are hard to influence or what materials that could be easily exchanged to recycled sources. Getting this type of input will also serve as a base for breaking down the targets further in the organization. Understanding what stakeholders believe to be achievable is important even though targets are set from a strictly science-based perspective. This is the case since targets can be seen as not credible if there is no investigation of the gap between what looks achievable today and what needs to be done. If targets are communicated internally with no planned actions connected to them they might be received as impossible to achieve.

The conclusion is that input from external stakeholder such as SBTi is important for all companies wanting to set targets while internal stakeholder input should vary according to the company’s specific situation. If the company is already working a lot on GSCM stakeholders might already feel like they have given input on what actions can be taken within their areas, whilst companies with less developed GSCM will need more internal stakeholder input. Letting internal stakeholders have input seems to give multiple benefits but also takes a lot of time and resources. The project group needs to find the right balance of these.

8.5 Modeling

Not all companies used modeling and simulations in the target setting process. ICOMP and Husqvarna did however put a lot of focus on this while Tetra Pak and Nestlé did not. This might be because both Tetra Pak and Nestlé set their targets on a short time horizon to 2020. Husqvarna mostly used modeling for their 2035 target on product use and ICOMP used it for their mid and long-term targets. This implies that modeling is more useful for setting mid and long-term targets than for short-term targets. This is probably the case because companies already know what actions they are going to take short-term and approximately what impact these actions will have.

Using modeling and scenario building can be beneficial in multiple ways. Even if targets are set through a strictly science-based methodology modeling is helpful when creating action plans for reaching the targets. Understanding what actions will have the largest impact is essential to not put time and resources on changes with minimal impact (Lawson and Marion, 2008). Modeling can also be a good tool for understanding what actions should be taken first and which ones will take longer time. (ibid.) If a bottom-up approach is used, modeling can also be used as an iterative tool to check the ambition level of targets. This is described further in the section 7.6 Setting time horizon and commitment level. Another purpose of using modeling is to internally communicate the targets and actions needed to reach them (Bertrand and Fransoo, 2002). Doing this can make people understand what they should do contribute to reaching targets. Lastly modeling is also useful for breaking down target within the organization.

The modeling approach used in this research empathized an iterative process where verifying and validating results were an important part of the process (Dym, 2004). Using a modeling approach like this one is recommended for creating structure and ensuring validity of the final model. Excel was chosen as modeling tool in both companies that used modeling. Using Excel has the advantage that most people can handle to program, everyone can open it on their own computers and it is relatively user friendly. The main disadvantage of Excel is that it can have trouble handling very large amounts of data and it is not built specifically for simulations. The conclusion from this may be that Excel should be used for relatively simple models while complex models require more advanced programs.

Companies that want to use modeling to understand their emissions and potential actions to be taken better can chose to do so by applying very simple modeling or very complex (Barbarossa, 2011). This choice should depend on how accurate the data is, time and resources available and how much is already known about the impact of different decisions. The research shows that even quite simple models can provide useful insights for setting targets and creating action plans for achieving targets.

When creating emission models a good approach seems to be to start by mapping all drivers and parameters. After this is done the most important parameters should be chosen. Parameters and scenarios in the model should be carefully selected from input from stakeholders.

The accuracy of GHG modeling depends highly on the accuracy of the GHG inventory. If data availability is low it will also be much harder to create an accurate model (Lawson and Marion, 2008). In this research, it was decided that no scenarios were to be modeled on the transport emission area. One reason for this was that data availability was low. Results from scenario modeling on transport would have a high level of uncertainty. Fortunately, transport constituted a small part of total emissions for ICOMP. When modeling GHG emissions it is important to remember that there are large uncertainties in results. Results should therefore not be seen as absolute truths, instead they should be seen as indicators for what needs to be done to take steps in the right direction. It is also important to understand the modeling is largely based on sales forecasts, making the results more uncertain the longer the time horizon is.

Since there exists little research on how to model GHG emissions (Sundarakani et al., 2010) the conclusions on modeling are mostly based on the empirical findings. In general, modeling seems to be a beneficial tool to use if targets are to be set on a mid or long-term horizon. For short-term targets it could also be useful if companies do not have well developed GSCM. The most important factors to consider when modeling GHG emission are clearly defining the purpose of the model, using a structured approach, making the model simple to understand and to document all methodology and assumptions.

8.6 Setting time horizon and commitment level

This study has shown that companies have quite different time horizons and commitment levels in their targets, confirming the theory by Grant (2003). Many companies have chosen to only set public targets on a short time horizon to 2020 while others have chosen to set targets for mid and long-term horizons as well. Even though setting science-based targets means that companies are doing their fair share there are multiple methodologies for setting targets and requirements for getting targets approved are not always clear. This affirms the findings by Ammenberg et al. (2001) and Rietbergen et al. (2015) that requirements are poorly defined and may be interpreted differently by auditors. It is impossible to compare the ambition of companies' commitment levels since they are all science-based but calculated from different methodologies, as SBTi says there is no best methodology but a methodology that fits your company the best (SBTi, 2015).

The research shows that targets on different time horizons have different purposes for the organization, this is also consistent with theory (Rietbergen et al., 2015). A short-term target is actionable and relatable, this is the reason Nestlé set their targets to 2020. A short-term target should be incorporated into business plans and aligned with other planned actions. A mid-term target (2030) relates to a more strategic level and should be incorporated in the company's strategic objectives. A long-term target (2050) serves as a vision more than an actual target. In general targets on shorter time horizons should set the company on the right trajectory for reaching the targets on the longer time horizons. According to theory combination is the preferred approach, this will make the targets both visionary and actionable (Grant, 2003; SBTi, 2015). ICOMP used all three time horizons to benefit from their individual strengths. This can however have the disadvantage of confusion as to what target to focus on (McTaggart and Gills, 1998). Tetra Pak and Nestlé on the other hand chose to only set official targets on a short time horizon. This can be advantageous since it makes it very clear what employees should focus on.

It is important that the target becomes a part of the company's overall strategy. It can therefore be beneficial to align time horizons to existing strategic targets and business plans. In the research this was applied by many of the companies. Most companies, for example Tetra Pak choose to align the time horizon for their scope 3 target with the time horizon for their strategy. This was one of the main reasons why they set their target to 2020. The alignment with strategy may also ease the internal communication of the targets.

The research confirms the SBTi (2015) approach to using absolute and relative targets. If a company only sets an absolute target and then makes a large divestment or shrinks their sales they could reach the target without any effort. If a company on the other hand only set a relative target they could grow a lot and reach their targets but still emit large absolute emissions. From this perspective absolute and relative targets might suit different kinds of companies. If a company is likely to grow a lot an absolute target is more beneficial to the climate, if the company shrinks a relative target might be better. Since it is impossible to foresee what is going to happen on long time horizons having both absolute and relative targets ensure that the final outcome will be ambitious from a climate perspective.

Another aspect of choosing between absolute and relative targets are requirements from SBTi. Most companies in this study had difficulties interpreting SBTi requirements, consistent with findings of Ammenberg et al. (2001) and Rietbergen et al. (2015). Husqvarna first wanted to set only a relative goal, but SBTi wanted them to have an absolute one. For Tetra Pak, it was the other way around, when they first wanted to set only an absolute goal. This insight was communicated to IKEA by the researchers and it was therefore, in combination with other objectives, decided that both a relative and an absolute target should be set. A conclusion is that it may be of favor for the company signing up to set both relative and absolute targets since the two targets communicate different perspectives of the same objective (Doyle, 1994; Meekings, 2011). A downside with setting both absolute and relative targets is that they might be harder to communicate to the organization. Having one clear target would create greater focus (McTaggart and Gills, 1998).

Targets on different time horizons could be set in different ways, the research indicates that an approach similar to the one presented in Figure 46 might be appropriate. All companies who set long-term targets used a top-down approach. This is the only reasonable way of setting a long-term target since it is essential for being a science-based target and because what people think is possible now is not irrelevant for a 2050 scenario. Development until 2050 is impossible to predict as many advancements will have been made by then. By this logic, long-term targets should be set using a top-down, strictly science-based, approach.

When it comes to targets on shorter horizons companies chose different approaches. Some companies calculated their science-based 2050 targets and linearly assigned the decrease in emissions to earlier time horizons. This approach is consistent methodologies such as the absolute contraction approach and the 3% solution (SBTi, 2015; WWF and CDP, 2013). Other companies chose their short-term targets using a more bottom-up approach where they assessed what they thought could be done in a short time frame. These approaches have advantages and disadvantages. Using a top-down approach for setting short-term targets ensures that targets are science-based and therefore ensure climate credibility. If targets are so ambitious that employees do not see them as achievable it can however cause problems (Walsh, 2000; Thompson et al., 1997). A short-term target needs to be actionable and the organization needs to believe that it can be achieved. Using a more bottom-up approach for setting short-term targets therefore seems to be preferable.

Based on the logic for setting short and long-term targets using bottom-up and top-down approaches, setting mid-term targets should be done by using a combination of these approaches. Using a combined approach can be done by an iterative process, presented in Figure 46. The approach should both take input on what is believed to be achievable and what is needed from a science-based perspective. In this approach modeling can be of large help to understand the impact of different actions.

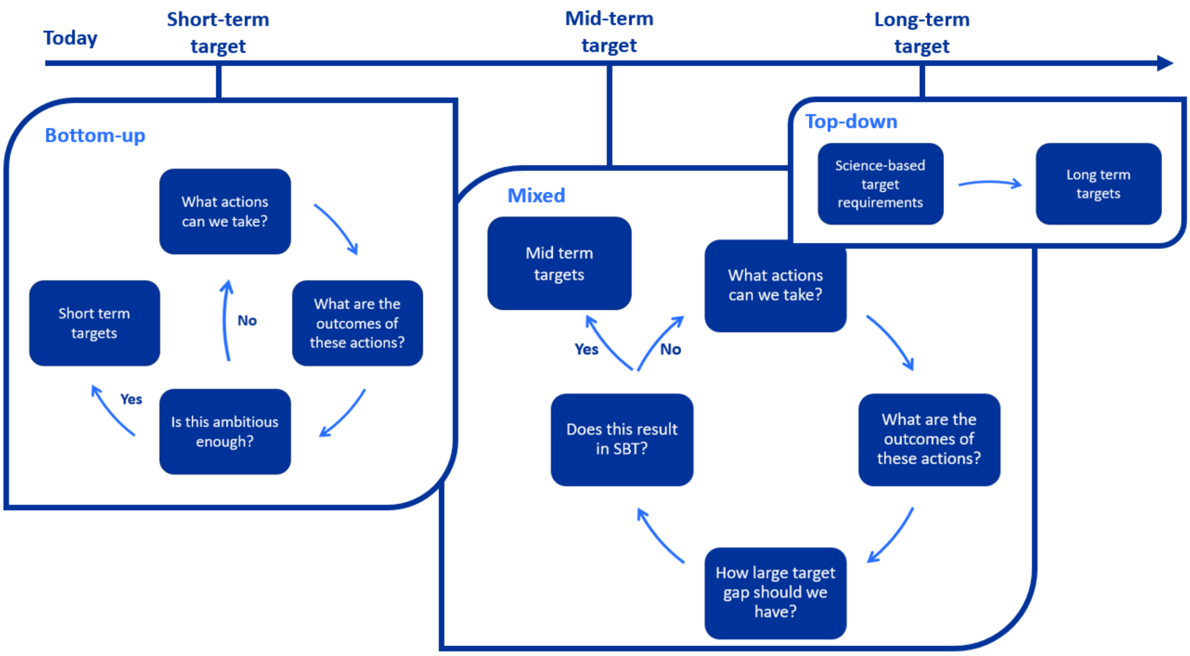

Figure 46. Recommended approaches to setting scope 3 targets on short-, mid- and long-term time horizons (authors' creation).

Other aspects to consider then setting targets are when the company's emissions will peak and if, and when, they will reach zero emissions. These are very hard to pinpoint, but will help companies in understanding when the trend should be broken. When the company's emissions peak will have a large impact on the climate since it will affect the total volume of emissions released. Modeling can be used as a tool to find the peak point. The zero emissions point seems unachievable for most companies today, therefore it will probably not be included in the 2050 time frame.

8.7 Communicating the targets

When setting science-based targets it is generally important to communicate that they are in fact science-based. Internally people then know that targets are ambitious enough without the company taking on a larger share of reductions than what is fair. The targets can be used to show that the company takes climate issues seriously and to get everyone to understand that this is an important priority. For external purposes, having SBT is a great way to show customers, investors and other stakeholders that the company is taking sustainability seriously. This can convince investors that the company is worth supporting in the long run. Setting SBT for scope 3 emissions can also be a great way to make action happen and to start decarbonizing the supply chain.

When the targets are set, it is time to communicate them both internally and externally. This is a highly important part of the target setting process and it determines how the targets are received and interpreted (Kleine and Von Hauff, 2009). It is therefore crucial to give a clear and explicit message which has management's support (Rietbergen et al., 2015; Walsh, 2000). All companies in this study found it very useful to highlight that targets were science-based, meaning that the ambition level has been validated by science. Aligning the external communication with the company's yearly sustainability report can therefore be beneficial. Even if the communication of the targets is among the last actions in the process, it seems to be a good idea to start the communication early. This is to some extent done implicitly since SBTi posts which companies that have signed up on their website. By communicating early that targets are being developed stakeholders, both internal and external, can be given the chance to contribute with input and feedback before the targets are set.

Internal communication of the goals has a lot in common with the procedure of collecting input from internal stakeholders. If this is done, the communication starts at an early stage. The benefits from doing this are that stakeholders will have more time to understand and learn about the targets and they will also have a chance to influence the outcome. A difficult part with internal communication is to assure the employees understanding and acceptance of targets. If employees are not that familiar with sustainability work, understanding the targets' impact on their jobs could be difficult (Kleine and Von Hauff, 2009; Du, Bhattacharya and Sen, 2010). It is a good idea to consider what phrasing and what measurement to use early on. As an example, Tetra Pak uses an index to communicate the as-is emissions and progress instead of using volume of CO_2e. This is something that was seen as very useful because it was easier to understand and it is therefore recommended for companies to consider. Another example of this is communicating targets in kWh instead of GHG emissions.

Another factor which will ease the internal understanding, is breaking down the targets within the organization in a good way. This is consistent with theory presented by Kleine and Von Hauff (2009) If targets are broken down into a certain unit, there is a much higher chance that the people working in that unit will understand what they need to do to contribute. This also creates a higher engagement throughout the company. To increase engagement even further it is important to set goals and communicate them for units in the company were a lot of people work. Husqvarna highlighted this due to the fact that the unit with the most employees worked, had a very small impact on the total emissions. They chose to set a target for this units, to engage employees and make them feel that they could contribute.

ICOMP will communicate their targets after the completion of this research. However, they have already announced externally that they have signed up and that they are in the process of setting their scope 3 targets. Internally managers have been updated on progress and stakeholders have been asked to give input. This has been discussed further in the section about stakeholders input. ICOMP got inspired by the approach of using an index for communication, but no decisions regarding this has been taken.

8.8 Tracking progress

To ensure that the company reaches the targets tracking progress is important. By doing this continuously the company will see if they are ahead or behind in what needs to be achieved to be able to reach the targets (Beamon, 1999). If modeling is used in the target setting process the model can be updated to track progress and used to decide on further actions needed. For this to be possible it is essential to make the model simple and easy to update. The model that was built for ICOMP contained descriptions on how to update the model when new data is available. When new data is entered into the model it can also be used to visualize progress. To make this a routine and a part of the company's overall progress tracking, it could be a good idea to include the targets in the overall strategy. This contributes to an integration of the target tracking process in daily business, not leaving it as a separate objective. Tracking progress also requires a governance structure where someone needs to be responsible for the tracking and make sure it is done correctly (Meekings et al., 2011).

How detailed the tracking of progress is could vary among different companies. Either the targets could be measured as total overall progress for the company. It could also be measured on more detailed levels. This way of working will probably contribute to more ownership, actions and improvements on a unit level. At Husqvarna, the unit managers were highly involved in the tracking progress. This resulted in the managers taking on responsibility and creating action plans to reach targets. Husqvarna also created new KPIs helping managers in the tracking and communicating progress. Nestlé choose to apply another approach by keeping the same KPIs as used before they set the targets. This may not generate as much focus to reaching targets, and it could be hard to distinguish the progress within GHG emissions specifically. Still, Nestlé used overall KPIs for their sustainability work which covered the scope 3 target well. The choice of creating a new KPI or not should include considerations on how many KPIs is reasonable to use, having too many could easily confuse and decrease the focus (McTaggart and Gills, 1998). Both positive and negative effects can be seen with the different approaches, but being able to distinguish the progress for the scope 3 target itself it generally considered important.

For IKEA, the tracking of progress will most likely be done both at a business unit level and at an overall Inter IKEA level. The units will track the progress of the targets in their specific areas, which will be created by breaking down the overall target for Inter IKEA. This will help to ensure that all units are on the right track. For ICOMP this means that they will track the progress for their own targets. This will help them to develop their sustainability work on a unit level. They will also keep track of progress on a more detailed level at ICOMP by measuring the progress for the different business categories.

When tracking progress it will be important for companies to adapt to changing circumstances. Even if an emission area is scoped out today because it is small does not necessarily mean that it will be small compared to other areas in the future. It is therefore important to do small follow ups on emission that are out of scope to check if it needs to be included. The supply chain influence is also something that can change over time, so periodic assessment is probably beneficial. It is also important to be able to update the inventory when data availability increases. Progress within GHG emissions can in the future also be highly dependent on changes companies cannot influence. An example of this is political decisions on renewable energy. It is therefore important for companies to be adaptive in their action plans and take advantage of innovations to come. Companies also need to be flexible on internal changes, areas believed to be easy to influence might not be. If the climate models of IPCC to follow the 2-degree decarbonization pathway change a revision of targets might be needed. If targets are set on a short time horizon new targets will need to be set in the future. Other events that might trigger changes in targets are changes in organizational structure and large investments/divestments.

8.9 Exploratory model

To summarize the cross-case analysis this sections presents an Exploratory model of a suggested target setting process and key considerations in each process step. Each component is also described in section 9. Conclusion. The model aims to answer the overall research question “How should companies set their supply chain (scope 3) GHG emission targets?”. The model is exploratory in the sense that it does not present absolute truths but aims to provide companies and academia with a suggested process and topics within the process worth considering. The model was created by applying findings from the empirical data and the analysis to the research framework. The suggested model will also be compared with existing theory.

8.9.1 Defining the Exploratory model

The model’s foundation is based on the research framework and consist of six main parts which are Scope, GHG inventory, Modeling & simulation, Targets & time horizons, Communicating targets and Tracking progress. After studying the empirical data and analyzing it the main conclusions were added to each of the six main parts. The two significant actions Stakeholder input and Assumptions were found to be beneficial to apply on several main parts. The main parts together with its recommendations are presented in Figure 47. The importance of management support was found to be a critical factor both in the theory and in practice. This is considered a prerequisite and is therefore not included in the Exploratory model.

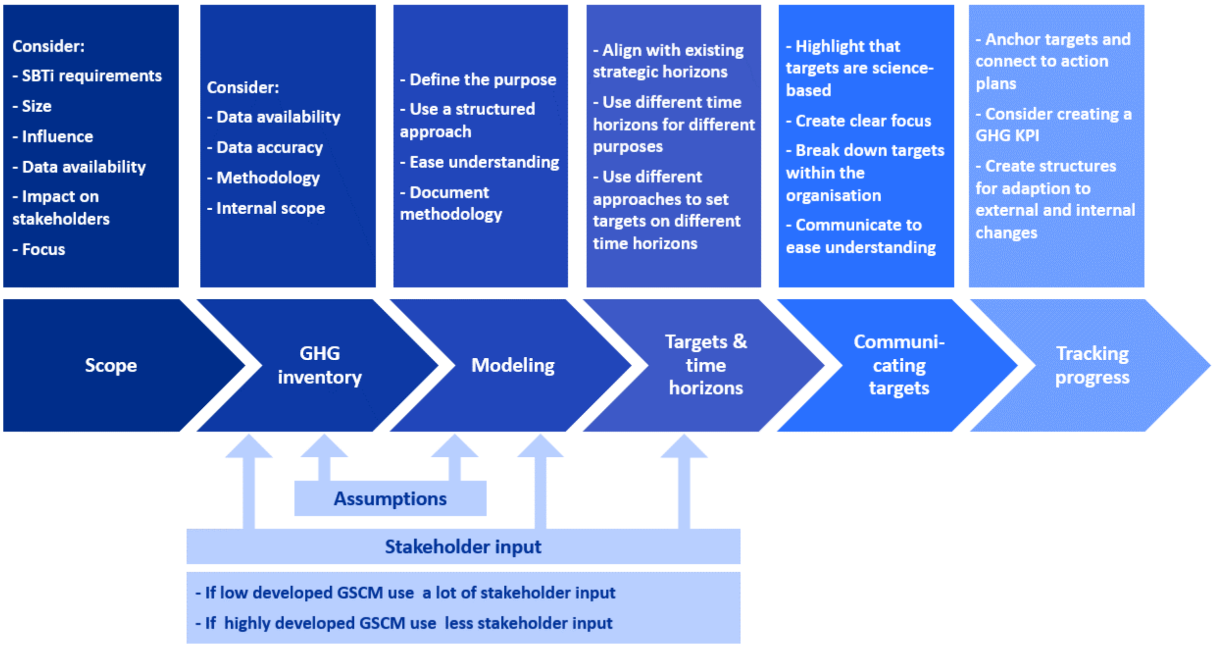

Figure 47. A summary of conclusions for how to set science-based scope 3 GHG emission targets (authors' creation).

8.9.2 Comparison with theory

The six main parts of the Exploratory model are very similar to the model found in the theory by (Rietbergen et al., 2015), described in section 5. Research framework. All the steps included in the model can also be found in the Exploratory model. In addition to that, the Exploratory model includes several steps components and actions which are new to theory. Some of the new components are new and could not be found in theory, while some could be found in theory but not specifically in theory connected to setting GHG emission targets. The Exploratory model is in Table 17compared to theory. An X means that the empirical findings were found in theory related specifically to setting GHG emission targets while (X) means that the findings also were found in theory but not specifically relating to setting GHG emission targets. An / means that the recommendations have not been found in theory and are therefore considered new additions. The sources to the connections to theory are presented throughout the analysis.

This model is also more adaptable and can be used by different types of organizations. Depending on how developed the current sustainability work is and of the ambition level, the model suggests different actions. The Exploratory model is also more detailed and discusses the process with more depth. It is also developed with the specific aim of setting science-based targets. No model which only focuses on this specific area exist in theory today. The model created by (Rietbergen et al., 2015) only discusses a more general process of setting GHG emission targets.

Table 17. The Exploratory model in relation to theory (authors' creation).

Components of the process	**Relation to theory**
Scope	X
SBTi requirements	X
Size	X
Influence	X
Data availability	X
Impact on stakeholders	X
Focus	(X)
GHG inventory	X
Data availability	X
Data accuracy	X
Methodology	(X)
Internal scope	/
Modeling	(X)
Define the purpose	(X)
Use a structured approach	(X)
Ease understanding	(X)
Document methodology	(X)
Targets & time horizons	X
Align with existing strategic horizons	/
Use different time horizons for different purposes	(X)
Use different approaches to set targets on different time horizons	/
Assumptions	(X)
Stakeholder input	(X)
If low developed GSCM use a lot stakeholder input	/
If highly developed GSCM use less stakeholder input	/
Communicating targets	(X)
Highlight that targets are science-based	X
Create clear focus	(X)
Break down targets within the organization	(X)
Communicate to ease understanding	(X)
Tracking progress	X
Anchor targets and connect to action plans	(X)
Consider creating a GHG KPI	(X)
Create structures for adaption to external and internal changes	(X)

9. Conclusion

The conclusion aims to respond to the overall research question, "How should companies set their supply chain (scope 3) GHG emission targets?". This is done by looking at the individual steps of the process, the individual research questions and the overall insights on setting targets.

Many companies today are increasing their supply chain sustainability efforts in response to climate change. One way companies are doing this is by signing up for the science-based targets initiative. Through the initiative, companies set GHG emission targets that are in line with their fair share of emissions from a scientific perspective. Few companies have done this so far and there is very little research on how it should be done. Since this is the case this exploratory study was conducted with the aim of contributing to academia and companies. Companies that have signed up have reported multiple benefits. It is anticipated that companies will continue to sign up, when doing this they will be in need of guidance on how to set targets.

Setting targets for supply chain emissions is often complex since data availability and possibilities to impact rely on other entities in the supply chain. The research has shown that target setting could beneficially be performed by a project group. The general process should include; scoping, creating a GHG inventory, modeling, setting time horizons and commitment levels, communicating the targets and tracking progress. Companies can during this process choose to have a varying amount of stakeholder input. Using a bottom-up approach including more stakeholder input and seems to be more appropriate for companies with less developed green supply chain management practices. A top-down approach, on the other hand, suits companies with well-developed GSCM practices and many GHG reduction initiatives in place.

When defining the scope of the SBT companies should firstly consider requirements from SBTi. Thereafter they should for each relevant emission area consider its size, possibility to influence, data availability and impact on stakeholders. The last important factor for deciding on scope is ensuring that the company has clear focus area and not too many emission areas are included.

In regards to research question 1.a (How should a GHG inventory be created?) the research showed that supply chain data is hard to collect and often lacking, which makes it necessary to make estimations. When creating a GHG inventory companies should consider data availability, data accuracy, methodology and internal scope.

The project group should to some extent gather input from stakeholders. The research showed that it could be beneficial for companies to choose the level of internal stakeholder input depending on current level of green supply chain management practices. A high level of internal stakeholder input has the advantage of anchoring targets within the organization and engaging people in the cause. A lower level of internal stakeholder input makes the target setting process more efficient.

Addressing research question 1.b (How can modeling be used to facilitate target setting?), the research has shown that modeling and simulations can be a useful tool to understand the impact of different actions and to communicate targets. When modeling GHG emissions companies should clearly define the purpose of the model, use a structured approach, making the model easy to understand and document all methodologies and assumptions.

When the first three steps in the process have been completed companies should decide on time horizons and commitment levels, this answers research question 1.c (How should time horizons and commitment levels be determined?). Aligning targets with existing strategic horizons is important to integrate the targets into the business. Targets can be absolute or relative, setting both types seems to be the most preferable from both a business and climate point of view. The time horizons have different purposes and can therefore be set by using different approaches. Short-term targets can use a bottom-up approach while long-term target need to have a top-down, science-based, approach. Mid-term targets can be set by a mixed, iterative approach.

Considering research question 1.d (How should targets be communicated and how should progress be tracked?), some conclusions can be drawn on communication and progress tracking. When targets are communicated it is important to highlight that they are science-based, which supports validity. Having a very clear focus makes it easier for internal and external stakeholders to understand. A part of the communication is to break down targets into business units to ensure understanding of how targets affect them specifically. Using other measures than CO_2e such, as indexes and kWh, can also be beneficial.

When targets have been set they need to anchored in the organization and be connected to action plans. Companies needs to establish a way of tracking the progress towards the targets. The most important part of tracking progress is making sure targets are integrated into the business and that action plans on business unit levels are constructed. Having a separate KPI for GHG emissions is beneficial to spark action, but adding a KPI should not be done if there are already too many. When tracking progress it is finally important for companies to be adaptable to internal and external changes that will need to affect targets and action plans.

Setting science-based targets for supply chain emission is a complex procedure, but following the by this research proposed process it will be somewhat easier. The need for companies to take responsibility for climate change will only increase and more companies will need to follow this path. This research contributes the academia and companies with insights on the process of how to set science-based targets. Hopefully it can also be a small piece of the puzzle of contribute to a better planet.

10. Contributions and further suggestions

This chapter summarizes how the research contributes theory and how this in turn can be used as guidelines for companies that are signing up to set science-based targets. Finally, suggestions for future research will be discussed.

10.1 Contributions to theory

As before mentioned, there is a lack of theory and documentation of practical examples regarding setting science-based targets. This research therefore contributes to theory in many. The three main contributions are highlighted here.

The first contribution is to provide practical examples and insights from four large companies. Since the SBTi is a relatively new initiative there has not yet been that many companies that have set these types of targets. Showcasing practical examples is a contribution to theory because it can help researchers understand the problems and limitations of setting targets and thereby guide future research.

The second large contribution is the proposing a six-step process to follow when setting science-based targets. This can be seen as a first exploratory try of theorizing a process for setting science-based targets in particular. This process can be further developed and validated by future research.

The third main contribution is the Exploratory model which presents the major insights on what to consider in each step of the proposed process. As discussed in section 8.9, the Exploratory model includes some components which have not before been connected to GHG emission targets setting and some that have not be found in existing theory. These new components are a contribution to theory. The research will also generate a deeper knowledge within the specific area of setting science-based targets.

10.2 Contributions to companies

As mentioned earlier, the amount of companies signing up for setting science-based targets is increasing. This means that more companies will be wanting advice and best practices on how to set these targets. At the same time, there exists little research on how this should be done (as mentioned earlier). This implies that this research can be of great use to companies.

This research provides both detailed practical examples and general advice and considerations. Companies can use the proposed process, consider the insights in the Exploratory model and apply specific practices used by IKEA, Husqvarna, Nestlé and Tetra Pak. The research can contribute to each company wanting to set targets by providing best practices and helping to avoid pitfalls. This can in the end lead to targets being set more efficiency and that agreed targets being credible both from a science-based and from an organizational perspective.

This research can help companies to get the courage to sign up to setting SBT, help them to set the targets and help them to achieve the targets. Providing examples and a clear process can make decision makers see how they can set target within their own organization, making it easier for them to sign up. The Exploratory model helps companies to set the actual targets. Each step in the process also prepares the company for actually reaching the targets. The GHG inventory is essential to reach the target since it provides the as-is situation. Modeling can also be a very helpful tool to understand how targets can be reached. The insights on tracking progress can provide companies with ideas on how to incorporate the targets into the organization and reach targets. Since this research can help companies to signing up to SBTi, set targets and reach targets it can ultimately be said that the research helps companies to reduce their impact on climate change.

10.3 Suggestions for future research

This master thesis has researched how to best set supply chain GHG emission targets which is an area where little research has been done before and where few documented practical examples exist. Since this research was performed as an exploratory single case study there is still much room for research within the same area. Further case studies could e.g. aim for theory building.

Each step of the target setting process could beneficially be researched further and in more detail. How to use modeling as a tool for GHG emission target setting seems to be the area where the most research is lacking. The process steps could in general benefit from research on how to apply knowledge within related areas, such as supply chain data availability, internal communication and performance tracking, to the specific situation of setting GHG emission reduction targets.

Since setting science-based targets is a relatively new phenomenon no companies have yet had to adjust or update their targets. This is an area which future research should look into. Companies have not yet reached their targets either. Companies would also benefit from research and innovations which addressing how to reach the targets they set.

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Appendices

Appendix A - Interview guide, Internal stakeholders

Before the interview

1. Determine time and place for the interview
2. Send the overall questions to the interviewee

During the interview

1. Presenting ourselves and the master thesis
    a. Present ourselves
    b. Present our work at IKEA
    c. Present the overall questions we intend to ask
2. Introductory questions
    a. What is your role at IKEA Components?
    b. How would you shortly describe your work in relation to GHG emissions?
    c. What are your views on GHG emission targets?
3. Targets
    a. What targets do you think to be reasonable for your business areas?
        i. On what time horizons?
    b. How would you assess the knowledge about GHG emissions in your business area?
4. Modeling
    a. What would you be interested in getting out of a model?
        i. What scenarios would be relevant for you?
    b. Where do you think the largest possibilities for GHG emission reductions within your business areas lies?
        i. What GHG emissions do you think are the easiest/hardest to affect?
        ii. How do you view the future within your areas?
        iii. What is your business area planning to do to reduce GHG emission within the next few years?
5. Concluding questions
    a. Possible specific business area questions
    b. Anything else that you feel is relevant, that we have missed to ask you?
    c. How may we use this interview in the final master thesis report?

Thank you for taking the time to help us.

6. Is it okay if we reach out to you if we have any follow up questions?
7. Would you like us to send you the report when it is done?

After the interview

1. Send feedback and possible follow up questions by e-mail.

Appendix B - Interview guide, External benchmarking

Before the interview

1. Determine time and place for the interview
2. Send the overall questions to the interviewee

During the interview

1. Presenting ourselves and the master thesis
    a. Present ourselves
    b. Present our work at IKEA
    c. Present the overall questions we intend to ask
2. Introductory questions
    a. What is your role in the company?
    b. What was your role in setting the science-based targets?
    c. Why did you want to set science-based targets?
3. The targets
    a. What was your overall thought on setting your targets?
        i. Absolute and relative targets, why/why not?
    b. How have you broken down the goals into sub targets?
        i. How were time horizons chosen? Why?
        ii. Other sub targets?
    c. How have you broken down the targets within the organization? E.g for different categories?
4. The process
    a. How would you describe your process for determining the targets
        i. Did you use any formal process?
        ii. How did you work with stakeholders?
        iii. What external partners did you work with?
    b. How are you going to work to reach the targets?
    c. What were your most important lessons learned?
        i. What is important when setting goals?
        ii. What were the main challenges with setting goals?

    Data collection
    a. How did you work to establish a baseline?
        i. What did you learn?
        ii. What were the challenges?
    b. How are you working to improve the data availability?

    Scope 3
    a. What were your overall thoughts on setting targets for scope 3?
        i. What was included in the scope and why?
        ii. How did you come up with the main focus areas?
    b. How did you decide on targets for scope 3, why were these targets chosen?
        i. Calculations?
        ii. Stakeholder input?
        iii. Simulation?

iv. Experts?

c. How “hard” do you think it will be to reach the goals?
    i. Where do you think you will be able to have the largest impact?

Models and simulations

a. Did you use any type of models or simulations?
    i. What scenarios were used? Why?
    ii. What assumptions were made? Why?
b. What were your challenges in doing this?
c. How have you benefited from the model after wards?

5. Updating and performance tracking
    a. How are you going to update the goals?
        i. How often?
    b. How will performance be tracked?
    c. What does governance the look like?
        i. Who is responsible for the goals being achieved?
6. Other questions
    a. How did you communicate the goals, internally and externally?
    b. What do you think is a good way of visualizing progress in a good way?
7. Concluding questions
    a. Do you have access to any documentation or similar that you can share with us? We appreciate everything.
    b. Do you have any overall tips/viewpoints to companies that are in the process of setting up their targets?
    c. Any other relevant things that you feel that we have missed to ask about?
    d. How may we use this interview in our report and in our work at IKEA?

Thank you for taking the time to help us.

1. Is it okay if we reach out to you if we have any follow up questions?
2. Would you like us to send you the report when it is done?

After the interview

1. Send feedback and possible follow up questions by e-mail.

Appendix C - Descriptions of the GHG protocol emission categories

Scope	Category	Description	Minimum boundary
1	Company facilities	Production units included in Production emission area, office space excluded	
1	Company vehicles	Not applicable	
2	Purchased electricity, steam, heating and cooling for own use	Production units included, office space excluded	
3	1. Purchased goods and services	• Extraction, production, and transportation of goods and services purchased or acquired by the reporting company in the reporting year, not otherwise included in Categories 2 - 8.	• All upstream (cradle-to-gate) emissions of purchased goods and services
3	2. Capital goods	• Extraction, production, and transportation of capital goods purchased or acquired by the reporting company in the reporting year	• All upstream (cradle-to-gate) emissions of purchased capital goods
3	3. Fuel- and energy-related activities (not included in scope 1 or scope 2)	• Extraction, production, and transportation of fuels and energy purchased or acquired by the reporting company in the reporting year, not already accounted for in scope 1 or scope 2.	

3	4. Upstream transportation and distribution	• Transportation and distribution of products purchased by the reporting company in the reporting year between a company's tier 1 suppliers and its own operations (in vehicles and facilities not owned or controlled by the reporting company) • Transportation and distribution services purchased by the reporting company in the reporting year, including inbound logistics, outbound logistics (e.g., of sold products), and transportation and distribution between a company's own facilities (in vehicles and facilities not owned or controlled by the reporting company)	• The scope 1 and scope 2 emissions of transportation and distribution providers that occur during use of vehicles and facilities (e.g., from energy use) • Optional: The life cycle emissions associated with manufacturing vehicles, facilities, or infrastructure
3	5. Waste generated in operations	• Disposal and treatment of waste generated in the reporting company's operations in the reporting year (in facilities not owned or controlled by the reporting company)	• The scope 1 and scope 2 emissions of waste management suppliers that occur during disposal or treatment • Optional: Emissions from transportation of waste
3	6. Business travel	• Transportation of employees for business-related activities during the reporting year (in vehicles not owned or operated by the reporting company)	• The scope 1 and scope 2 emissions of transportation carriers that occur during use of vehicles (e.g., from energy use) • Optional: The life cycle emissions associated with manufacturing vehicles or infrastructure

3	7. Employee commuting	• Transportation of employees between their homes and their worksites during the reporting year (in vehicles not owned or operated by the reporting company)	• The scope 1 and scope 2 emissions of employees and transportation providers that occur during use of vehicles (e.g., from energy use) • Optional: Emissions from employee teleworking
3	8. Upstream leased assets	• Operation of assets leased by the reporting company (lessee) in the reporting year and not included in scope 1 and scope 2 – reported by lessee	• The scope 1 and scope 2 emissions of lessors that occur during the reporting company's operation of leased assets (e.g., from energy use) • Optional: The life cycle emissions associated with manufacturing or constructing leased assets
3	9. Downstream transportation and distribution	• Transportation and distribution of products sold by the reporting company in the reporting year between the reporting company's operations and the end consumer (if not paid for by the reporting company), including retail and storage (in vehicles and facilities not owned or controlled by the reporting company)	• The scope 1 and scope 2 emissions of transportation providers, distributors, and retailers that occur during use of vehicles and facilities (e.g., from energy use) • Optional: The life cycle emissions associated with manufacturing vehicles, facilities, or infrastructure
3	10. Processing of sold products	• Processing of intermediate products sold in the reporting year by downstream companies (e.g., manufacturers)	• The scope 1 and scope 2 emissions of downstream companies that occur during processing (e.g., from energy use)

3	11. Use of sold products	• End use of goods and services sold by the reporting company in the reporting year	• The direct use-phase emissions of sold products over their expected lifetime (i.e., the scope 1 and scope 2 emissions of end users that occur from the use of: products that directly consume energy (fuels or electricity) during use; fuels and feedstocks; and GHGs and products that contain or form GHGs that are emitted during use) • Optional: The indirect use-phase emissions of sold products over their expected lifetime (i.e., emissions from the use of products that indirectly consume energy (fuels or electricity) during use)
3	12. End-of-life treatment of sold products	• Waste disposal and treatment of products sold by the reporting company (in the reporting year) at the end of their life	• The scope 1 and scope 2 emissions of waste management companies that occur during disposal or treatment of sold products
3	13. Downstream leased assets	• Operation of assets owned by the reporting company (lessor) and leased to other entities in the reporting year, not included in scope 1 and scope 2 – reported by lessor	• The scope 1 and scope 2 emissions of lessees that occur during operation of leased assets (e.g., from energy use). • Optional: The life cycle emissions associated with manufacturing or constructing leased assets

3	14. Franchises	• Operation of franchises in the reporting year, not included in scope 1 and scope 2 – reported by franchisor	• The scope 1 and scope 2 emissions of franchisees that occur during operation of franchises (e.g., from energy use) • Optional: The life cycle emissions associated with manufacturing or constructing franchises
3	15. Investments	• Operation of investments (including equity and debt investments and project finance) in the reporting year, not included in scope 1 or scope 2.	• See the description of category 15 (Investments) in section 5.5 for the required and optional boundaries-