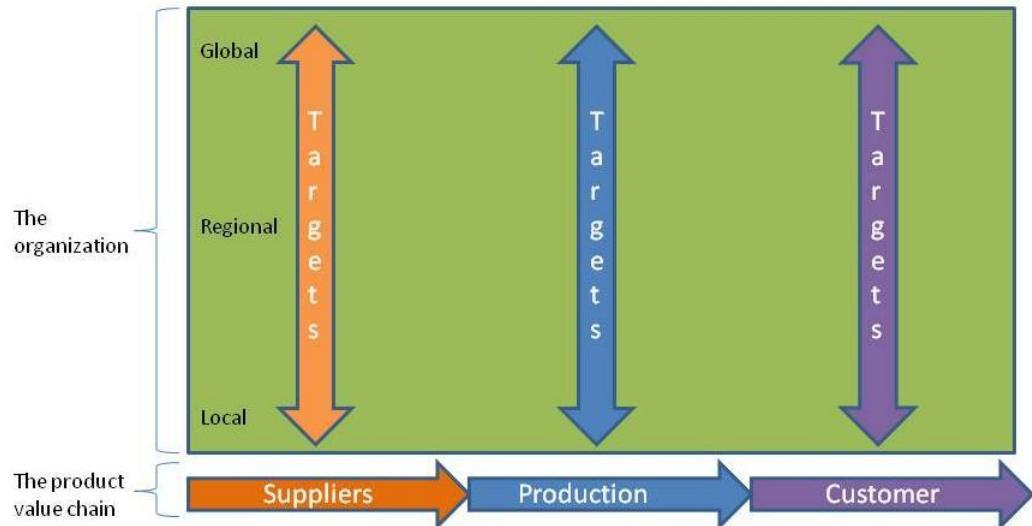


CHALMERS



Implementation of sustainability objectives from a product value chain perspective An organizational mapping and analysis of Eka Chemicals

Master of Science Thesis in the Master Degree Program Industrial Ecology

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CHALMERS UNIVERSITY OF TECHNOLOGY

Gothenburg, Sweden, 2011

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Cover picture: Implementation of sustainability objectives from a product value chain perspective, introduced in section 1.4.3. The ideal implementation process.

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Abstract

The aim of this master thesis study is to map and analyse the sustainability work performed within Eka Chemicals, limited to two targets, the operational eco-efficiency and the carbon policy targets. The study has been performed with qualitative interviews in two groups, the first group of people were closely involved in the sustainability organization, whilst the second group was chosen as a cross-section of business functions connected to the product case study Eka DR.

The result of the mapping showed a sustainability organization consisting of a sustainability focal point, a sustainability network and a sustainability communication and strategy group. The HSE organization was also proven central to the aim of the study since it is within this organization that targets are translated to site level.

The results were analysed based on an analytical framework containing three main methods for reaching a successful implementation of targets and strategies. The main methods are communication, targets and alignment and reward systems. The analysis showed that the awareness of and the loyalty towards the two targets studied was generally high amongst the persons working with sustainability. They are mainly working on a global level of Eka Chemicals or are focused towards the production activity in the product value chain. For persons working on a more regional and local level in the purchasing, marketing and sales departments the awareness was low.

The targets are translated in a structured and well functioning way through the HSE department of the company, which leads to a focus in the production. The result of this is that the purchasing, marketing and sales personnel do not have targets connected to the operational eco-efficiency or carbon policy which were studied in this project. Motivation for working with sustainability is high across the organization, which forms a good foundation for further implementation of sustainability targets.

To conclude, the study shows that Eka Chemicals has got a good foundation for working more with sustainability due to the high internal motivation. The awareness of the targets is not spread across the whole organization, neither is the target setting. The present process for translating targets is structured and well functioning, but is focused on production. More of a life cycle management thinking with communication both within and outside the company could enhance the sustainability work at Eka Chemicals.

Keywords: Sustainability, organization, implementation, product value chain, balanced scorecard, life cycle assessment

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Process RD&I department at Eka Chemicals

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Abbreviations

BU – Business Unit

sBU – sub Business Unit

DJSI – Dow Jones Sustainability Index

EPM – A system used for environmental performance measurement within AkzoNobel

ESCM – Environmental Supply Chain Management

HSE – Health, Safety and Environment

KPI – Key Performance Indicator

LCA – Life Cycle Assessment

LCM – Life Cycle Management

MBO – Management by Objectives

NGO – Non-Governmental Organization

OEE – Operational eco-efficiency

QHSE – Quality, Health, Safety and Environment

RBC – Research, Business development and Communication, a support function within Eka

SCM – Supply Chain Management

T&E – Technology and Engineering, a support function within Eka

WRI – World Resource Institute

WWF – World Wildlife Fund

WBCSD – World Business Council for Sustainable Development

1. Introduction

Sustainability is a rapidly growing field on the corporate agenda and is given an enhanced importance for strategic decisions. At present, there is a paradigm shift from the scenario of business as usual and greening on the side, towards incorporating sustainability into the corporate strategy as well as into the core activities. The aim is to set both short and long-term sustainability goals at all business areas in order to create a competitive advantage. The challenge of today is to transform the often quite ambitious vision and mission of the company to actual actions and improvements. This requires a thorough understanding of the functions and work processes of the organization in order to handle the complexity of issues that need to be addressed.

This report aims to map this transformation of translating strategy into action, to assess to what extent the implementation process has been successful at Eka Chemicals and to detect areas for improvement. The focus area is the interface between the sustainability work performed within the organization and the value chain for the product case study.

1.1 Background

As portrayed in Figure 1, there are several external parties involved in this master thesis. The main parties of the project are the EU programme TOSCA, Chalmers University of Technology and AkzoNobel. A business unit within AkzoNobel, Eka Chemicals, is directly involved in the project as this unit constitutes the case study and also provides a supervisor.

From the point of view of the thesis, TOSCA is the contractor which serves as an indirect bridge between the two departments Environmental System Analysis at Chalmers and the corporate sustainability expert team at AkzoNobel. These two departments are directly involved in the thesis as they both provide the project with a supervisor.

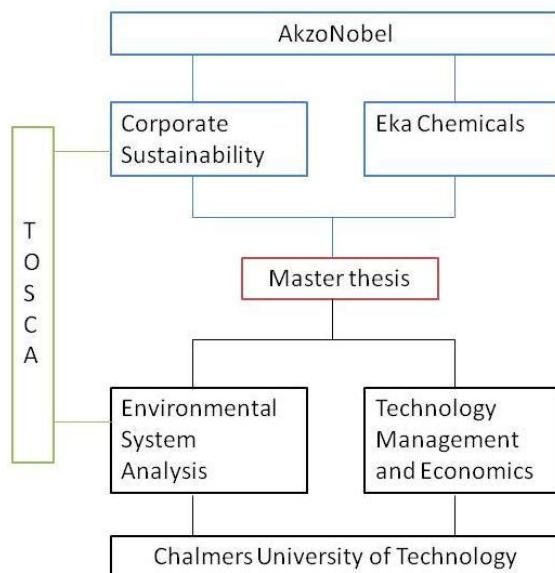


Figure 1: The different parties involved in the master thesis

Since this master thesis is performed by two students at the master programme Industrial ecology within their Master of Science degree of Industrial engineering and management, the aim is to combine these two fields of study into the field of environmental management, as presented in Figure 2.

The topic and case study of this report are elaborated in collaboration with the two supervisors at AkzoNobel and the supervisor at Chalmers University of Technology. Within the field of Industrial Engineering, the balanced scorecard methodology is one of the major instruments presented for performance management. Since the balanced scorecard is used as a performance management tool at AkzoNobel, this methodology was chosen to be the backbone of this report in order to assess the implementation process, from strategy to action.

Life cycle assessment, which was used in a product case study of a paper chemical at Eka Chemicals, is one of the main tools within the field of Industrial Ecology and also the major methodology for environmental assessment used at the corporate sustainability expert team.

The organizational management perspective and the life cycle perspective are in this report combined into a study of the environmental management of product key value chains.

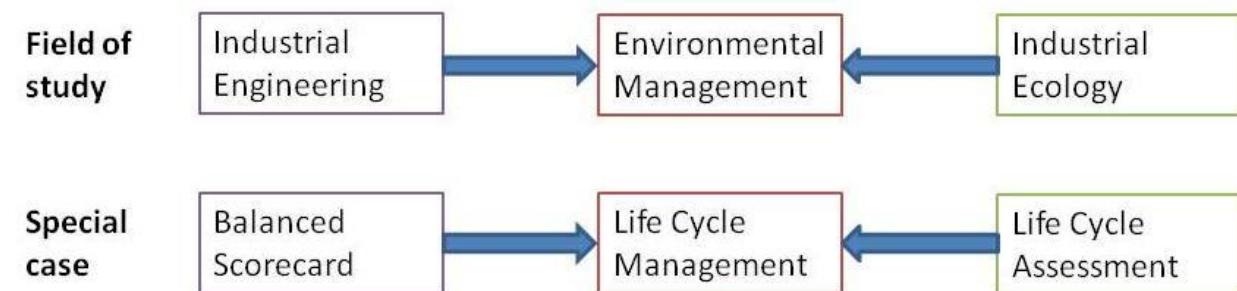


Figure 2: The fields of study and the special cases within these fields that are combined in the master thesis to form Environmental management and Life Cycle Management

1.1.1 AkzoNobel

AkzoNobel is a paint, coatings and specialty chemicals company with head quarters in Amsterdam. In 2009 AkzoNobel had almost 55,000 employees and 13 billion euro in revenue. The company is divided into three business areas, decorative paints, performance coatings and specialty chemicals (1).

Decorative paints produce paints for interior and exterior decorative and protective use, for both the professional and the Do-it-yourself market. Known brands are for example Nordsjö, Dulux and Sikkens. Performance coatings have products aimed at the industrial sector and are divided into the following five sectors, industrial coatings, powder coatings, car refinishes, marine and protective coatings and wood finishes and adhesives. A known brand from the marine and protective coatings is International. Specialty chemicals produce chemicals used in food, disinfectants, plastics, cosmetics and asphalt to name a few. A known brand is Jozo salt. Within Specialty chemicals, the business unit Pulp and paper chemicals is located, also called Eka Chemicals (1).

Eka Chemicals

Eka Chemicals produces bleaching and performance chemicals for the pulp and paper industry. They also offer complete services like on-site production, where the customer can benefit from the experience and competence that Eka possesses (2). Eka Chemicals have around 2700 employees in 19 countries (2). Their vision is to (2):

- *Be the preferred supplier of pulp and paper chemicals globally*
- *Develop related businesses that support and contribute to our overall performance*
- *Grow through innovation and unique know-how*

Elektrokemiska aktiebolaget (EKA) was founded in 1895 by Alfred Nobel. In 1986 the company was acquired by Nobel Industries which later merged with Akzo, to form AkzoNobel in 1994. The head office of Eka Chemicals is located in Gothenburg, Sweden (2).

Sustainability

AkzoNobel strives to, simultaneously and ethically, deliver profitable economic growth, to lower their environmental footprint and to develop the talent of their employees. Sustainability is included in the strategy as well as in the management tools and three focus areas have been selected. These are eco-premium solutions (a program for developing more sustainable products), talent development and carbon management. (3)

To measure and follow up on the development of sustainability, AkzoNobel uses a dashboard of measurable targets. The main strategies are to remain in the top three of the Dow Jones Sustainability Index¹, achieve top quartile safety performance and to deliver a step change in people development. (3)

The long-term ambition is to have by 2015, 30 % eco-premium sales, reduce the cradle-to-gate carbon footprint with 10 percent and to achieve sustainable fresh water use at all AkzoNobel sites. Eco-premium solutions are a way to define sales for more sustainable products within AkzoNobel. As an incentive, the executive bonuses have been connected to the result in the Dow Jones Sustainability Index.

Eka Chemicals has one additional sustainability policy, which is only relevant to the pulp and paper industry. In the policy Eka limits their cooperation to companies that, as a minimum, follow practices, laws and guidelines of the forestry industry in the country where they operate and source fibre raw material from environmentally and socially responsible sources. Eka also encourages internationally recognized certification schemes. (2)

1.1.2 TOSCA

The master thesis will become one part of the TOSCA project. It is a project jointly funded by AkzoNobel, SCA, Chalmers University of Technology and the EU Life+ programme. The purpose of the TOSCA project is to show how companies can work towards a sustainable development in their organization and along the supply chain. In order to accomplish this, both research by Chalmers and examples from the participating companies have been collected (4).

Within the TOSCA project, reports on sustainable development have been published, for example regarding sustainability strategy, assessment tools, data handling and communication. These reports together with experiences from the sustainability work at AkzoNobel and SCA creates the background for an education module presented at www.tosca-life.info.

¹ This target changed during 2011, as to be a leader in sustainability. (Elisabeth Stokes 2011-02-24, conference presentation on Sustainability at AkzoNobel).

1.2 Purpose

The purpose of this study is to analyse how the sustainability objectives in the AkzoNobel corporate dashboard have been implemented at the business unit Eka Chemicals. A life cycle perspective will be included in the analysis, since it is a cornerstone of the sustainability work performed within AkzoNobel. The foundation of the analysis is constituted by the indicators stipulated for two of the corporate targets. The strategy in focus is to be top three on Dow Jones Sustainability Index (DJSI)¹, and specifically within that strategy AkzoNobel will focus on operational eco-efficiency, as will this study. The second target in focus is the AkzoNobel carbon policy which aims at reducing the cradle-to-gate carbon footprint with 10 % by 2015. In order to have a specific case study and a life cycle perspective on the analysis of the corporate dashboard, an addition to an existing LCA study will be conducted for the paper chemical Eka DR.

1.3 Aim

The aim of the study is to deliver tangible results to Eka Chemicals that suggest improvements to their implementation of the operational eco-efficiency and carbon policy targets. Specifically the aim is to:

- map and analyse the sustainability work in Eka Chemicals connected to the operational eco-efficiency and carbon policy targets
- perform an expansion of an already conducted LCA of the paper chemical Eka DR that will be used as a case in the study and by this include a life cycle perspective to the analysis
- locate deficiencies and suggest improvements to the sustainability work

1.4 Problem formulation

The emphasis and starting-point for this study lies in the step from the sustainability objectives in the corporate AkzoNobel dashboard to the developed implementation plans for Eka Chemicals. Subsequently, the step from implementation plan to actual implementation in the organization will be investigated, mainly based on interviews with key persons within the company. The entry is to investigate the questions mentioned below related to the paper chemical Eka DR, where applicable.

1.4.1 Question formulations

In order to map how Eka Chemicals works with implementing the two sustainability targets (stated in the purpose) in their organization, the main questions that will be examined are the following:

- How is the organization built up to support the implementation of the two sustainability targets in Eka Chemicals?
 - What means and incentives are used to transform the implementation plans into action?
- Is the implementation supporting the two sustainability objectives or are there any discrepancies?
 - How well has the implementation succeeded for the Eka DR product?

1.4.2 Problem discussion

According to Rainey, the perspective of the balanced scorecard is the next natural step for the field of environmental management (5). By building balanced objectives into every product, service, process and operation the company will not only be able to exceed compliance but create a sustainable competitive advantage. This will consequently create value for all the internal and external stakeholders. In order to achieve this, the company must expand the magnitude of environmental management from the domains

of operational management and environmental specialists to also include managers and specialists within RD&I, product design, marketing and sales, public relations, supply chain management, accounting and corporate law (5).

With the background of Rainey's argument on balanced scorecard in environmental management, it is crucial to investigate the intention of the corporate dashboard and its impact on all the above mentioned functions at Eka. In addition, according to Kaplan and Norton a dashboard of financial and non-financial indicators is no guarantee for the supply of a balanced scorecard management system (6). Hence, it is important to analyse the context in which the dashboard is used. If the dashboard is used as a part of a balanced scorecard management system, the investigation may be focused on how Eka Chemicals formulates implementation plans according to objectives in the dashboard. But there is also the possibility that the board of management has the intention that the business units should use the balanced scorecard (BSC) as a management system, but that it is not practised in that way by the business unit Eka. Then the analysis may focus on how Eka can make better use of the dashboard, towards the philosophy of the BSC as well as setting up implementation plans. Depending on the use of the dashboard and the balanced scorecard the analysis and result of the study may differ.

A critical fact is that the sustainability part of the dashboard is quite new, introduced in 2008, so it might not yet have "caught on" and the way in which it is to be used might not yet be clear, neither for top management, nor for the practitioners. This is also an issue that must be taken into account when analysing the use of the dashboard.

A problem with investigating organizations and work routines is that it is not an exact knowledge, people's opinions and beliefs play a part in how they answer questions. By using the specific case of Eka DR the aim is to make the questions more concrete and therefore get a snapshot of reality. With Eka DR as an entry point, interviews will be held with employees at different functions at Eka Chemicals, employees which have no specific role in the sustainability work.

1.4.3 The ideal implementation process

During the project the development of an ideal process for implementation of sustainability objectives from a product value chain perspective has evolved. This process is presented in a picture, see Figure 3, and has been used as a foundation for the analysis of the organization.

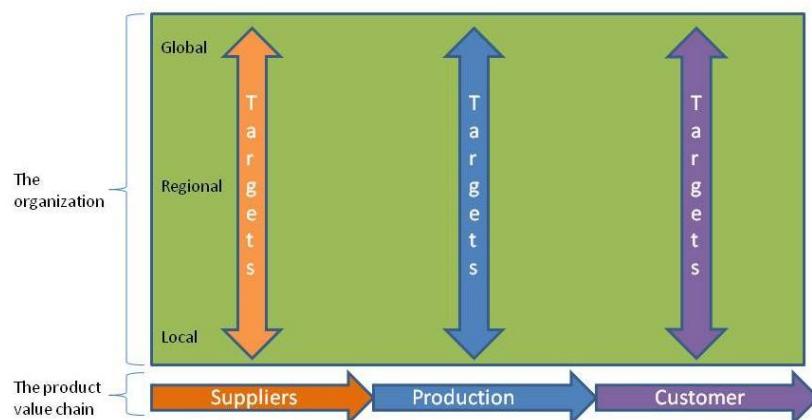


Figure 3: Implementation of sustainability objectives from a product value chain perspective

The picture represents an organization and the essential structure and knowledge that is needed for a successful implementation of the sustainability objectives. At the bottom the different parts of a product

life cycle is represented by three arrows, including the suppliers of raw material, the production of a product and the customers purchasing the final product. The square above represents a company and its personnel working to produce a product, by having purchasing personnel, RD&I and production personnel and sales and marketing personnel. In the organization it is important that personnel at all levels of the company, from global to local, and personnel at all departments of the company are loyal to the sustainability strategies and targets steering the business. This is represented by the green colour of the square. At last the vertical arrows represent that all personnel should have targets connected to the sustainability strategy, to enable that work is being performed at all parts of the company.

1.5 Report outline

In this section the outline of the report will be described to simplify the reading and prepare the reader for the sections that will be presented. The report is divided into 11 chapters and 3 appendixes. Before the first chapter, a list of abbreviations is presented that might be useful during the reading of the report.

Chapter 1 Introduction

In this section the background and main parties in the master thesis is presented together with the aim of the study. During the project work an ideal process describing the implementation of sustainability objectives was developed which is also introduced in the introductory chapter.

Chapter 2 Prior research

In this section prior research within the field of industrial ecology, life cycle assessment, balanced scorecard and life cycle management is presented. The purpose of presenting this research is not mainly to use it as a basis for analysis. It is instead to provide the reader with a background to the field industrial ecology, an understanding of the methodology life cycle assessment and an introduction to the concept life cycle management. Finally Eka Chemicals uses balanced scorecard as its main means of steering the company, hence this background introduces the reader to their business concept.

Chapter 3 Definition of concepts

In this chapter the definition used by the authors for a number of central concepts are explained.

Chapter 4 Method

The method for the main parts of the report is described in this chapter together with a discussion about the reliability and validity of the results. In this section it is also possible to find details on how the interviews were performed and on the limitations of the study.

Chapter 5 Analytical framework

The texts in this chapter have been used as the main foundation for the analysis of the results, the conclusions and recommendations. They are areas important for a successful implementation process and were chosen from the literature about balanced scorecard since that is a strategic performance management system used within Eka Chemicals.

Chapter 6 The current sustainability work

This is the result of the interviews presented as a mapping of the sustainability work at Eka, together with the prerequisites at the corporate level. This mapping is one of the main purposes of the master thesis.

Chapter 7 Selection of areas of interest

After performing the mapping, an analysis was made and from that some areas of interest were selected for a deeper analytical description.

Chapter 8 Analysis

In this chapter the empirical result from chapter 6 is analysed by use of the analytical framework in chapter 5 to enable a deeper understanding of the areas that need further development. In the last sections the authors reconnect to the two targets that have been studied, to see what implications the analysis has had on them.

Chapter 9 Conclusions

The analysis and main point are summarized for the reader to get a clear picture of the conclusions of the master thesis study.

Chapter 10 Recommendations

In this chapter the authors aim at giving Eka and other companies in similar situations recommendations on how to proceed in their work towards fully implemented sustainability strategy and targets.

Chapter 11 Bibliography

All references are presented here.

2. Prior Research

The research fields presented in this chapter constitute the backbone from which the analytical framework for the master thesis has evolved. They also form a background to the understanding of the subject for the thesis and the performance management system used at Eka Chemicals.

2.1 Industrial Ecology

Industrial Ecology is an emerging, yet rapidly-growing, scientific field that examines materials and energy uses and flows in products, processes, industrial sectors and economies. This can be analysed at a local, regional or global level (7). The core of industrial ecology – the industrial ecosystem model – is to transform the use of materials and energy from a linear to a cyclic mode. This conceptual framework has become an approach for studying the interactions of the modern technological society with the environment (8).

Industrial ecology focuses on the role of industrial companies, in order to reduce the environmental impact throughout the whole product life cycle: from the extraction of raw materials, via production, transports and use, to the waste management (7). The focus on industrial companies has two main reasons. The first is that industry is the part of society that is the largest source of environmental damage. The second reason is that industrial ecology views companies as key agents for environmental improvement since they have the technical expertise to accomplish this change (9)

An example of how industrial companies can act together as agents for environmental improvement is the industrial district in Kalundborg, Denmark. The cluster of industrial facilities exchange by-products and wastes so that the output from one factory is the input to the next. This way of closing the flow is the industrial ecosystem model, also called industrial symbiosis (9).

As for the concept of sustainability, it is crucial to have the systems perspective in industrial ecology and understand the interplay between the three pillars, environment, economy and society. Having acquired this mindset, the vast taxonomy of industrial ecology can be understood with concepts such as dematerialization (decoupling of resource use from economic growth) and eco-efficiency (total emissions/total production²).

Since there are many practical implications of Industrial Ecology, several operational tools have emerged, such as Design for Environment, Material Flow Analysis, Technology assessment, Multi Criteria Analysis and Cost Benefit Analysis.

2.1.1 Environmental Management

Environmental Management is a business approach that aims to create long-term stakeholder and shareholder value by finding opportunities and handling risks which are coupled to the three sustainability pillars (also known as the “triple bottom line”) (10), i.e. economic, environmental and social developments. (11)

The scientific field of Environmental Management started to evolve in the mid-1970s when there was a large increase in the number of environmental laws and regulations, (5) to a large extent due to the oil crisis in 1973. In the beginning, the focus was on pollution control and the corporations did not consider going beyond compliance. Environmental Management has since then developed from “a business-as-usual and greening on the side approach” to be considered as a fundamental part of the business strategy. (5)

² The production can be measured in physical mass or in monetary value (Henrikke Baumann 2010-04-29, lecture on Environmental accounting).

Strategic dimensions of environmental management are the factors that influence the economic survival of a company. One implication of a strategic perspective on environmental management could be to integrate environmental considerations and responsibilities in all management functions. (12)

In order to pursue a sustainable development strategy and to find the market's potential for sustainable products and services (11), both considerable investment and a long-term commitment to market development is necessary. (13) It is not very likely that this investment will result in increased short-term profits, but in a future competitive advantage. (13) However, not all investments and efforts have to be of a great magnitude, eg. for pollution prevention there is a great deal of "low-hanging fruit" (14) - easy and inexpensive improvements with a fast result.

A company may need to increase their costs to respond to environmental pressure, but the competitive advantage can be created by forcing the competitors to increase their costs even more. (15) This can be done by forming a group with similar companies within a sector to set private standards or, by setting the regulatory agenda, i.e. lobbying on policy makers to create regulations that favor the company's products.

Many business people perceive the concept of environmental management as a synonym to risk management. Even though this perception has its origin in the business-as-usual scenario, effective risk management can itself be a source of competitive advantage. (15)

2.2 Life Cycle Assessment

Life cycle assessment (LCA) is a methodology for determining and analysing the environmental impact of products and services. An LCA study follows the product, or service, through its life cycle. The origin is the raw material extraction, often referred to as "the cradle". The study then investigates the environmental impacts of the production and the customer use phases of the product. Finally, the waste management process and disposal phases are examined, also denoted as "the grave" in the LCA terminology. (16)

As portrayed in Figure 4, the use of resources and emissions are quantified for the product under evaluation. It is a complex procedure since the whole industrial system involved in the life cycle of the product is accounted for. Therefore, a methodology has been elaborated in order to handle, but also to standardise, the comprehensive study of the environmental impact of a certain product. The main steps of the LCA procedure are shown in Figure 5. (16)

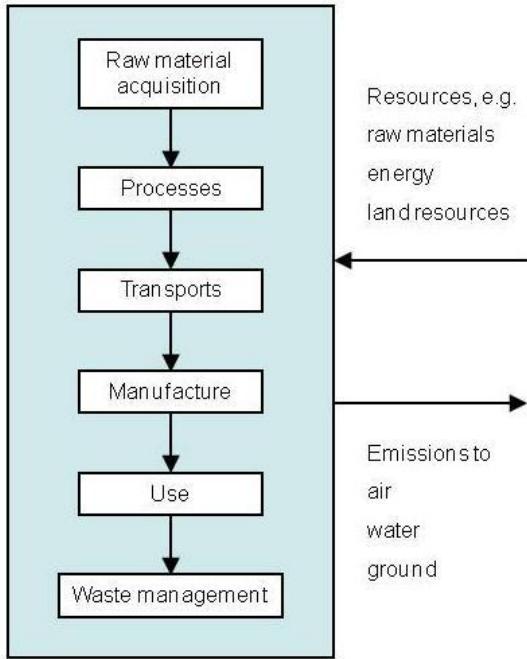


Figure 4: The life cycle of a product. The boxes represent physical processes and the arrows are flows of energy and matter. (16)

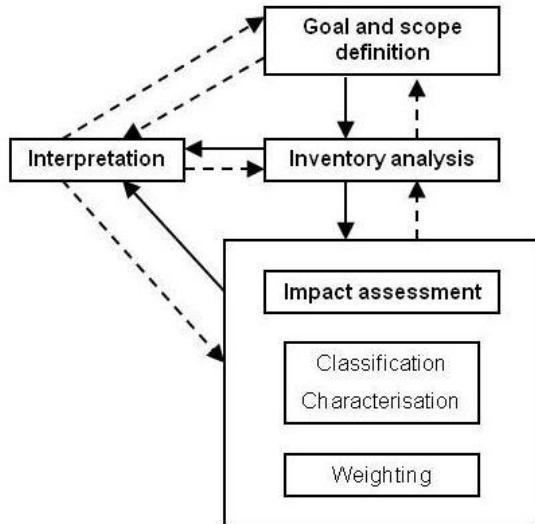


Figure 5: The LCA procedure. The boxes are methodological steps and the arrows represent the order of these steps. Dotted arrows indicate possible pathways. (16)

In the goal and scope definition, the product in focus is presented along with the aim of the study. In this first step, the functional unit – the environmental impact related to the function of the product - is decided on along with the system boundaries, i.e. the scope of the study. (16)

Second, the construction of the life cycle model - a flowchart of the activities and the flows between them - is made in the inventory analysis phase. It is in this phase that the extensive calculations are carried out, of the resources used as well as of the pollutant emissions that are produced during the life cycle. The result of these calculations is a mass and energy balance for the product. The balance is somewhat incomplete since it is only the environmentally relevant flows that are included in the system. In order to carry out the calculations, a thorough, and often time consuming, data collection must precede the computation work. (16)

The third and final phase is the impact assessment, the purpose of which is to describe the environmental impact of the activities in the system. The aim is to aggregate the information from the comprehensive inventory analysis in a few parameters that provide environmentally relevant information. Within the impact assessment phase there are three steps: classification, characterization and weighting. (16)

The first step, classification, is to sort the inventory results into the class of environmental impact to which they contribute, eg. CO₂ and CH₄ both contribute to the class Global warming potential (GWP). The classification is followed by the characterization step where the inventory results within each class are calculated in order to determine the relative contribution to each type of environmental impact. The calculations in the characterisation step can be aggregated even further in the last step, weighting, to produce a one-dimensional index. There are many different weighting methods, but they all have in common that even though they are based on natural science, human values and preferences are always

added. Weighting is an optional step in LCA while classification and characterization are mandatory steps (according to the standard ISO 14042). (16)

There is a number of international standards for LCA, ISO 14040 – 14043, that states the following application: identification of improvement possibilities, decision making, choice of environmental performance indicators (EPIs) and market claims. (16)

LCA is one of many environmental assessment tools for products. The advantage of LCA is that the whole product system is studied and sub-optimization is thus avoided. This is a prerequisite for achieving the main application and purpose of LCA, i.e. to identify improvement possibilities for changes that favour the environment. (16)

2.3 Balanced Scorecard

The balanced scorecard translates the mission and strategy of a company or organization into targets and measures. These are ideally organized into four different perspectives: financial, customer, internal business processes and learning and growth. (17) However, the balanced scorecard should not be used as a traditional measurement and control system, but as a communication and learning system. (6)

Robert Kaplan and David Norton presented the concept of their strategic performance management tool Balanced Scorecard, in the *Harvard Business Review* in 1992. The new method originated from a shift within the business world concerning short term financial goals and control. In order to stay in business, the executives of a company had to start thinking beyond profits and return on investment. However, developing the capabilities for long-term viability will not produce profits the current year, only costs. To accomplish these long-term goals in the day-to-day operations is the fundamental reason why companies require a balanced scorecard. (18)

A major problem with the former strictly financial performance methods is that they can only provide information about how the company performed yesterday but neither what is happening at present nor what will take place in the future. Many industries are today characterized by rapid technological changes and in order not to lose market shares, the companies must be able to predict the customers' future needs. The balanced scorecard allows the board of management to measure what is happening in the company and to look ahead in a better way. (19) The use of a balanced scorecard may be referred to as an alternation of path from financial control to strategic control. (18)

The intention with the balanced scorecard, to link short-term operational control to the long-term strategy of the business, is focused on a few critical key ratios in selected target areas. In this way, the company is forced to govern and monitor the daily operations as they have an impact on the development of tomorrow. The balanced scorecard method is therefore based on three dimensions in time: yesterday, today and tomorrow, as presented in Figure 6. (18)

At first glance, the diversity of measures on a Balanced Scorecard might seem somewhat confusing, but properly constructed scorecards fulfill a unity of purpose since all the measures are chosen to achieve the integrated strategy. (18)

2.3.1 The different perspectives

The scorecard is balanced in the sense that the four perspectives aim to provide a complete description about the business, see Figure 6. (20)

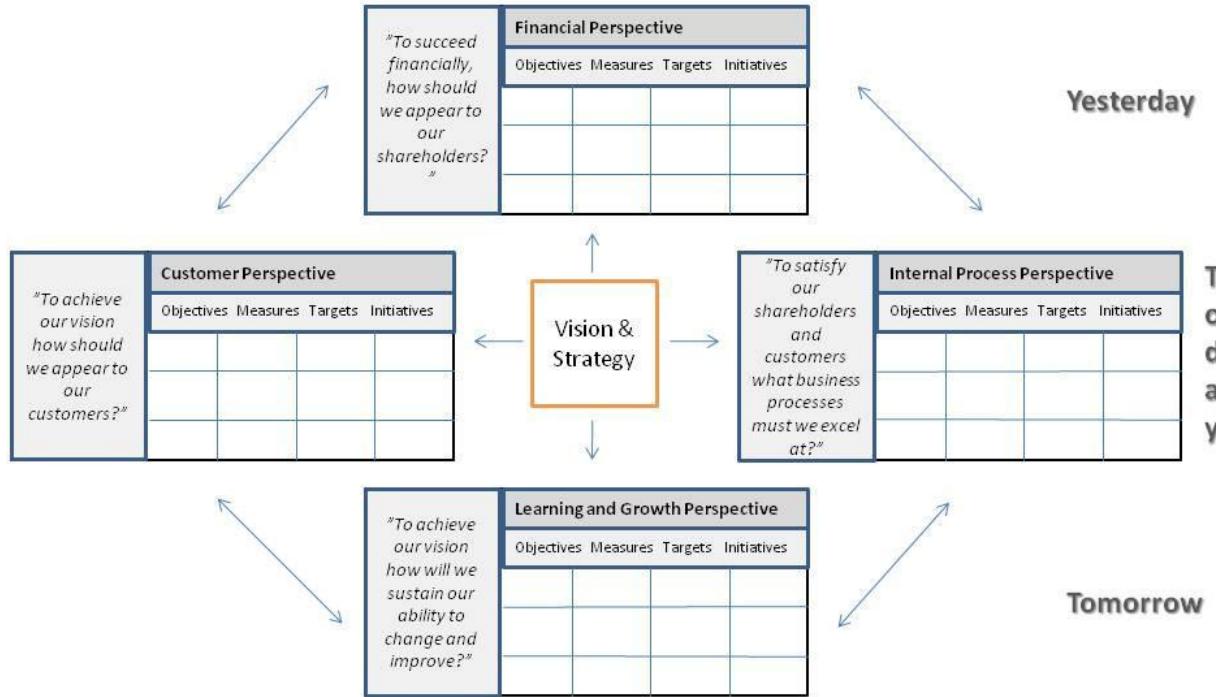


Figure 6: The balanced scorecard. (18)

Financial perspective: The first perspective, the financial, is built on the traditional way of evaluating a company based on its profitability. The financial measures are important for summarizing the economic consequences of actions already taken, as they reveal to what extent the company's strategy and implementation are contributing to actual improvement. (6) This perspective shows the results of the strategic actions taken in the other perspectives and it also establishes several of the long term goals. (18)

Customer perspective: The second perspective, that of the customer, depicts the present state with the customer in the center and the customer's perception of the company. In this perspective, the customer and market segments for main competition are identified and adequate measures are chosen for the performance in the targeted areas of the business unit. The key measures include customer satisfaction, customer retention, new customer acquisition, customer profitability and market share in the targeted areas. The segment-specific drivers represent those factors that are critical for customers to switch or to remain loyal to their suppliers. (6)

Internal business process perspective: The third perspective, the internal business process, also depicts the present state and focuses on internal routines and processes. In this perspective, the critical internal processes, where the organization must perform well, are identified and measures are developed accordingly. The measures focus on the internal process that will have the largest impact on customer satisfaction and will reach the company's financial goals. The BSC method differs from traditional methods in the respect that instead of trying to monitor and improve existing processes, the scorecard approach aims to identify totally new processes in order to meet the financial and customer objectives in a better way. (6)

Learning and growth perspective: The fourth perspective, learning and growth, looks into the future and focuses on how the company should develop and improve in order to continue to exist and grow. Companies are usually not able to accomplish their long-term targets for customers and internal processes by using today's technologies, capacities and competences. In addition, the increasing globalization drives continuous improvements of companies' capabilities to deliver value to the stakeholders, particularly to the customers and shareholders. (6)

When constructing the balanced scorecard, there are some important issues to take into account. The main ones are: (18)

- How to organize the work, particularly the process of translating the goals into action, i.e. breaking down the objectives of the scorecard throughout the organization. How far down should the scorecard go, all the way to the individual level?
- Deciding on which perspectives to include. It is usually enough with the four standard perspectives, but each organization is free to elaborate their own scorecard.
- What the measures really measure, which ones to select, how many, are all measures used for setting goals and who decides on these questions. The measures should be chosen so that the persons who are concerned by them are aware that the measures are directed to them.
- What kind of balance to be emphasized, eg. balance between different time frames.

2.3.2 The means to make the balanced scorecard a success

Just putting together a number of key measures into four squares does not make a scorecard. In order to function, the scorecard must acquire widespread anchoring and support. Managers must be able to handle the difficult trade-offs they will encounter due to resource constraints and employees must accept the scorecard as a relevant management tool. (18)

The balanced scorecard method is useful at different levels within an organization as it is an iterative process between strategy development, management control, IT systems and continuous improvement and learning, see Figure 7. Scorecards promote communication within the company and thereby increase the company's capability to adapt to its surroundings and testing new ideas. (18)

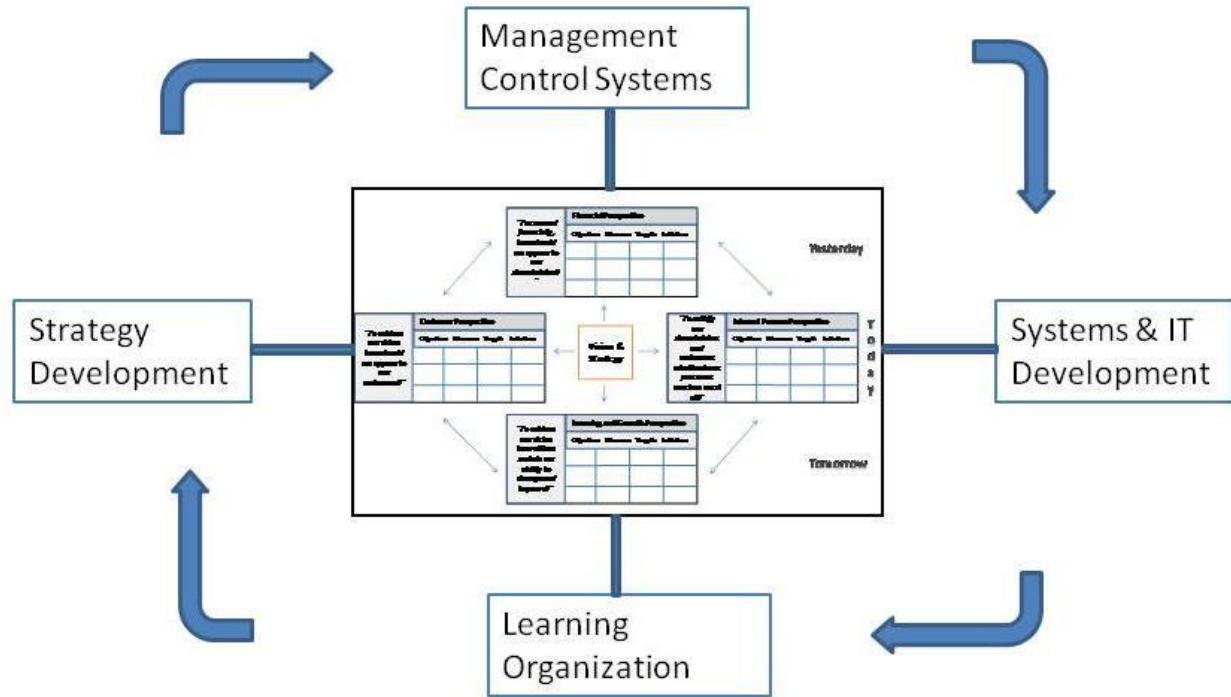


Figure 7: The balanced scorecard process (18)

The alignment of an organization to a shared vision and common direction is a comprehensive and complex process. Large organizations use several interrelated mechanisms to translate the strategy and the balanced scorecard into local objectives and measures that will direct the priorities of individuals and teams. Usually, three distinct methods are used for the implementation of the balanced scorecard: (6)

1. Communication and education programs
2. Goal-setting programs
3. Reward system linkage

These methods are described in-depth in chapter 5, Analytical framework.

When implementing and using the balanced scorecard methodology, there are many difficulties and challenges that the organization will encounter. The key to make the balanced scorecard a success is to make use of the flexibility that is inherent in its method and to adjust the scorecard to the unique situation. (20)

2.3.3 Balanced scorecard and environmental management

As presented in section 1.4.2 Problem discussion, the perspective of the Balanced Scorecard is the next natural step for the field of environmental management. By building balanced objectives into every product, service, process and operation, the company will not only be able to exceed compliance but also to create a sustainable competitive advantage. This will consequently create value for all the internal and external stakeholders. In order to achieve this, the company must expand the magnitude of environmental management from the domains of operational management and environmental specialists to also include managers and specialists within RD&I, product design, marketing and sales, public relations, supply chain management, accounting and corporate law. (5)

2.4 The life cycle perspective

In order to reach a sustainable product value chain, a prerequisite is to perform environmental management of the product chain with a Life cycle approach. For describing this work, there is a vast variety of concepts, definitions and methodologies. Theoretic literature research in the field concludes that the predominant notions are: Life Cycle Thinking (LCT), Life Cycle Management (LCM), Environmental Supply Chain Management (ESCM) and Green supply chains. (16)

Life Cycle Thinking is a mindset, an intellectual methodology used for improving technologies, processes and products. It is a way of thinking that consists of cradle-to-grave evaluation (5) without going into the details of an LCA study (16). The methodology includes analysis of the operations of upstream and downstream entities, from the viewpoint of the own company, and considers the following five steps: (5)

- 1 - Raw material acquisition and distribution through the supply network
- 2 - Materials handling: processing, fabrication and assembly
- 3 - Distribution
- 4 - Sale, use and service of the product
- 5 - Disposal and recycling

The purpose of the use of LCT is to achieve a reduction of the environmental impact and to simultaneously improve profitability as well as social dimensions. To be successful requires thorough analyses of product specifications and calculations on the most beneficial prioritization between economic, technical and environmental aspects. (5)

The business approach Life Cycle Management (LCM) operates within the framework of LCT as it applies the ideas of LCT into practice. As the concept LCM implies, it is management and organization of the environmental work along the whole life cycle instead of just focusing on the own company. (16) LCM is used for corporate decision making processes that comprise environmental consequences at any point of the product value chain. (21) The method can be used for both large and small companies as long as they are aiming for continuous improvement by reducing their ecological footprint while maximizing the socio-economic values. (22)

The environmental supply chain management approach originates from the field of supply chain management which in turn originates from a combination of logistics, marketing, operations management and purchasing management. The purpose of supply chain management (SCM) is to improve consumer value by increasing the effectiveness as well as the efficiency of the operations within the supply chain as a whole. To achieve this, work needs to be done with eg. the cost of purchasing, inbound and outbound delivery service, quality management, process and product innovation and risk management. This requires an extensive cooperation between the different entities in the supply chain and this is the idea of SCM, that companies can no longer compete as separate islands but supply chains compete against supply chains. (21)

Environmental supply chain management basically consists of the same type of questions, actions and relationships but they are always in relation to the environment as to minimize the impact on the natural eco systems. The issues for improvement address the whole life-cycle of a product or service with regard to design, acquisition, production, distribution, use, re-use and disposal of the company's goods and services. The aim is to convert the knowledge and understanding of the complex of problems and its

management into changed behaviour and practices. This integration of strategic thoughts and operational processes is the implementation phase which can be carried out through eg. employee training. (21)

However, even though the tools that are connected to environmental supply chain management, like extended producer responsibility, product stewardship and life-cycle assessments are not very new, their implementation have been insufficient. The challenge is therefore to adopt and develop these approaches and accept the responsibility of the life of a product as a whole. (23) The environmental supply chain management toolbox also comprises monitoring, summarizing and reporting of environmental information about the progress and actions taken to the different stakeholders of the company. The documentation of this information is mainly focused on supplier performance, audits, design, waste minimization, training, reporting to top management and goal setting. (21)

Since the definition of green supply chain management is very similar to environmental supply chain management, the former concept will not be further deployed in this text. They are both synonyms to the greening of the supply chain, i.e. green purchasing, green manufacturing and materials management, green distribution and marketing plus reverse logistics. (23)

However, even though all the four notions Life cycle thinking, Life cycle management, Environmental supply chain management and Green supply chains are related to the environmental management of the product value chain the concept LCM will hereafter be used since this terminology relates the most to the product case study of this thesis. LCT and LCM have a stronger product value chain focus whereas the approach of ESCM and GrSCM is the corporate value chain. Due to the fact that the thesis analyses the implementation process of sustainability and LCM is the practical implication of LCT, LCM seems to be the appropriate term.

By having a life cycle thinking of its products a company may gain competitive advantages, or rather competitive pre-emption, which means securing an advantage in advance. This can be done by gaining limited access to a resource, like a raw material or resource or by establishing rules, regulations or standards that are formulated to fit the company's capabilities. By doing so, barriers are created for other companies to enter or grow on the market. (13) For example cost may be raised for company's competitors, when trying to reach the environmental performance set in the standard. (15)

The market for more sustainable products is seldom lucrative in the beginning. (13) Managers need to contemplate if it is positive or negative if competitors follow their lead on sustainable products and business. There are two options, first if the customers are willing to pay for the more sustainable products and business principles, the company should refrain its competitors from imitating the behaviour. Second if customers are not willing to pay a premium price, the company's strategy may include forcing its competitors investing the same amount or more to reach the same level of environmental performance. (15)

Including the competitive advantages, Emmet and Sood suggests a number of benefits from working with life cycle management, here summarized in five bullet points.

- Competitive advantage – Managers may improve their decision making, by using the more holistic information flows that LCM generates leading to superior strategic decisions.
- Cost reduction - Achieving better cost efficiency by innovative thinking and better communication with partners outside the company which may lead to for example improved product development.
- Innovative thinking – By inducing a new way of thinking and supplying new type of information, innovative thinking leading to improved products/services and value which can generate entrance in new markets and new business opportunities.
- Improved workplace culture by attracting and retaining employees
- Better risk management (24)

3. Definition of concepts

In this chapter the definitions used in the report for different concepts and an explanation of other central concepts are presented.

3.1 Sustainability

Sustainable development can be defined in many ways, however the most common definition is from the Brundtland Report: (25)

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs"

All definitions of sustainable development are rooted in systems thinking. (26) There are three systems that should strive for being sustainable simultaneously: the economic, the social and the environmental system. This system perspective is called the three pillars of sustainability. (27)

The concept of sustainability usually means that all human and business activities that use natural resources are carried out at rates that are equal to or less than the Earth's natural carrying to renew these resources. (5)

3.2 Health, Safety and Environment

Health, Safety and Environment is a new kind of corporate professionals that are assigned the responsibility of handling both occupational safety issues and environmental policies within organizations. This emerged in the 1980s when the process started of joining health and safety departments, environmental compliance personnel and the technical expertise that handles pollution control and waste management. (28)

The concern for the health and safety of industrial workers has a long history; the first regulations were published already in the late 19th century. As the industrial care for the environment has a much shorter record, the legal framework is not yet as established for environmental legislation as it is for health and safety. During the last couple of decades, health and safety management and environmental management have shared more and more common ground in the legal framework and international industry standards. (29)

For example, there are the World Bank Group Environmental, Health, and Safety Guidelines (known as the "EHS Guidelines") which are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). (30)

In the chemical industry, HSE generally refers to all programs intended to protect the environment, employees and third parties from any harm in case of an accident or a disturbed condition at a facility processing, handling or storing hazardous chemicals. These HSE programs include occupational safety, industrial hygiene and all the environmental protection programs. (31)

3.3 Carbon footprint

The carbon footprint is an approach to map and assess the total amount of greenhouse gas emissions that are directly and indirectly caused by an activity or that are accumulated over the life stages of a product. (32)

The carbon footprint has become a widely used concept in the public debate, as well as in the business world, on responsibility and abatement action to reduce the human impact on the global climate change. The term carbon footprint is rooted in the language of Ecological Footprinting and the common baseline is

that the carbon footprint stands for a certain amount of gaseous emissions that are relevant to climate change and associated with human production or consumption activities. However, there is no consensus on how to measure or quantify a carbon footprint. The spectrum of definitions ranges from direct CO₂ emissions to full life-cycle greenhouse gas emissions and not even the units of measurement are clear.

Nevertheless, even though the system boundaries may vary, there is an emerging general agreement to define the carbon footprint as a generic synonym for emissions of carbon dioxide and other greenhouse gases expressed in CO₂-equivalents. This is also the valid definition for AkzoNobel and this report; see section 6.2.2 for the definition of system boundaries in the carbon policy. (33)

3.4 Dow Jones Sustainability Indexes

The Dow Jones Sustainability Indexes, DJSI, are an international ranking of the leading sustainability-driven companies. The DJSI were launched in 1999 and since then, specific weighting criteria have been developed for each industry sector. (34) The benchmark is performed by the Swiss investment group SAM (35) and they make the assessments for the three corporate sustainability areas: the economic, environmental and social dimensions. In the environmental dimension, the factors for concern are Environmental Management System, Environmental performance, Climate strategy, Product stewardship and Biodiversity. (34)

The purpose of the DJSI is to provide asset managers with reliable and objective benchmarks to manage sustainability portfolios. At present, more than 70 DJSI licensees are held by asset managers in 19 countries. These licensees manage, in total, over 8 billion USD based on the DJSI. (34)

3.5 Eco-efficiency

The concept eco-efficiency was coined by the World Business Council for Sustainable Development (WBCSD) in 1992. It is based on the idea of creating more goods and services while using fewer resources and thereby creating less waste and pollution. The notion eco-efficiency is a quota of total emissions divided by total production.

The 1992 Earth Summit approved eco-efficiency as a way for companies to implement Agenda 21 in the private sector, and the term has now become synonymous to a management approach directed towards sustainability. (26)

4. Method

The work process is focused on achieving the aims, stated in section 1.3 Aim, and the research questions are used as a complement to help understand and break down the aim. There is no known problem presented by Eka Chemicals, hence the main focus is put on mapping the organization and investigating if there are any areas for improvement.

To limit the study two targets are chosen amongst the sustainability targets used within AkzoNobel and therefore also applied within Eka Chemicals. The targets selected are the operational eco-efficiency and carbon policy targets. More information about them is presented in section 6.2 The sustainability targets.

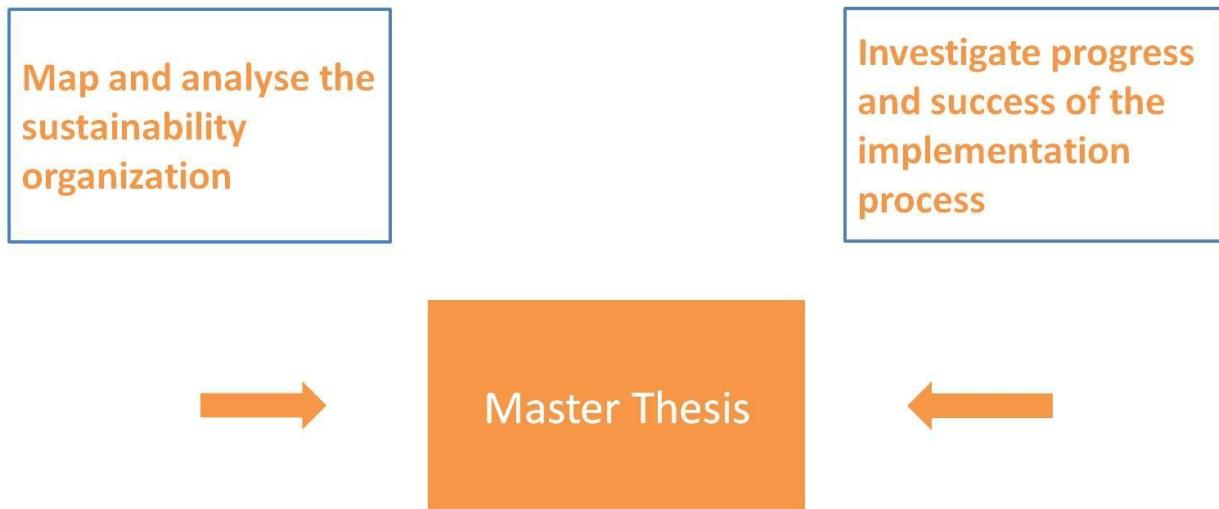


Figure 8: The two-folded method of the master thesis study.

The approach of the study is two-folded as shown in Figure 8. First the mapping and analysis of the sustainability organization and secondly the investigation of how well the implementation process succeeded. The first part is answered mainly in the empiric description of Eka's organization and work processes surrounding the two targets studied. The second part, concerning the actual progress of the implementation of the targets, is answered mainly in the analysis where conclusions are drawn about the success of the implementation of the two sustainability targets and areas for improvement. To make the study more concrete a case study of one specific Eka product, Eka DR, was used.

When the purpose and goals of the master thesis was stated and the planning of the project finalized, the work with achieving the goals of the master thesis started. The master thesis is constituted of 6 main actions that lead to results in three steps. In Figure 9 the process of the master thesis project is presented, the actions are numbered 1-6 and the results a-c.

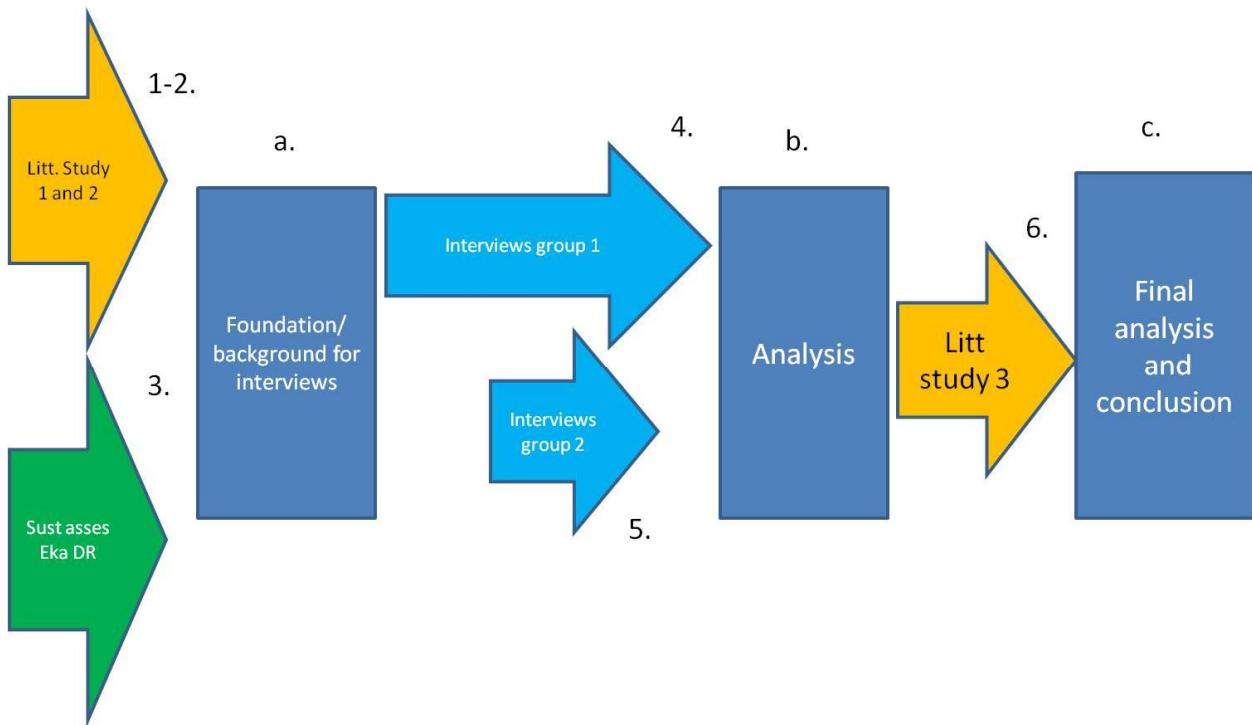


Figure 9: The work process of the master thesis project

Two parts were started simultaneously to increase the efficiency of the work process.

1-2. Number 1-2 represents the first two steps of the literature study which is performed in the early phase of the master thesis project.

3. Number 3 in Figure 9 represents the sustainability assessment of raw materials for Eka DR. This was performed as a Life Cycle Assessment and qualitative assessment of social aspects of three raw materials feasible for use in the Eka DR production.

a. Literature study step 1 and 2 led to that knowledge was acquired about the balanced scorecard methodology and a framework for implementation including theory about, communication, targets and alignment and reward systems and motivation. These areas were used when formulating the template for questions used in the interviews.

The product Eka DR was used as a case study in the master thesis project, by performing the Life cycle assessment and sustainability assessment. A good understanding of the product and the conditions surrounding the products was acquired.

4. Interviews were performed to map the organization and locate areas of improvement.

5. A second group of interviews were performed in a semi structured way. They were aimed at a cross-section of business functions surrounding the product Eka DR. The purpose of the interviews was to investigate the progress and success of the implementation of the two selected sustainability targets in the organization surrounding the Eka DR product case study.

- b. After performing the interviews, an analysis was made based on the empiric material and the theoretical studies made in literature study 1 and 2. After performing this analysis it was decided that a third step of the literature study would be performed. The purpose of this was to add literature about the barriers to implementation and also include a section about life cycle management, since this is included in one of the selected targets, the carbon policy.
6. A third part of the literature study was performed to find more theories that would support the analysis, conclusions and recommendations.
- c. Finally the empirical material was analysed with the help of the theories found in the three steps literature study and conclusions were drawn about areas for improvement of the Eka sustainability work processes.

4.1 Literature study

The literature study is performed in three main steps.

Search one, in Figure 9, is the initial search which forms the first introduction to the literature and help form ideas for what literature to use.

Examples of search words in search 1: Environmental management, implementation, environmental strategy.

After getting the information that AkzoNobel use the balanced scorecard approach, the focus shifts towards focusing on balanced scorecard literature and the implementation of balanced scorecard methodology. With this focus, relevant literature about implementation was located and three areas were chosen as a foundation for the interviews. The three areas are communication, targets and alignment and reward systems and motivation.

Examples of search word in search 2: Balanced scorecard, communication.

After performing the interviews it is apparent that more literature is needed on two specific fields of interest. It is barriers to implementation and Life Cycle management. This literature was added in the final parts of the work process to support the findings made in the interviews.

Examples of search words in search 3: Life cycle management, environmental supply chain management, life cycle thinking, barriers to implementation.

The literature searches have mainly been done at the Chalmers library and at the University of Gothenburg library. Advice and tips on literature has also been received from the supervisor at Chalmers.

4.2 The sustainability assessment of raw materials of EKA DR

A life cycle and sustainability assessment was performed for one product within the Eka product portfolio. A life cycle assessment (LCA) was performed according to standard LCA-methodology, for example described in Baumann and Tillman (16), to increase the understanding of the product and its environmental performance. The study formed a background to the semi structured interviews performed around the Eka DR series product which served as a case study about the progress and success of the implementation process.

4.3 Empiric studies

The empiric study is constituted of interviews with 17 persons at Eka Chemicals. 16 of the interviews are divided into two groups depending on the purpose of the interview, see Figure 10, and one additional interview was made to validate information.



Figure 10: The two-folded aim of the master thesis study and the interview groups corresponding with the two perspectives.

Group 1 is interviewed to map the sustainability organization and understand how Eka Chemicals has been working with implementing their sustainability strategies. This group is constituted of personnel closely involved in the sustainability work, for example the sustainability focal points and parts of the sustainability network, the director of technology and engineering and key persons in different business functions such as communications and marketing. Within this group the international perspective is also included.

Group 2 is interviewed to investigate how well the implementation of the two targets has succeeded in the organization. A cross-section of different business functions are chosen to cover a wide variety of personnel working with the Eka DR series in different areas of Eka. By doing so it is possible to investigate how well the information about the targets is spread and if the targets are translated to all levels of the company.

4.3.1 Sample

In the master thesis study the selection of interviews has been made strategically. A strategic selection is based on following principles: (36)

- Select a number of variables or characteristics that has a theoretical significance
- Then select respondents matching the variables selected

For the two groups of interviews the following characteristics were chosen, presented in Table 1 and Table 2.

Group 1, total 11 persons

Focus area	Sustainability	Sustainability	HSE	HSE	HSE
Representatives of all organizational levels and work groups	Sustainability network	Communication/strategy work group	BU	sBU	Site
Persons	Yes	Yes	Yes	Yes	Yes

Table 1: Characteristics for selection of respondents

One additional person was added to the selection of respondents at a late stage of the study and that was a manager from the purchasing department. This addition was made based on the fact that information was missing from that department, since they were not involved in the appointed groups or organizational structures.

Group 2, total 5 persons

Product	Eka DR	Eka DR	Eka DR	Eka DR	Eka DR	Eka DR
Department	Purchasing	Process RD&I	Product RD&I	Production	Marketing	Sales
Persons	Yes	Yes	No*	Yes	Yes	Yes

Table 2: Characteristics for selection of respondents. * It was not relevant to interview a person from the product RD&I department.

The purpose of using a strategic selection method is to get adequate variance of respondents to the interviews, but still interview relevant persons for the topic. Often when searching for respondents within an organization, a so called “gate-keeper” is used as a tool to find the right kind of people. The risk with this is that the “gate-keeper” will locate respondents not only according to the specified categories, but also people that are “interesting”, “has an opinion” and “is knowledgeable”. It is also important to remember that respondents to a qualitative assessment selected by a strategic selection in no way is representative from a statistical standpoint, hence it is not relevant to discuss how many of them that has shown a particular pattern or any similar information of statistical type. (36)

4.3.2 Unstructured interviews

An unstructured interview leaves the responsibility of the structure to the respondent instead of letting the interviewer set a structure. An unstructured interview have several different uses, but the purpose for the unstructured interviews in this master thesis study was to look for problems and areas of interest to investigate further in a later and more structured investigating method. The prerequisite of an unstructured interview is that the researcher does not know what information or problem is available and therefore does not know how to investigate this (37). This matches the situation in the master thesis since Eka did not have any formulated problem. The first task was consequently to map the sustainability organization and its work with the two selected sustainability targets. After the mapping it was possible to perform more structured interviews and analysis.

The Group 1 interviews were performed according to a template with set questions that can be found in Appendix III Template for unstructured interviews. The template was adapted to each role or function in the company, hence the questions differs depending on role or function. If several persons with the same role were interviewed they were given the same questions, but this was only the case with three persons. The purpose of these interviews was to map the organization and what work was performed on

sustainability and therefore it was not suitable to limit the interviews by using a more structured interviewing format.

4.3.3 Semi-structured interviews

The semi-structured interview is a flexible type of interview that has the possibility to deliver good quality data if performed in the right way. In a typical semi-structured interview the same questions are given to all respondents of the survey and approximately the same amount of time is planned. The questions should be well prepared and preferably tested in a pilot study to enable further development of the questionnaire. Attendant questions are used to ensure that the same issues are covered for all respondents. (37)

A semi-structured interview may also contain some unstructured elements, like open questions or probe questions. In open questions the interviewer is not looking for a specific type of answer, but for example the respondent's opinion about an issue. Probe questions are used if the interviewer senses that there is more information to be found and want the respondent to further develop his story. (37)

When preparing the questions, decisions have to be made regarding if the focus should be wide and cover a range of issues or if the focus should be on only one issue. Each question should be developed to cover a specific issue, with the goal that the respondent does not feel that he or she has already answered that question earlier during the interview. As a complement to each question some main points may be listed to ensure that they are handled in the interview. A way to develop main points is by doing a pilot study. (37)

For the interviews performed with the persons working with Eka DR, Group 2, semi-structured interviews were used. One questionnaire is developed and used during all interviews and the time is set to approximately 1,5 hour. The questions were a mixture of open and structured questions, since the purpose is to investigate facts as well as their attitudes towards specific issues. The interview is not focused at a specific area, but is wide to cover all aspects of the analysis. The questionnaire is to be found in Appendix II. Unfortunately a formal pilot study was not performed, due to lack of time. Since the interviews were few it was estimated that the pilot study would be too time consuming in comparison to the amount of interviews totally performed.

4.4 Analysis

The analysis was performed alongside the interviews as more information was revealed. After performing all interviews but one, which was added at a later stage to confirm the picture from the analysis, a thorough review of all the interviews was performed and the analysis was discussed between the two authors of this report and relevant supervisors of the thesis. When doing this review it was apparent that more literature and some complementing interviews were needed which were added in a later step of the work processes.

4.5 Reliability and validity

High reliability demands a very standardized situation, which is not the case with qualitative interviews where for example the mood of the respondent and the situation differs. The most important part of qualitative assessments is to show that it is credible. The aim is to discuss the four different components of the concept reliability, as one part of the credibility discussion, to examine the analysis from this perspective. (36)

- Congruence – which deals with the question of similar questions that consequently also will measure the same thing. Regarding qualitative interviews one reason for asking similar questions might be to find different perspectives on the same issue.
- Precision – which deals with how the interviewer has recorded the result of the interviews and if the perception has been checked for accuracy.
- Objectivity – deals with how the responses are processed and if different interviewers find different results or the same.
- Constance – which deals with change over time, but this concept is not relevant to qualitative interviews as claims the author Jan Trost, since locating change is often the focus for qualitative interviews.

The two most relevant components of reliability in this master thesis are the precision and the objectivity. The interviews were performed with high precision since a recording was made of the interviews, which then was summarized to a transcript. By using a recording it is always possible to go back to the interview to check that the information was correctly perceived. The respondents of the semi-structured interviews were given the opportunity to control the result of the summary and make comments if any information was not interpreted in the right way. For the more unstructured interviews this possibility was not available which was tackled with follow-up interviews with some respondents to confirm the results of the analysis and the thorough review by several AkzoNobel employees, including the sustainability focal point at Eka.

When dealing with qualitative interviews and persons the objectivity always suffers since both the respondents and the interviewer are affected by the situation. It is inevitable that the information received is processed by the interviewer and some interpretations will have been made. At approximately half of the interviews conducted in this study, two interviewers were attending which leads to a greater objectivity since the interviewers' opinions may be compared. In the other half only one interviewer was present, but this was compensated by that for those interviews the respondents were given the possibility to review the detailed summary of the interview.

Validity describes if the study manages to measure what it was planned to be measured and if the results are valid. There are several strategies to prove validity, to request feedback from the respondents of the interviews performed is one. The validity is in that case decided by the respondent, who investigates if the researcher has perceived the information correctly. Some researchers claim that this is the best way of checking the validity since the respondents have the best knowledge of the field. A disadvantage with this validity test is if the respondents do not share the true experiences or try to give a perception of the situation that is not valid. (38)

The semi-structured interviews were reviewed by the respondents to check for any misunderstanding which was then corrected. Some respondents were also contacted again to add information and clarify other. By this the content was confirmed. The sustainability focal point at Eka, also a supervisor of this study, has also reviewed the work to validate the information. By doing these steps we believe that the information in this study has a relatively high validity, but it must be stressed that the study shows the authors' picture of the sustainability organization at Eka as received through the interviews.

In 2009 a number of interviews with Eka personnel were performed in a research project within the Environmental systems analysis department at Chalmers. The result of these interviews and the interviews performed in this master thesis study in 2011 was compared and the result was very similar which increases the credibility of the master thesis's result.

4.6 Limitation

The study is limited to one business unit within AkzoNobel, Eka Chemicals, and do not cover the work processes of other business units or the full work processes of the corporate organization. The corporate organization is described briefly to inform the reader of important background information about the targets studied and to present parties that Eka Chemicals cooperate with.

Only parts of the corporate sustainability strategies are covered in this master thesis study. Two concepts are chosen for the study, the operational eco-efficiency and the carbon policy and the targets connected to these concepts.

The target of being top three in Dow Jones Sustainability Index was changed during 2011, as to be a leader in sustainability. Since this change was made during the progress of the Master thesis and has not, during the project time, had any major implications on the working processes of Eka Chemicals, it will not be taken into account in the analysis and conclusion of this study.

5. Analytical framework

In this chapter, the means to induce implementation are presented: communication, setting targets and reward systems. These three areas originate from the balanced scorecard methodology and the overall aim is to create motivation to work towards the corporate goals. The last section, barriers, maps the most common obstacles that are encountered in the implementation process.

5.1 Communication

The way towards implementing a strategy begins with educating and involving the people who will execute it. In order to have a successful implementation, the strategy must be shared, i.e. communicated and explained, to all the employees that are going to work with it. (6) A study that distinguished high-performing organizations from low-performing organizations produced the following data in

Table 3, stressing the importance of good communication processes: (39)

	Well-Performing Organizations	Poorly Performing Organizations
Employees have a good understanding of overall organizational goals	67%	33%
Senior managers are highly effective communicators	26%	0%

Table 3 The importance of well functioning communication processes. (39)

Also, the employees should be encouraged to come with suggestions for improvement. This kind of feedback makes the employees feel responsible for the future of the company and stimulates them to take part in both the formulation and implementation of the strategy. (6)

In order to emphasise the importance of internal communication of a new strategy, the following comparison with external marketing will be presented.

If a marketing director is about to introduce a new product, there is a row of well-elaborated processes that the company will follow. First, the company will start a marketing campaign to inform potential customers that there is a new product on the market (creating product awareness). The next step is then to register the sales to find out how many customers that actually bought the product (product market share). Subsequently, the company will try to assess whether customers continue to buy the product after the first trial (product loyalty) and recommend others to buy the product (product missionary). The aim for marketing campaigns is to educate and influence potential buyers until behaviour patterns have been modified in the desired direction, i.e. to buy the product. (39)

If it is instead the general manager who is about to launch a major new strategy, the processes for this are absent. Most companies do not inform the employees about the new directions, so in general, less than 5 percent of the employees understand the strategy of their own company. This is the situation of today's organizations, even though the behaviour patterns are much more difficult to change for employees implementing a new strategy than for consumers buying a new product. Hence, when executive managers are about to launch a new strategy, they should be using communication processes that are similar to those that are used when new products are launched. The first process is then

education about the strategy (creating strategy awareness), the next step is evaluation of whether the employees have understood the strategy (strategy mind share), followed by assessing whether the strategy is being implemented by the employees in their day-to-day work (strategy loyalty) and also examine if there are any ambassadors who are teaching and motivating others to implement the strategy (strategy missionary). (39)

Although the internal communication processes might appear more difficult to quantify, they could be measured in a similar way to how companies measure the external communication processes towards their customers. Therefore, companies should allocate resources and approve communication budgets to educate their employees, in the same way they support budgets for external marketing of new products. (39)

These ideas may seem somewhat extreme, but they are now becoming the norm in strategy focused organizations. An instructive quote was made by Gerry Isom, the former CEO of the health insurance company CIGNA:

“One of the most difficult things is to take a well-articulated executive plan and have the people sitting at their desks in Des moines understand how they contribute to that plan. We need to educate all of our people to understand what they can do when they come to work every day to influence this company.”
(39)

The approach described in the quote is top-down communication, but not top-down management since it is up to each employee at their local site to find proactive ways for achieving the company's strategic objectives.

5.1.1 Communication plan

A business unit that implements a new strategy through objectives on the balanced scorecard can have as many as 15 000 employees. When trying to change behavior patterns of this amount of people, it is crucial to have a communication and education program and that the program has a comprehensive plan which is also continual and periodic. (6)

The aims of the communication program should include the following: (39)

1. “Develop an understanding of the strategy throughout the organization”
2. “Develop buy-in to support the organization’s strategy”
3. “Educate the organization about the balanced scorecard measurement and management system”
4. “Provide feedback, via the balanced scorecard, about the strategy”

There are many tools that are available for communicating the strategy and the objectives of the balanced scorecard down through the organization, for example: meetings, brochures, newsletters, education programs and the company intranet. There is a spectrum of communication channels used when launching a new strategy. The spectrum goes from “rich channels” to “lean channels”, from eg. face-to-face communications, small group meetings and telephone conversations, via e-mails and large group meetings to formal speeches, newsletters and reports. The former (the rich channel) is highly effective as it permits the communicator to deliver the message in a personal way and respond to questions, but it is the most expensive and also limited in its reach. The latter (the lean channel) is much more economical than rich channel communication and has a broader reach, but lacks the personalization and feedback loops. (39)

In order for the communication program to be effective, the tools must be mixed and woven together and the overall aim should be to achieve long term organizational alignment. There are several fundamental questions that should be answered when the program is elaborated: (6)

- “What are the objectives of the communication strategy?”
- “Who are the target audiences?”
- “What is the key message for each audience?”
- “What are the appropriate media for each audience?”
- “What is the time frame for each stage of the communication strategy?”
- “How will we know that the communication has been received?”

The key people that are going to elaborate the communication program and adopt it to each target audience could preferably be the corporate communications director together with the director of strategic planning. The strategic planning director then supplies the content for the messages to each group while the communication director is responsible for the communication process itself. After the launch of the program, the two directors may then assess its effectiveness with periodic employee surveys with feedback about how well the education process is working. (6)

5.1.2 To use the balanced scorecard in order to create a strategy based dialogue.

If balanced scorecards are to play an important role throughout the organization, the steps from strategy awareness to strategy missionary must be achieved. (6) In addition to the communication program, different platforms for discussions should be created and encouraged as a means towards strategy acceptance by the employees. The balanced scorecard can in itself be used as a communication tool. (20)

Therefore, balanced scorecards should be used at different levels in the organization in order to enable these kinds of strategic discussions among different internal stakeholders. Those kinds of discussions are traditionally held in the board of management group, but should also be held between executives and line managers, between line managers and the in-house shared service functions and between all kinds of managers and the employees.



Figure 11 The use of balanced scorecards in different kinds of discussions throughout the company. (20)

Figure 11 illustrates some of the potential dialogues that balanced scorecards may give rise to. They are illustrated from a management perspective in order to emphasize that it is the responsibility of the board of management to make the scorecards be in use and implemented. If the board of management does not see to it that the scorecard is given appropriate attention, it is less likely that its implementation will spread throughout the organization. All these four types of dialogues are important, but the way in which the scorecard is discussed and used by the employees determines whether the organization will succeed with the implementation of the new strategy.

Organizations that keep the employees updated on the scorecard have a better possibility to realise their strategy since:

- The employees become more strategy focused since they understand the business mechanisms and participate in the development of initiatives that lead to results
- The organization becomes more flexible as it is more capable of seizing opportunities and respond to threats
- The organization becomes less hierachic because more employees take part in the intellectual work of analysing cause-and-effect-connections.

5.2 Targets and alignment

As the previous section concluded, communication of the strategy and the objectives of the balanced scorecard is the first step towards alignment of the business unit's strategy on an individual level. However, since behaviour patterns of employees are difficult to change, it is not enough just to create awareness and monitor the level of implementation. More incentives are needed and an important driver is to link the balanced scorecard to team and personal goals. The high-level strategic goals need to be translated into concrete actions that are specified for each individual. An example of breaking down the corporate goals is presented in Kaplan and Norton, *The Balanced Scorecard: translating strategy into action*.

"An on-time delivery objective for the business unit's customer perspective can be translated into an objective to reduce setup times at a bottleneck machine, or for rapid transfer of orders from one process to the next. In this way, local improvement efforts become aligned with overall organizational success factors." (6)

The method of monitoring change and progress with individual objectives is not unique for the balanced scorecard methodology; it has existed for many decades. However, traditional management by objectives (MBO) is very different from balanced scorecard in that MBO lacks the alignment of the corporate strategy to the team goals and personal objectives. MBO is based on the goals of the department and they are therefore often sub-optimal and narrow and they are usually also based on short-term financial goals. Bottom-line of traditional management by objectives is that the employees are just wanted to improve their current work. (39)

The intention of the balanced scorecard methodology is the opposite of MBO in that it provides a thorough understanding, to everyone in the company, of the corporate and business unit strategy and explains where the team and individual fit into this context. Personal and team objectives that are elaborated with the balanced scorecard methodology ought to be strategic, cross-functional and long-term. (39)

The most important outcomes of the use of balanced scorecard are probably coordination of actions, organizational alignment and a common focus. In order to succeed with the implementation and use of the scorecard, some critical positions to consider are the following. (20)

- Decide whether there should be a general scorecard and, if so, whether to use it as a point of reference for translating the goals down through the organization.
- Regard the relation between scorecards at different levels as logical rather than mathematical, but use identical measures if the same success factors are relevant for different scorecards.
- In order to incorporate the bottom-up perspective, include local participation in the development of scorecards even if there is a general corporate scorecard that governs the process. Arrange meetings between similar departments so that they can share experiences and use it as a benchmark when developing the scorecard.
- Carefully consider whether the measures of the scorecard should describe the situation of the local department or if they should also measure the outcomes of collaborations with other units (eg. customer loyalty, which can depend on the encounters with several different functions within the company.) A positive effect of scorecards is that it becomes very clear that responsibility must be distributed - and sometimes remain shared – and that this is reflected in the scorecards.

There are many different ways that organizations use to link the result of the individual or local team to the business unit and corporate goals. Homogenous organizations can focus on relatively few measures since the outcomes are relatively easy to measure, eg. in a sales organization it would be mostly in the financial and customer perspective. (39)

More diverse and complex organizations share the outcomes and strategy they are aiming to reach and embrace a bottom-up perspective. They permit each team or individual to set up personal goals that they can influence and monitor and that will have an impact on the business unit's outcomes. In order to formalize the process of translating the goals down through the organization while at the same time allowing a bottom-up approach, there are several different methods, eg. individual construction of a balanced scorecard, integration with existing planning and quality processes (TQM) and integration with human resources processes. (39)

5.2.1 The process of translating the goals: setting the objectives together

How an organization elaborates goals for the measures in the scorecard reveals a lot about how the organization uses the balanced scorecard. If the goals are assessed by a small group of scorecard specialists, controllers or managers on a level which is superior to the level that the goals are intended for, then it is very likely that the scorecard is perceived only as surveillance mechanisms. Under these circumstances it is usually in the controlled unit's interest to outperform the goals and thereby they will try to negotiate the goals down as far as possible. To set the goals then turns into a process of negotiation between superior and inferior units, with the risk that the parties start the process with hidden agendas. If the scorecards are instead primarily set and used by the unit they describe, then it is much more likely that they serve as a level of ambition that is important to reach. These ambitious objectives then serve as challenges that all the employees in the unit must endeavour to reach. (20)

When setting goals for scorecards there is a lot to be learned from traditional literature about budgeting. The budget literature usually summarizes the different ways to structure the budget process as "top-down" or "bottom-up". The top-down method is usually used as a mechanism to allocate responsibility to subunits, based on the overall goals. Only if identical measures are used for all levels and units within an organization, it is possible to define aggregated goals that can be translated down through the

organization. If, on the other hand, unit specific goals are used, the goals are best set by the bottom-up approach, since this requires deep insight into local situations. (20)

In order to create a commitment to the goals, the bottom-up method is usually much more effective than the top-down alternative. If a superior unit has set the goals and inferior unit deviates from the plan, it is possible to refer to the too high level of the goals instead of the performance of the unit. (20)

The process of setting the goals does not have to be neither comprehensive nor complicated. It is usually sufficient to gather the employees during a day and discuss the ambitions for the year ahead. The process should start with a short orientation on previous results and the overall goals of the company, followed by small group discussions on what to aim at in each perspective and for each measure. By the end of the day the small group will rejoin in plenum and collectively decide on appropriate measures based on the joint knowledge in the room. (20)

5.3 Reward systems

After the communication and education programs are established, as well as the goal-setting processes, the linkage towards an incentive and reward system can begin to be elaborated. This is the last method, when applying balanced scorecard performance management, for creating motivation for the employees to work towards an alignment of the corporate strategy. (6) The balanced scorecard methodology allows incentive pay plans to be extended throughout the organization, down to the front lines and back offices, for the first time. (39)

However, it is not evident for most companies whether and how to link an already existing compensation system to the scorecard measures. But if the balanced scorecard is really intended to change the behaviour patterns and organizational culture, there must be a link between incentive compensation and the achievement of scorecard objectives. Therefore, the question should not be whether, but when and how this connection shall be developed. (6)

There are, in general, two types of motivation: intrinsic and extrinsic motivation. (40)

Intrinsic motivation is defined as motivation through the work itself, motivation from within. (4) This motivation takes place when employees feel that the work they do is intrinsically interesting, challenging and important while it involves the freedom to act, autonomy or exercise responsibility. A prerequisite is also to experience possibilities for using and developing skills as well as opportunities for personal advancement and growth. (40) Managers can enhance intrinsic motivation in many ways. First they can emphasize the positive vision and ideals of the company so that the employees feel that they want to contribute to the overall mission. Second, they can involve the inferior units in the goal-setting process to increase the probability that these units will perceive the goals as reasonable (as stated in the previous section, *Goals and alignment*). Third, managers can communicate the cause-and-effect linkages behind the strategies so that the employees better understand their roles in helping the company to achieve its goals (as stated in the earlier section, *Communication*). (41)

Extrinsic motivation is defined as what is done to or for people to motivate them, motivation from outside. (17). This includes rewards such as payment, recognition, praise or promotion and punishments like withholding payment, criticism or other disciplinary actions. (40) Financial incentives are important elements in the design of most performance measurement systems, like in the balanced scorecard methodology, as stated above. To induce extrinsic motivation, financial performance awards can be linked to the achievement of goals and targets, usually in the form of bonuses. (41)

Some companies want to link their reward program for senior managers to the outcomes of the balanced scorecard measures as soon as possible, since financial compensation is such a powerful tool for enhancing extrinsic motivation. The bonus calculation for senior executives could for example be: 50% based on reaching economic value-added targets over a three-year period and the other 50% based on the elaboration and accomplishment of measures in the three nonfinancial perspectives of the balanced scorecard. (6)

The benefits of connecting the personal economic interest of the senior executives with achieving the strategic goals of their business unit are quite evident. However, there are some risks associated with linking the balanced scorecard measures to the incentive and reward system. Therefore, the following questions should be examined before developing the incentive program: (6)

- “Are the right measures on the scorecard?”
- “Are the data for the selected measures reliable?”
- “Could there be unintended or unexpected consequences in how the targets for the measures are achieved?”

If the scorecard measures are not a good indication of the corporate strategic objectives and if the short-term achievements are not aligned with achieving of the long-term goals, then there will be disadvantages in elaborating a reward system based on balanced scorecard. Since it is also very difficult to be sure that the right measures have been chosen, it is recommended to initially regard the balanced scorecard as a hypothesis for testing the cause-and-effect relationship between the different perspectives and their measures. (6)

Another concern is that in traditional reward programs, multiple objectives are usually handled by weighting, i.e. percentage weights are assigned to each individual objective. This allows considerable bonus amounts to be paid even when the achievement is unbalanced. The business unit could for example over perform on a couple of objectives while underperforming on the others with low weights. Then, the scorecard would become unbalanced and the whole methodology would be useless. (6)

Above all, the most important factor to ensure, when developing an incentive and reward program, is that the long term balanced objectives are not conflicting with achieving short-term financial performance. (6)

5.4 Barriers

Most authors who write about the Balanced scorecard methodology believe in the concept to the extent that they forget to mention the problems and difficulties that some companies encounter when working with scorecards. The troubles that might arise could be typical for implementing and working with scorecards and thereby the deviations at a specific company do not have to be a sign of poorly performed implementation. To realize this usually helps to overcome the difficulties. By being aware of the barriers the company can better prepare for the problems they might encounter later on. (20)

There are four predominant barriers to effective strategy implementation: (20)

1. Deficient communication and definition of the vision and strategy
2. Lack of alignment, the strategies are not linked to unit and personal goals
3. Lack of resources, the strategies are not linked to long- and short-term resource allocation
4. Poor or inadequate feedback

The four barriers are portrayed in Figure 12 below. Each barrier can be overcome by implementing the Balanced scorecard methodology in a well-informed and conscious way. (20)

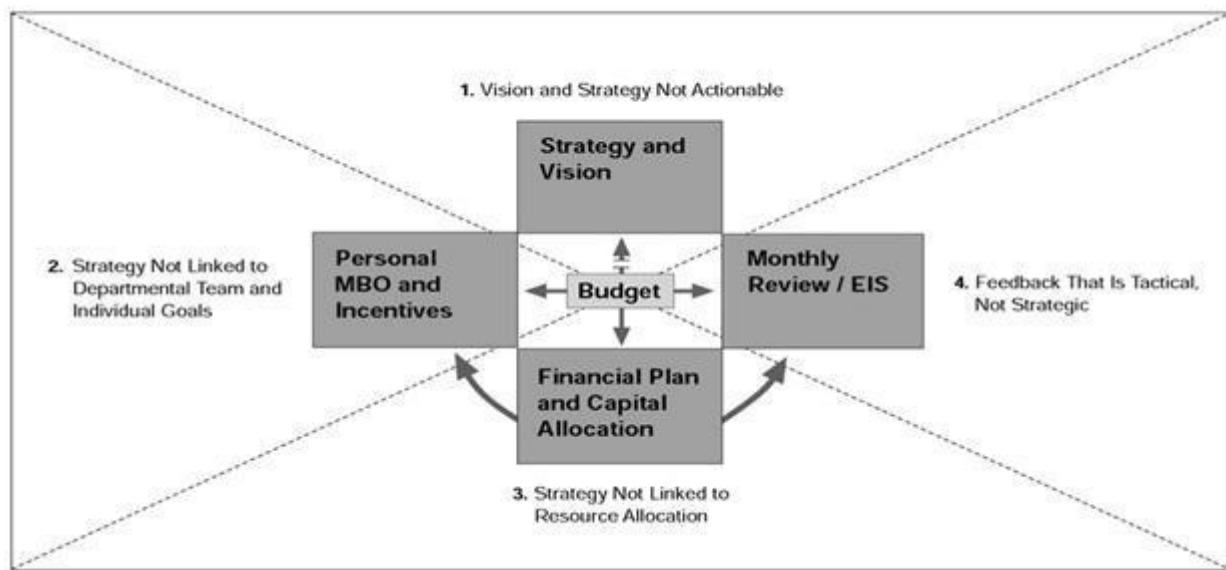


Figure 12. The four barriers to strategic implementation (20)

Barrier 1: Deficient communication and definition of the vision and strategy

The first barrier for implementing a new strategy arises if the company is not able to define its vision and strategy in understandable terms that are actionable. If the company has a vision and mission that cannot be translated into actions, the result will be fragmentation and sub-optimization. Then, it does not matter how ambitious and fantastic the vision might sound since its pompous language might be the very reason why it cannot be implemented. If this is the case, then the board of management have usually failed to reach consensus between themselves on what their vision really means, i.e. "what is unclearly said is unclearly thought."³ If there is lacking unity about the definition and meaning of the strategy, then different groups will act according to their own interpretations. Hence, they will follow different agendas and set up action plans that are not aligned with the rest of the company, regarding eg. quality and continuous improvement. (6)

Barrier 2: Lack of alignment

If the long-term goals of the business unit are not translated into objectives for departments, teams and individuals, then a second barrier for implementation of the strategy will arise. The major objective for the

³ Esaias Tegnér (Swedish author)

department will then be the financial performance and the subunits and individuals within the department will be focused on achieving the short-term profitability goal. The building of capabilities for achieving the long-term strategic objectives of the company will then be set aside. The reason for this barrier might be that the human resource managers have failed to facilitate the alignment of the goals throughout the company. (6)

Senior managers tend to disagree about whether reward systems are beneficial for the alignment of the goals, but most agree that the communication and goal-setting process improve the alignment of all units and individuals to the strategy. (6)

Barrier 3: Lack of resources

The third barrier to a successful implementation of balanced scorecard is resources. Lacking knowledge is a common reason why the balanced scorecard methodology sometimes fails, as knowledge is actually one of the most important resources in a scorecard project. The required knowledge is not primarily about the balanced scorecard as such, but rather about the facts that are needed to be able to start a discussion about which direction the company should take. Lacking knowledge is a weakness that has very little to do with scorecards. Balanced scorecard projects might on the contrary lead to new interest in data about customers, costs, competitors etc. The need to bring out such data is one reason why the second most important resource is time. Many individuals within the company need to reserve an adequate amount of time and effort and it is not a mere question of motivation to do that. There are many obvious limitations in terms of other duties and other processes of change that competes for time and attention. Sometimes it is also necessary with some more dedicated resources, eg. IT software. (20)

On the level of management, the failure is not to link action plans and resource allocation to the long-term strategic goals. At present, many companies have different processes for long-term strategic planning and for short-term annual budgeting. The consequence of this is that capital allocation is often not linked to the strategic priorities. Major initiatives, eg. continuous process improvements are then performed without notion of priority or strategic impact. Subsequently, the focus of the monthly or quarterly reviews then lies on the deviations between the actual performance and the budgeted operations, instead of on whether progress is made on strategic objectives. The reason for this barrier might be that the executives for finance and strategic planning have separate agendas and do not cooperate, and that they do not see that their work needs to be integrated. (6)

Barrier 4: Poor or inadequate feedback

The fourth barrier for the implementation of a strategy is the lack of feedback on how the strategy is being implemented and whether it is working. At present, most management systems only provide feedback on short-term operational performance and the majority of this feedback is on financial measures. The feedback is usually about the deviations between actual results and the budgeted operations. In general, very little or even no time is spent on analyzing indicators of strategy implementation. A survey stated that as many as 45 % of companies spend no time reviewing strategy or making decisions about strategy in their periodic performance review meetings. The consequence is that the departments within the company have no means of getting feedback on their strategic work and without feedback the company as a whole has no means of testing, evaluating and learning about their strategy. (6)

The reason for this barrier might be that the information is inadequate which leads to poor feedback. The executives that are responsible for this are thus the vice president of information systems and also the vice president of finance, who is responsible for the strategic review process. (6)

6. The current sustainability work

One of the main aims of this study is the mapping of the sustainability work within Eka Chemicals, which is described in this chapter. In addition, definitions of the two sustainability targets eco-efficiency and carbon policy are introduced as well as presentations of Eka's organization and the sustainability organization of AkzoNobel. If nothing else is stated, the text in this chapter is based on empirically collected information from interviews with personnel at Eka Chemicals and AkzoNobel or internal documents and websites.

6.1 Sustainability at AkzoNobel

In this section, the organization of the sustainability work and the sustainability objectives for AkzoNobel at a global level will be described briefly, to introduce the groups that Eka Chemicals cooperate with and the concepts used.

6.1.1 The sustainability organization

The sustainability work in AkzoNobel is constituted of a sustainability council, a sustainability director, sustainability focal points in the business units of AkzoNobel and a corporate sustainability team, including functions for sustainability ideation, sustainability engagement and communication and a sustainability expertise team. The purpose of the sustainability council is to embed sustainability in the management cycle, to measure and follow up the progress and to advise the Board of Management of AkzoNobel on the sustainability strategies. Each business unit within AkzoNobel has a sustainability focal point which leads the implementation in its own organization. The sustainability focal points have regular meetings to exchange information between BUs. They can get support from the sustainability expertise team regarding for example environmental assessment and its implementation. (4)

A sustainability award is handed out each year by AkzoNobel and the BUs can apply with projects they have performed. There are four different categories, the BU award, Health and Safety award, environmental award and eco-premium solutions award.

6.2 The sustainability targets

The sustainability strategy and objectives of AkzoNobel are presented as a strategy, three key focus areas and a dashboard with Key performance Indicators.

The strategy for Sustainability in AkzoNobel is formulated in the following three statements.

- Remain in the top three in the Dow Jones Sustainability Indexes⁴
- Reduce our Total Reportable Rate of injuries to 2.0 per million working hours by 2015, equivalent to the best five of our peer sector
- Deliver a step change in people development, in part through substantively improving the diversity in our company

⁴ This target changed during 2011, as to be a leader in sustainability.

Three key focus areas are also presented at the AkzoNobel website. They are:

- Creating value from Eco-premium solutions
- Talent factory development
- Carbon management through the value chain

The sustainability Key Performance Indicators are collected in a public dashboard aimed at AkzoNobel and the top management of the business units.

- Improving our safety performance
- Increasing turnover from eco-premium products which are both eco-efficient and attract a premium
- Developing sustainable water management at all sites
- Reducing our carbon emissions from cradle-to-gate
- Adherence to and training in our Code of Conduct
- Strengthening the diversity of our workforce
- Implementing leading people development programs

The focus areas of this master thesis are on the operational eco-efficiency, which is one part of the evaluation connected to the DJSI, and on the key focus area of carbon management through the value chain.

6.2.1 Operational eco-efficiency in AkzoNobel

One part of the sustainability strategy of AkzoNobel is being the top three in Dow Jones Sustainability index⁵ (3). This is the part connected to environmental performance. The ranking in DJSI is included as 50 % of the top management long-term bonuses. In this manner an incentive is created for focusing on improving the environmental performance of the company.

The Dow Jones Sustainability Index is divided into different business sectors and based on the Corporate Sustainability Assessment performed by SAM (Sustainability Asset Management). The assessment is based on three dimensions: economic, environmental and social. Within the environmental dimension in the Chemical sector, environmental reporting, environmental policy and management system, operational eco-efficiency, product stewardship, climate strategy and genetically modified organisms are included. 35 % of the result is allocated from the environmental parameters according to the SAM weighting scheme. The information is collected from the company itself by web-based questionnaires, documents and interaction with the company together with media and stakeholder analysis.

To pursue the target of remaining in the top three of DJSI, focus within AkzoNobel has been put on the operational eco-efficiency. The operational eco-efficiency is defined as nine environmental parameters.

1. Energy (TJ/ton product)
2. Direct green house gases (t CO₂/ton product)
3. Indirect green house gases (t CO₂/ton product)
4. NO_x (t/ton product)

⁵ This target changed during 2011, as to be a leader in sustainability.

5. SO_x (t/ton product)
6. Total waste (t/ton product)
7. Volatile organic compounds (t VOC/ton product)
8. Chemical oxygen demand (t COD/ton product)
9. Fresh water use (m³/ton product)

AkzoNobel's target is a 10 % reduction of the environmental footprint, a weighted average of the nine parameters, and a 70 million euro cost saving by 2012. The long-term target is set higher, to 30 % reduction of the environmental footprint.

In the process of reaching the targets within operational eco-efficiency, a three step program has been defined which contains finding opportunities, defining projects and executing projects. Within the program tools for defining projects have been developed and experiences have been collected to support the implementation process. An extensive display of a reporting tool is also available on the AkzoNobel intranet, an example is presented in Figure 13. On the intranet site it is possible to trace the emissions down to each unit, BU, sBU or site of AkzoNobel, for all the nine categories.

The program was initiated by the board of management, the sustainability council and the operations council. Within the project there is a program management group and an expert group that support the responsible person in the business units.

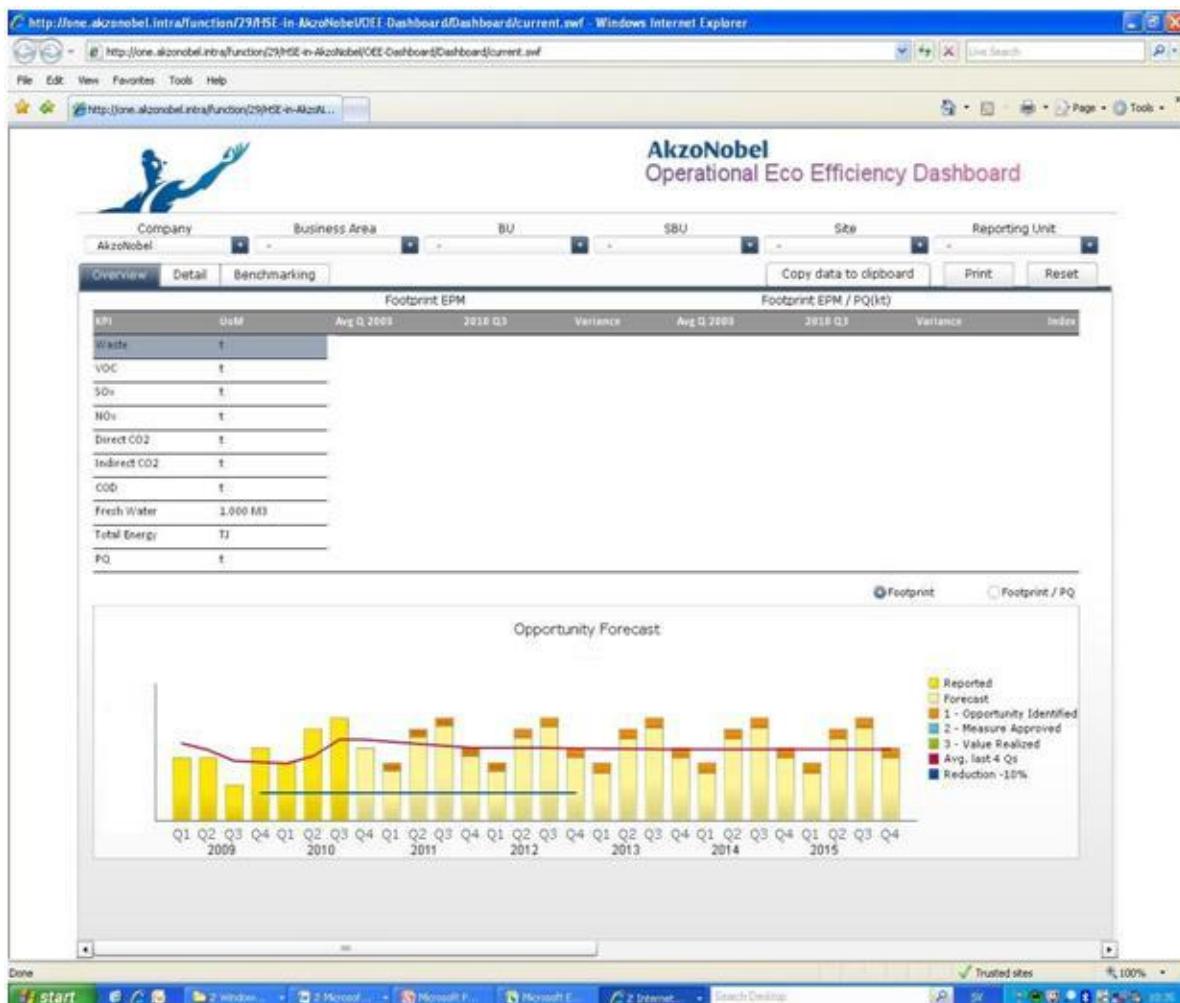


Figure 13: The operational eco-efficiency dashboard

6.2.2 The AkzoNobel carbon policy

The AkzoNobel carbon policy was issued in 2009 (3). AkzoNobel recognizes that climate change will affect global environment, society and the business world and that they need to work not only with their own operations but along the value chain of their products (3).

The work to create the policy was initiated in 2007 and a coordinated program was developed during 2008. The framework is based on the Greenhouse Gas Protocol and life cycle thinking. It was tested by the World Resource Institute and Dutch and Swedish NGOs. During 2008 the framework was tested by business units within AkzoNobel and in 2009 it was launched within the whole organization. (3)

The AkzoNobel Carbon policy states that (3):

- AkzoNobel will measure the cradle-to-gate carbon footprint of its key value chains in 2009 and update these measurements every 3 years.
- AkzoNobel will reduce its cradle-to-gate carbon footprint by 10 % per metric ton of product by 2015 compared to 2009.

- AkzoNobel aims to control its absolute scope 1 & 2 greenhouse gas emissions (based on its current business portfolio) no higher than 2008 levels by offsetting organic growth entirely by energy efficiency and fuel mix improvements.
- AkzoNobel strives for a paradigm shift in carbon management through continuous innovation, aiming to reduce cradle-to-gate carbon footprint by 20-25 % per ton of product by 2020, compared to 2009.
- AkzoNobel will provide carbon-efficient solutions to customers contributing to the existing AkzoNobel objective of 30 % annual sales from eco-premium solutions by 2015.

Within the Carbon policy AkzoNobel has policy statements for measurement and reporting, reduction, communication and advocacy, best practice and accountability. More information about each category will be presented below. (3) Each BU within AkzoNobel was requested to complete a carbon management plan in line with the policy AkzoNobel issued.

Measurement and reporting

To support customers in the carbon footprint reductions, the carbon policy states that AkzoNobel will measure the impact of major downstream applications. (3)

Reduction

To create a good management of the carbon emissions AkzoNobel will work with innovation, energy efficiency, fuel mix and improvements in the sourcing activities. The innovation activities should result in eco-efficient and carbon-efficient products for AkzoNobel's customers and partnership with both customers and suppliers aim at developing new solutions. (3)

Communication and advocacy

Staff, customers, suppliers, investors and the general public will be informed about the carbon management plans of AkzoNobel. Specific staff communication and training will be provided to involve all employees in the goals for sustainability (42).

Best practice

AkzoNobel will identify best practice approaches on emission trading and increase internal and external expertise to facilitate improvements. AkzoNobel will also transfer good practices. (3)

Accountability

Since carbon management is of strategic importance the board of management has the ultimate responsibility for the carbon policy. The BU managers are in turn responsible for developing and implementing a carbon management plan in their respective organizations. Corporate activities will monitor the progress of the business units towards the carbon policy and targets. To highlight the importance of the carbon management, the carbon policy states that it should be a routine in business management processes. (3)

Measurement of the cradle-to-gate footprint

The cradle-to-gate carbon footprint of AkzoNobel is calculated each year by the business units, which are supported in this process by the sustainability expertise team within AkzoNobel. There are three scopes used, as defined in the Green House Gas Protocol Initiative (43). As shown in Figure 14, scope 1 includes emissions from own productions, whilst scope 2 includes emissions from the energy use required for the production. Scope 3 is divided into upstream and downstream, where upstream covers the extraction and production of raw materials and downstream the use and end-of-life of products. In a cradle-to-gate footprint scope 1, 2 and 3 upstream are included.

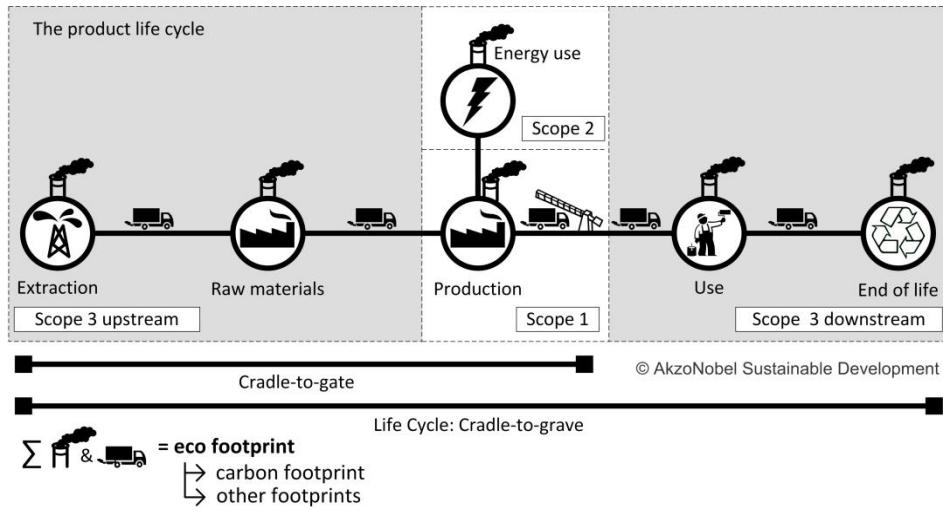


Figure 14: Definition of scope for the carbon footprint (44)

6.3 The organization of Eka Chemicals

In this section, an overview of Eka Chemicals is presented, followed by in-depth description of the two global units, RBC and T&E, which are the departments that are most involved in the sustainability work.

6.3.1 Eka Chemicals

Eka Chemicals is a business unit (BU) within AkzoNobel. It consists of four global support functions and four sub business units (sBU), see Figure 16. Within Eka Chemicals there are three major product groups: bleaching chemicals, paper chemicals and specialty products. The three product segments are presented according to sales in Figure 15. Bleaching is the largest product segment according to sales numbers, but is constituted of only a couple of large products. The paper chemicals segment includes a larger variety of products but contributes with a smaller sales percentage.

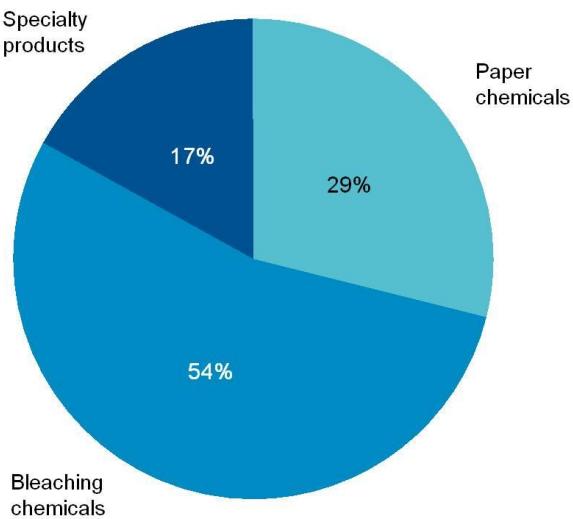


Figure 15: Sales by product area

The specialty products are located in a separated sBU since its markets differ from the pulp and paper products. The bleaching and paper chemicals are organised according to the geographical regions: Europe including Russia, Americas including both south and north America, and Asia-Pacific including South Africa. The global support functions Control and finance, Information management and HR will not be described further since they have not been investigated closely in this master thesis project.

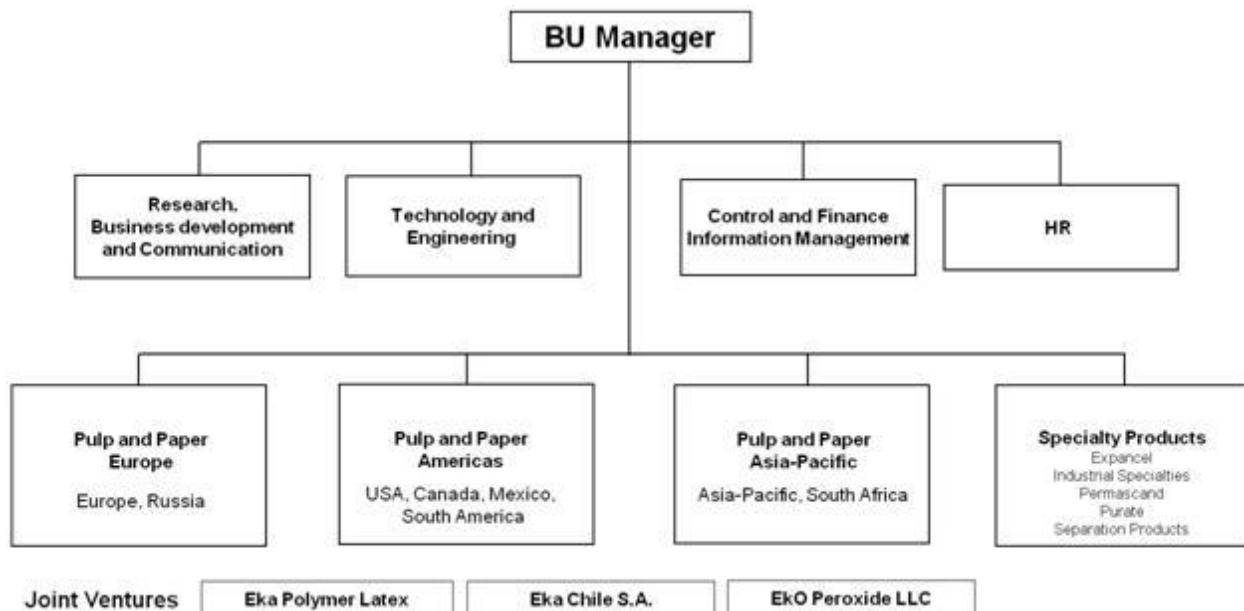


Figure 16: The organizational chart of Eka Chemicals

6.3.2 Research, Business development and Communication (RBC)

In the department Research, Business development and Communication, see Figure 16, the global unit Research Development and Innovation (RD&I) with focus on product development is located, together with business development, the communications department and the global marketing department. Product strategies and launching of new products are examples of tasks where the organizational positioning facilitates the work.

The RBC also collaborates much with other parties. The communication department cooperates with the Human Resources department and also stretches its contacts to the corporate AkzoNobel level. Global marketing and Product RD&I work closely with Technology and Engineering to ensure suitable cost structures for the products. AkzoNobel has formulated processes that describe cooperation between the marketing and purchasing departments, in this master thesis study no such link has been found at Eka Chemicals.

The global communication department operates within three overlapping fields. Internal communication directed towards the employees of Eka Chemicals, customer communication and external communication indirect to customers. The third field includes for example communication with non-Governmental organizations (NGOs) and media contacts.

In the global marketing department, support is directed towards all product segments and the work includes for example developing business strategies and launching new products to the market. The department is also responsible for business analysis and management systems.

The global marketing department has a close cooperation with regional marketing departments situated in the sub business units. This is a difference from the communications department, where all sub business units do not have communications departments.

6.3.3 Technology and Engineering (T&E)

Technology and Engineering is another part of the Eka organization central to the sustainability work, see Figure 16 and Figure 17. T&Es mission is to develop, implement and manage Eka's processes and technologies, which includes for example making processes cost-effective by creating sustainable and continuous improvements and by providing new solutions. T&E have three main groups; Process RD&I, Global Technology and Eka Engineering. In T&E there is also a global BU CSR/HSE manager (from here on called BU HSE manager) and a global purchaser with focus on energy.

The main task of process RD&I is the development of new process technology and they contribute mostly in the beginning of the working process within T&E. Global Technology come in at a later stage, as technology owners when technologies are approaching implementation. Last Eka Engineering takes part in the process to plan and build new technologies on site.

T&E have a close cooperation with the operations department and the sites in all types of projects. Global Technology also cooperates with the marketing organization of the geographical regions to follow and ensure Eka's position on the market. Process RD&I have besides the operational cooperation also contact with the purchasing department to evaluate the raw material supply and quality.

The process RD&I department focuses on developing the production processes of existing products to increase efficiency and reduce cost and at the same time ensuring the same quality of the product. This may involve for example reducing the amount of energy used or evaluating new raw materials. Process RD&I also includes thinking of the products and processes from a long-term perspective to ensure their longevity. Eco-efficiency criteria have been defined for the RD&I process with the aim to develop products

and processes which have higher eco-efficiency compared to existing technologies on the market. The criteria are a number of questions, one should consider from a life cycle perspective, in the RD&I process.

Global Technology owns the technologies used within Eka Chemicals. They drive “operational excellence” by benchmarking the sites, in order to find the best practice technologies and spread these across the BU. Global technology’s main priority is to keep the manufacturing cost as low as possible in order to create competitive advantages, support growth and add customer value.

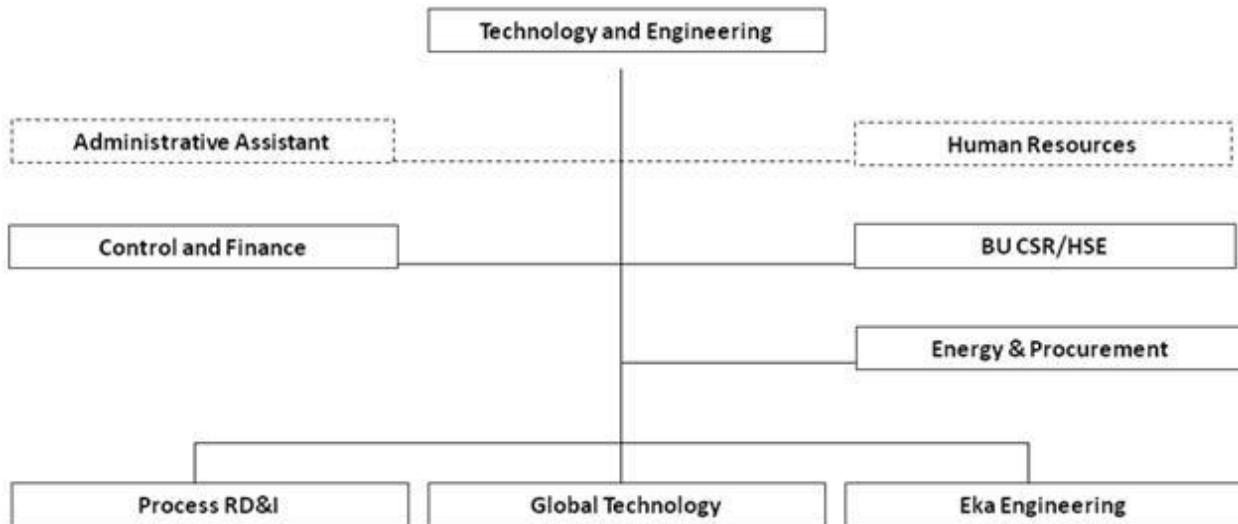


Figure 17: The organizational chart of Technology and Engineering

6.4 The sustainability organization in Eka Chemicals

The sustainability work in Eka is broad and covers a wide number of aspects and business functions such as RD&I, marketing and HSE, but the work is at the same time focused around one step in the product lifecycle, the production.

6.4.1 The sustainability project

In 2008 the sustainability targets were included in the AkzoNobel corporate dashboard. Within Eka it was decided that a project team would be put together to align the sustainability work with the new targets. The purpose of the project was to create awareness of sustainability within Eka, formulate targets on BU and sBU level, develop action plans and identify competencies to reach the set targets. The manager of the department Process RD&I was appointed project leader and sustainability focal point. The project team members were the HSE managers of the three geographical regions in the sBU organizations, a member of the global marketing department and support from the AkzoNobel sustainability expertise team.

6.4.2 The sustainability organization

Each business unit within AkzoNobel has an appointed sustainability focal point. In Eka Chemicals the Sustainability focal point is dividing the time between being focal point and being manager for the process RD&I department within Technology and Engineering. The purpose of the sustainability focal point is to coordinate the different sustainability initiatives of the organization and facilitate the realization of actions. It is also to collect information, like guidelines, from AkzoNobel and make sure that they are translated into Eka and that results are reported back to AkzoNobel. The focal point functions as an internal and external communicator about sustainability, with the motive to inspire the employees and answer external

requests. The external contacts concerning sustainability may be for example, the contact with the AkzoNobel sustainability expertise team that performs environmental assessments, contacts with NGOs like WRI, WWF and WBCSD and media. The sustainability focal point is not part of the Eka management team, but reports directly to the director of Technology and Engineering that in turn is part of the management team.

The sustainability focal point gathers sustainability network meetings every year, the number and regularity of meetings have varied. They were many in the beginning when the sustainability project was active, but have become fewer due to difficulties to coordinate all members. Last year there was one sustainability network meeting. In these meetings persons involved in the sustainability work are gathered to get updates on what is happening within Eka and to receive news from AkzoNobel. The functions that are invited to the sustainability network are, the sustainability focal points of the sub business units together with some of their staff from the HSE-departments, representatives of the Technology and Engineering department, marketing personnel involved in the sustainability work and representatives of the AkzoNobel sustainability expertise team.

A group consisting of the sustainability focal point, marketing and communications managers is developing the plan for future sustainability work in Eka.

[6.4.3 Carbon policy targets](#)

The AkzoNobel carbon policy was issued in 2009 and after performing the first cradle-to-gate calculations a carbon management plan was demanded from the business units. Eka Chemicals issued their carbon management plan in the spring of 2010. It was formulated by the Sustainability focal point in cooperation with other expertise at Eka and it uses the AkzoNobel carbon policy as a template. The main parts of the carbon management plan are:

- **Measurement and reporting**

Details on how measurement and reporting should be performed are described and responsible persons are appointed.

- **Responsibilities for actions to reduce the carbon footprint**

Actions and responsible persons are specified to enable target setting for the carbon footprint in Eka's own operations and supply chain. Activities that will facilitate reaching the targets are also specified together with active initiatives.

- **Innovation**

In this section innovation of products, technologies and partnerships are connected to carbon footprint reductions. Actions and responsible department are appointed and active initiatives.

- **Communication and advocacy**

Concrete tasks are specified with a responsible person.

- **Best practice**

General tasks are specified together with a responsible person.

- **Accountability**

Approval and plan for follow-up.

- **Progress measurement, reporting and targets**

Targets are specified and a person is appointed as responsible for the targets.

The carbon management plan was posted on the intranet of Eka Chemicals in early 2010, but has not been widely communicated within the company. The people involved in the sustainability workgroups are familiar with the plan, but do not seem to use it as the steering document for their work within this field. On the other hand many of the tasks mentioned are already dealt with in the different departments appointed.

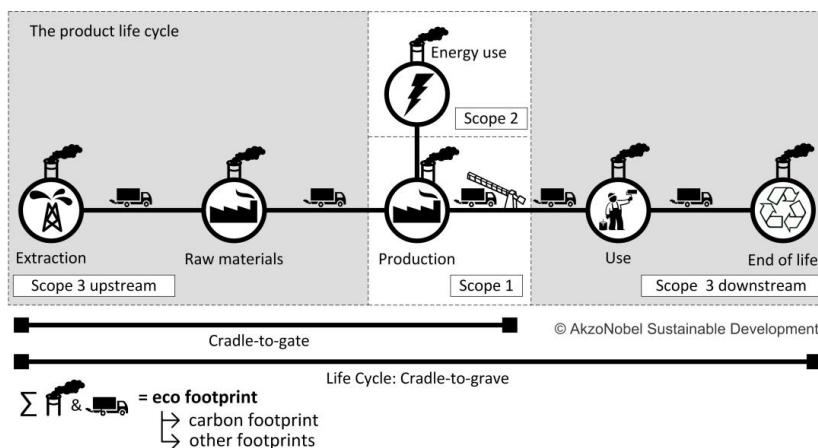


Figure 18: Definition of scopes for the carbon footprint (44)

6.4.4 The carbon footprint of Eka Chemicals

The main contributor in 2008 to Eka's carbon footprint was scope 2, the energy use, see also Figure 18 for definition of the scopes. The second largest contributor was scope 3. At Eka the focus is on scope 1 and 2 in the carbon policy. Scope 2 is especially interesting, which is connected to the bleaching products, since they have an energy intensive production process. This is also a major cost driver for Eka. For the paper chemicals, scope 2 is not an equally dominant contributor to the CO₂-equivalent emissions and scope 3 has a more significant impact.

The goals for the carbon policy are set and communicated through the goal setting process of the HSE-departments. Amongst the goals, only scope 1 and 2 are stated and not the full cradle-to-gate target. Scope 1 and 2 are also measured and followed-up in EPM, a reporting system (further described in section 6.4.6) and on the Operational eco-efficiency dashboard. The scope 3 upstream on the other hand is not followed continually in the quarterly reporting within Eka, but calculated by the AkzoNobel sustainability expertise team once a year.

6.4.5 Operational eco-efficiency

The operational eco-efficiency as one part of the Dow Jones Sustainability Index is a focus area of the sustainability work within Eka Chemicals. The ranking in the Dow Jones Sustainability Index is used as one indicator for the long-term bonus to the top managers at Eka. At lower management levels in Eka,

generally the bonuses are neither connected to the Dow Jones Sustainability Index nor to other sustainability indicators. However, individuals may have personal objectives relating to sustainability linked to their bonuses.

The Dow Jones Sustainability Index is evaluated each year. The parameters specified in the operational eco-efficiency are closely connected to the production efficiency and the reduction of environmental impact from the production facilities. In Eka these parameters correspond to the work performed within the environmental area in the HSE departments and the goals are therefore also distributed in the same way as other goals within the HSE department. More information about how the targets are set and translated in Eka can be found in section 6.5.4.

The actual performance of environmental parameters within AkzoNobel is reported in the EPM-system. Each site reports their performance quarterly, and the data is then reviewed for accuracy. In the final step of revision the BU HSE manager verifies the EPM-reporting. The EPM-system is then combined with the prognosis tool VTT, the Value Tracking Tool, to create an operational eco-efficiency dashboard for AkzoNobel. In the dashboard, see Figure 13, each site's environmental performance against the targets can be tracked, together with a prognosis for future reduction potentials.

AkzoNobel has a program for improving the operational eco-efficiency of the company. Eka Chemicals is represented by the Global Technology manager who is also the OEE focal point within Eka. Several initiatives and working groups have been created for achieving a continuous improvement within the operational eco-efficiency. Eka's Global Technology manager is the expert group leader for energy within the AkzoNobel operational eco-efficiency program and coordinates the work with benchmarking problems and solutions in all BUs of AkzoNobel. The goal is to find solutions that the whole AkzoNobel can benefit from.

There are projects about waste management within Eka. The three main contributors to waste within Eka were closely studied to locate the main waste streams so that they could be minimized. In one project new solutions for the waste was investigated, for example finding a use of the waste at other sites and discussions were also held with suppliers of waste handling.

6.4.6 Investment decisions

The investment decisions are made within the line organization including for example the site and operations managers. All investments compete against each other in the same forum and there is no separate budget for investments concerning environmental improvements.

Several respondents have answered that not getting an investment was the reason why they did not reach the target which was set for the environmental performance. Within Eka it is normally not a problem to get approval of an investment if the investment is well-founded with calculations and knowledge and if the payback time reasonable. Sometimes the payback time is a problem for environmental performance improvement investments, since the payback time may be longer than for other investments within the company. According to the sustainability focal point, it is possible to get funding for investments with longer payback time, if a significant environmental performance improvement can be shown.

6.4.7 The sustainability innovation award

Besides the bonus system to Eka's top managers, there is a sustainability innovation award handed out within Eka. Projects which led to substantial improvement of environmental impact or projects related to successful eco-premium solutions can be awarded. Some examples of areas that may be relevant for the award are, waste reduction, energy efficiency, carbon reduction, sustainable water management, reduction in emissions to air or water and eco-premium solutions projects.

6.5 HSE within Eka Chemicals

The main information in this chapter is based on information from the sub-business unit Pulp and Paper Europe and not on the American or Asia-Pacific regions. Their way of working is described generally in a separate chapter. The reason for this limitation is that the investigation is much more detailed on pulp and paper Europe due to the fact that the product case study Eka DR is situated within that regional sBU.

The Health, Safety and Environment (HSE) organization has been present in the company for a long time. The routines and decision process paths are clear and well established and the communication between departments is well functioning.

It is within the HSE departments that most of the targets concerning health, safety and environment are translated from top to bottom within Eka. The HSE area deals with similar topics as sustainability but with a different perspective that is more local and connected to the own production and its impact on the environment.

In Eka's working processes concerning operational eco-efficiency the work is very much intertwined between HSE and sustainability, since all parameters in the operational eco-efficiency are measured and followed-up within the HSE departments. Two main parts of the cradle-to-gate footprint in the carbon policy, scope 1 and 2, are also included in this work process since they are two of the nine parameters in operational eco-efficiency.

6.5.1 The HSE organization

At a global level HSE is separated from sustainability, since two different persons are responsible for the topics, the BU HSE manager and the sustainability focal point. Both report to the same manager, the director of T&E, who takes the issues further to Eka's management team. The BU HSE manager functions as a communicator between AkzoNobel and Eka, by translating the AkzoNobel targets to BU level and by reporting the environmental performance to AkzoNobel. Within Eka the BU HSE manager has a global coordinating role which includes driving the HSE work forward.

The BU HSE manager coordinates the HSE-network. In the network there are representatives of the different regional units, Europe, America and Asia-Pacific, representatives of the specialty chemicals sectors and representatives of product development RD&I, and Technology and engineering. The HSE-network raises questions regarding setting goals and the realism of these goals, reporting and how to drive the HSE work forward. The HSE-network constitutes a link between the HSE work and the sustainability work within Eka, since several persons, for example the sub business unit (sBU) HSE managers, also participate in the sustainability network.

6.5.2 HSE at the sBU level – examples from PPE

The Pulp and Paper Europe (PPE) sub business unit has a QHSE department, headed by the QHSE manager which is also the sustainability focal point for the sBU. The issues of HSE and sustainability are not handled separately in the sub business units. They are dealt with as one concept and the same manager and group are responsible for the two subjects.

The sBU QHSE manager of PPE is part of the management team of the sBU and report to the head of PPE, the sBU manager. The responsibilities of the QHSE department are: working environment and safety at work, quality, security of sites, environmental targets and reporting at site level. The term sustainability is most often used in connection to the environmental issues. The QHSE department translates BU targets to site level and performs follow-up on the progress, these processes will be further described in section 6.5.4 The target setting process.

The QHSE department supports the sites in issues such as how to implement the AkzoNobel standards at the sites, how to adapt the environmental targets to the specific conditions at site level and how to work with following up the targets. Sometimes the group functions as a communicator between the plants to find best practice solutions that other production sites may find useful. They also support with specialist knowledge, for example within environmental chemistry. The more technical issues connected to solving process technical problems is the responsibility of the Technology and Engineering sub-business unit and its departments, Process RD&I and Global technology.

6.5.3 HSE at the production site – examples from Eka DR

At the production site there is an environmental coordinator that is responsible for keeping the production within the environmental permits issued and working with the targets translated from the sBU. The environmental coordinator is the main contact towards the QHSE department of its sBU and should distribute information about environmental questions to the personnel at site level. The resources for the environmental coordinator's role differs depending on plant size, some plants have one full employee, whilst others share one employee between different responsibilities at a plant or even between different plants. For Eka DR there is one person allocated for being coordinator for quality and environmental questions, but in reality this employee is also very much involved in other tasks at the site.

6.5.4 The target setting process

The target setting for operational eco-efficiency and the carbon policy is mainly managed through the HSE-departments, see a schematic illustration in Figure 9. In this study, the target setting process has been followed from BU-level down into the sub business unit PPE and further into the production of Eka DR.

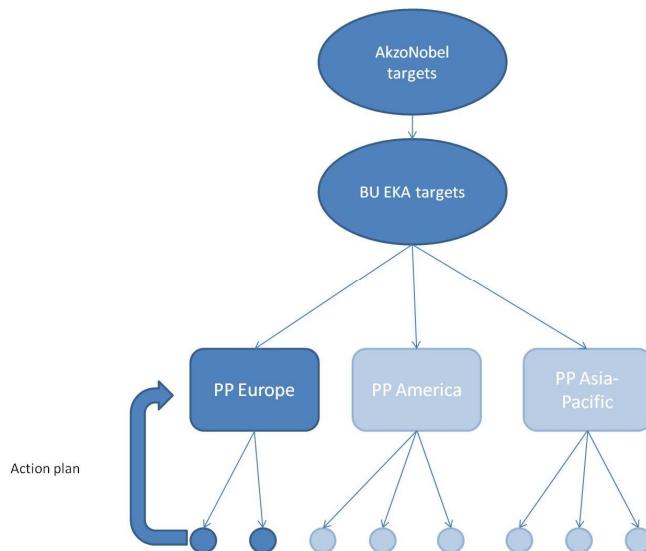


Figure 19: The target setting process

It is the responsibility of the BU HSE manager to translate the AkzoNobel targets to BU level, i.e. to Eka Chemicals. In the HSE-network the targets are discussed and it is decided what Eka Chemicals can contribute to the AkzoNobel targets and finally targets for Eka Chemicals are formulated. The HSE-network functions as the link between the site level and the target setting for Eka Chemicals. It is the task

of the sBU HSE managers in the HSE-network to claim the opinions from site level in order to make the goals realistic to achieve.

The sustainability targets and the targets communicated through the HSE organization are not fully consistent, which leads to that some targets are not communicated. The HSE organization has its focus on the environmental site parameters included in the operational eco-efficiency, but the full cradle-to-gate carbon footprint is not included. Scope 1 and 2 from the carbon policy is covered within the operational eco-efficiency targets, hence Scope 3 upstream is left out.

At PPE level

The Eka HSE targets, including sustainability, are sent out to the HSE managers of the individual sub business units and they translate the goals further to suit their respective organizations. The sub business units allocate the goals themselves, where they decide how they may contribute to the BU targets and then set the targets for their specific sBU. The results are then measured and followed-up to track the progress.

When the goals have been translated to sBU level, the next step is to translate the targets to site level. The process for doing this is described as performed in Pulp and Paper Europe (PPE) for 2011. It has been done in similar ways earlier years. In PPE a meeting was summoned by the QHSE department with product segment managers and personnel from Global technology, but not including environmental coordinators from each site due to difficulties in coordinating such a meeting. Instead the product segment managers were included with the purpose to spread the information further to relevant persons, whilst Global technology personnel were included since their efforts often are needed to reach the targets. At the meeting the goal was to set targets that were quantifiable and consistent across the segment so that comparisons can be made between products. At the meeting one short-term goal that should be tangible within 2011 and one long-term target that required larger investments were put up. The targets were decided on at the meeting and sent to the environmental coordinators of the sites.

The coordinators should propose an action plan describing how to reach the decided targets together with designating responsible persons and identifying the resources needed to reach the targets. The sites report back to the HSE department of Pulp and Paper Europe each quarter on their environmental performance in a TQI-reporting document. The action plan and reporting enables the HSE department of PPE to follow up on the progress of reaching the targets continually throughout the year.

The plan is that the HSE department should have regular meetings with the sites to follow-up on the performance of the targets.

At site level, the Eka DR case

At the site level of Eka DR, the targets are received from the HSE department in Pulp and Paper Europe. In the beginning of each year the management team of the site have a meeting to take into account, the AkzoNobel, Eka and PPE directives and the demands from authorities and decide on the environmental targets for the site. At site level they also put up more ambitious targets that are not demanded from PPE, to achieve a continuous improvement of the sites environmental performance.

It is the members of the management team of the site who have the responsibilities for that the targets are reached. As an incentive, they have the targets of their site connected to their P&D dialogue and they then delegate tasks to site personnel. The P&D dialogue is a personal target setting and evaluation tool used within AkzoNobel. P&D stands for Performance and Development dialogue and is used as a foundation for the performance review between the managers and the employees. The site personnel also have targets in their P&D dialogue connected to the targets for the site. All employees must have safety

targets, but the sustainability targets are also translated into the P&D dialogue of operators and other personnel. Not all employees have sustainability targets, the different topics are distributed across the work force.

At the individual level

In order to translate the targets to an individual level, each employee has a P&D dialogue, which is a tool for goal setting, development and feedback on a personal level. The P&D dialogue is evaluated two times per year in a discussion with the superior manager and also in smaller updates around the year.

As from 2011 all employees should have targets about safety in their P&D dialogue, but there is no common directive concerning environmental or sustainability targets. Some employees have personal targets for sustainability whilst others do not have this in their P&D dialogue.

6.6 The life cycle perspective of Eka DR

In this section the work with suppliers, production and customers will be described together with reflections around the sourcing, production and market and sales departments connected to the product Eka DR.

To give a background to the work performed in the product case study a presentation of the product and the "Sustainability assessment of raw material alternatives for Eka DR" is presented in the section 6.6.1 The product case study of Eka DR.

6.6.1 The product case study of Eka DR

In this section the product Eka DR will be described based on, public information available in Triantou's (45) master thesis and a brief summary of results from the sustainability assessment of raw materials performed within this master thesis⁶, see Appendix I Product case study of Eka DR for the full report. The LCA in the sustainability assessment was an expansion of the LCA performed by Triantou in 2009 (45).

The product Eka DR was used as a product case study in the master thesis⁶. To enhance our understanding of Eka DRs technical properties a sustainability assessment of raw material alternatives was made. It is constituted of a Life Cycle Assessment comparing the three raw material alternatives and a qualitative assessment of the social perspective of palm oil, see Appendix I.

Eka DR is an alkyl ketene dimer used in the paper making process. It is an internal sizing chemical, which is used to give paper hydrophobic properties. This gives the paper a more waterproof surface and better printing properties. Eka DR is produced in two major production steps. (45) The first is the Eka DR wax production, where the main raw materials are fatty acids and phosphorous chloride. After transportation to local dispersion plants, the wax is diluted to a liquid form and then transported to the paper mill.

Three different raw material alternatives for fatty acid are compared, tallow based fatty acid, palm based fatty acid and palm/rapeseed based fatty acid. The functional unit used in the LCA study is the amount of Eka DR required for sizing one tonne of copy paper and the system that was investigated was from cradle-to-gate, but also including the distribution to the paper mill. The impact categories that was evaluated was global warming potential, acidification potential, eutrophication potential, photo-chemical ozone creation potential and land use. Detailed results of the study with presentation of diagrams

⁶ Implementation of sustainability objectives from a product value chain perspective

comparing the different raw materials and dominance analysis for the different impact categories may be found in the full report in Appendix I.

The main conclusions of the LCA are that tallow based fatty acid is the best alternative from an environmental perspective since it had the lowest environmental impact in all impact categories. Much of this result is dependent on the allocation made between the tallow and the meat in the production process of tallow. The palm/rapeseed oil based fatty acid is the worst alternative in all but one impact category, since palm oil is a more efficient crop to grow than rapeseed. In the dominance analysis it was clear that the fatty acid is the most significant contributor to the environmental impact in all but two cases. If tallow based fatty acid is used in the production of Eka DR, also the starch in the dispersion process and the phosphorous chloride are significant contributors.

In the evaluation of social aspects of the palm oil several areas of concern were found. One serious finding was that there is evidence of both child labour and forced labour on palm oil plantations. To be able to avoid these unsustainable methods guidelines for certified sustainable palm oil has been developed by an organization called the RSPO – Roundtable for sustainable palm oil. The conclusion is that palm oil has several social concerns and a better alternative is to purchase certified sustainable palm oil or to visit plantations to perform own evaluations.

6.6.2 Working with suppliers

The main focus at Eka is on the suppliers of electricity for the production of bleaching products. This is due to the fact that the use of electricity accounts for major cost and is also the largest contributor to carbon emissions. However, emissions from raw material production is the second largest contributor in Eka globally and for the paper chemicals the raw materials are the most significant contributors to the carbon emissions and the Scope 3 upstream will therefore be one focus of this study. There are and have been a number of projects and initiatives in Eka concerning sustainability and raw material suppliers. During the sustainability project in 2009 the carbon footprint for a number of products was calculated. Supplier evaluations are performed and in this evaluation sustainability and HSE are included in general terms, but not specifically connected to the cradle-to-gate carbon footprint. There are discussions about the raw materials with most environmental impact and how these can be replaced. There is also research performed comparing substitutable raw materials, quality and environmental impact. For renewable raw materials social aspects are taken into account and certifications are investigated to avoid buying unsustainable options.

Few of the initiatives are directly connected to the carbon policy of AkzoNobel or the carbon management plan of Eka. When asking people involved in the sustainability work about how they work with scope 3 upstream they are aware of that it is included in the carbon policy, but they think that working with it is either not relevant for their particular work or that it is vague and complicated. Besides the yearly cradle-to-gate calculations made by the AkzoNobel sustainability expertise team, eco footprints are prepared for selected products and reporting into the carbon disclosure programme, but no continuous work is performed within Eka Chemicals. In the interviews with the people who are working close to Eka DR the information obtained from the respondents was homogenous, the carbon policy and its targets is not widely known and neither is the concept of working with the scope 3 upstream emissions.

In the cooperation with raw material networks and the AkzoNobel corporate purchasing department, sustainability is discussed and a sustainability presentation has been distributed to be used in contacts with suppliers. In this study, the purchasing department stated that they did not have any targets connected to sustainability or the carbon policy and there was no pressure from the top management at Eka to put focus on this. For the purchasing department it is important that it is transparent which

parameter that should steer the decisions. Today it is the profitability and quality that steer the purchasing decisions and not the sustainability aspects of the product.

Vi kan ju naturligtvis följa information och hålla oss uppdaterade, men målsättningar det måste komma från ledningsnivå.

Of course we can follow the information and keep up to date, but the targets have to come from the top management.

Quote, Purchasing personnel

[6.6.3 Working with production](#)

The basis for the environmental work on the site of Eka DR is the regulatory compliance of environmental permits that must be followed in order to be able to continue with the production. These regulatory limits of emissions have always been closely monitored and the work with following related environmental parameters is therefore not new at site level. At the Eka DR production site ISO14001 is used as the environmental management system. At the implementation of ISO14001 the whole staff at the production site was involved in mapping their environmental impact which led to that everyone is now well aware of permits and the main environmental impact from the production. Since the management system was implemented, the areas working environment, quality and production have also been included in order to be able to use one system for all areas. In addition, the site holds an incident reporting system where all staff can record incidents in any of the areas. The management team of the site revises the reported incidents and put an action plan into place. Targets from AkzoNobel, Eka and PPE have also been added to the site's environmental agenda.

The focus at site level is mainly on the parameters included in the operational eco-efficiency. Noticeable is that the mapping of carbon dioxide emissions and the work with carbon policy is new at the site and year 2011 is the first time that something connected to the carbon policy is included in their targets from PPE.

The responsibility for the environmental targets at the site is distributed across the site management team and they delegate tasks to the site personnel. The targets for safety, working environment and the environment have been spread across the P&D dialogues of the operators. The process RD&I department also have clear targets for environmental parameters that connect the sustainability targets of Eka to the production process of Eka DR.

At site level the respondents stress that their main task is to produce Eka DR and that their resources are mainly allocated to the production. Their main responsibility is to manage the production process and restore it if there is an incident. Therefore, there is little room to carry out extra tasks and projects for process improvements. Problems mentioned are vacant position at site level and change in the personnel, at the site and in the supporting functions.

Man har inte så mycket resurser att man kan peta in nya saker och det känner man när det hela tiden kommer nya direktiv. Det är inget fel på direktiven, men det matchas inte med resurser och det tror jag många känner.

We don't have a lot of resources so it is difficult to add new tasks, which is apparent when new directives arrive. There is nothing wrong with the directives, but they are not matched with resources, which I think many experiences in the organization.

Quote, Production personnel

[6.6.4 Working with customers](#)

One part of the marketing strategy at Eka is to keep the customer focus in all that they do. The customer support extends beyond the pure selling of products and into services surrounding the products.

Consequently, the focus of the environmental work is not only on Eka's own operations, but on how emissions can be reduced and how resources can be saved for the customer. Eka also has an ambition not to cooperate with customers that are involved in dubious business, which implies that they sometimes put pressure on customers to prove that they are working according to sustainable business principles.

Over a long time perspective, the number of customers requesting carbon and eco footprint has increased. Some customers are drivers of this development, like Wal-Mart in the American market. However, the overall demand from customers for more sustainable products and their willingness to pay is not large. Sustainability argumentation works, if the purpose is to market products that enhance the sustainability at the customer's production.

The respondents state that sustainability generally is not a sales argument, but it can be used to create a story around the product. The raw material is generally of importance for the customer. The raw material is interesting due to the understanding of security of supply, sustainability and to be able to prepare for the general debate about raw materials. To use renewable raw materials is not always positive from a customer perspective since the volatility of the prices is much higher.

Through internal surveys and strategy work at Eka, it has been concluded that there needs to be an enlarged focus on the external communication. In the communication with potential customers, the environmental arguments will be lifted to a larger extent in order to position Eka and its products as more sustainable.

At the local level of sales and marketing departments there was low awareness of the concepts of the carbon policy and operational eco-efficiency, but the Dow Jones Sustainability Index was more familiar. Also the parameters within the operational eco-efficiency were well known, but the sustainability work was not found very relevant for the marketing and sales personnel connected to Eka DR.

The respondents state that they do not have any targets on sustainability and that this is a barrier for working with sustainability more actively. If it is neither included in the work description nor in the personal targets, they cannot prioritize these questions in their workload. There needs to be a clear statement from the top management at Eka that these questions are prioritized for the personnel, in order to be able to prioritize this. This is not the case as per today.

[6.7 The international perspective – Americas and Asia-Pacific](#)

In the American and Asian-Pacific regions the work with sustainability and HSE are coordinated under one role and are not divided into two as in Eka's global organization. In the Americas, the responsibility of the sustainability personnel is wider than in the European region, covering for example regulatory affairs and product stewardship. The organization of the two regions differs in some respects. The American region is organised in a similar way as the European, with a HSE/Sustainability department and personnel responsible within these departments for different areas of expertise like environment, quality and safety. The Asia-Pacific region is, on the other hand, organised according to country and there is both central HSE-resources and HSE resources in the different countries.

Both Americas and Asia-Pacific receive targets from the BU level and translate them further into their organizations. The two sBUs have brought up different examples of their sustainability work. The American region has performed an educational marketing campaign intended for the public and mostly aimed at schools, industries, conferences and customers. The purpose of this campaign was to change

the negative perception of the chemical industry. In the Asia-Pacific region, changes are primarily driven by cost savings and not by the concept of sustainability. An operational point of view is used to work with energy and transport savings. A major problem is lack of competencies. It is difficult and expensive to hire personnel with the right competence within HSE and that speak English.

6.8 Cooperation and communication

Within the sustainability group, the participants have a close collaboration and well functioning communication. The respondents state that they have a good contact with the two key persons, the sustainability focal point and the BU HSE manager. The networks seem to function as forums where different business functions and expertise can meet and interact.

The internal communication within Eka concerning sustainability has previously been intertwined with other internal communication and has not been presented separately. The targets investigated in this study, of the carbon policy and operational eco-efficiency, have not been communicated separately.

According to the answers, from the respondents who are not directly connected to the sustainability work groups, the awareness of the two sustainability targets appears to be low in the organization. However, the Dow Jones Sustainability Index and the target for a top three placement are well communicated throughout the company⁷. The concept of operational eco-efficiency was not known, but the parameters included were, in general, more familiar. The parameters included in the operational eco-efficiency are not new and have been measured in the production also before the target connected to the DJSI was issued. It is merely the combination of these nine specific parameters and the focus it puts on the efficiency of production that is new and collected under the term of operational eco-efficiency.

The AkzoNobel carbon policy and its targets were not known by any of the interviewed persons at functions connected to the Eka DR production. This picture of low awareness is supported by the statement that the carbon management plan has only been communicated within Eka to a certain extent.

6.9 Attitudes and motivation

The attitude towards the environment and working with environmental performance improvements are very positive at Eka. Since not all of the respondents in the Eka DR group were familiar with the targets, it was not possible to map the attitudes in detail. Overall the respondents that knew about the targets were positive towards them. They stated that the targets were perceived as ambitious, but that it is good that the targets are this ambitious. They also stated that in order to reach ambitious targets, you need to take action and allocate resources for achieving the targets. The high ambition also implies that there will be a cost involved in meeting the targets.

Man måste spänna bågen för att komma någon vart och få förändring, så de [the carbon policy targets] är egentligen ganska bra satta.

You have to try hard to get somewhere and achieve change, so they [the carbon policy targets] are appropriate.

Quote, RD&I personnel

The bonus system is not relevant for most respondents and therefore the personal motivation is what drives them forward. All respondents have a high personal motivation and want to work with reducing the impact on the environment. Even if some of the employees do not have targets for sustainability, they still

⁷ This target changed during 2011, as to be a leader in sustainability.

point out improvement potentials and make changes happen, whilst others find it difficult to prioritize sustainability in their full workload.

7. Selection of areas of interest

After reviewing the empiric material collected by interviews and from internal documents, four areas of special interest were defined that will be more closely analysed. As a basis for the selection of topics, the theoretical framework presented in chapter 5 was used.

These four areas of special interest were chosen:

- Communication regarding the strategy to be implemented is important and in the interviews large differences in the level of knowledge have been located amongst different personnel categories.
- Throughout the interviews performed at Eka, the strong motivation and positive attitudes towards working with sustainability was prominent. This is a success factor for implementing targets in an organization.
- The target setting process and how measures to reach the targets have been planned and executed were followed throughout the organization. For success, it is essential to have targets at all levels that are connected to the strategy. Both well established structures and room for improvements were found within Eka.
- Lack of resources both in the form of money for investments and lack of personnel is a common barrier to implementation. These barriers are also reasons that have been expressed by the respondents, as to why different measures have not been taken to reach the appointed targets.

8. Analysis

With background in the analytical framework and the empiric mapping of the sustainability organization at Eka Chemicals, the analysis is presented in this chapter. The first four sections are areas of special interest that are directly related to the analytical tools: awareness, motivation, targets and resources. The two latter, the carbon policy: scope 3 and operational eco-efficiency are the consequences, i.e. the impact that the former areas have had on the two targets that are studied in this report.

8.1 Awareness

The awareness of the sustainability concepts and targets vary greatly across the personnel at Eka Chemicals. The awareness will be analysed based on the four steps: strategy awareness, strategy mind share, strategy loyalty and strategy missionary (39). They are presented as five steps in Figure 20.



Figure 20: Steps of awareness

The persons involved in the sustainability work have a good understanding of the concepts and targets involved. Sustainability is well implemented in their day-to-day work and they are therefore mainly in the step of strategy loyalty, see Figure 21. These employees are mainly located at a global level of the company and at regional and local levels in the part of the organization working with the production.

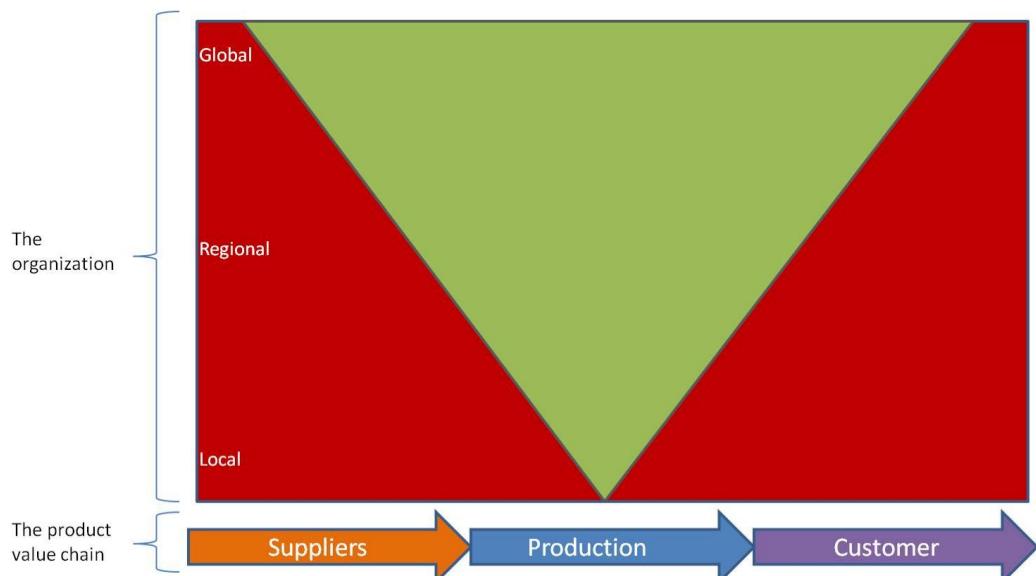


Figure 21: Awareness of the two concepts carbon policy and operational eco-efficiency.

There is one part of the targets that even the personnel working closely with sustainability do not demonstrate full strategy loyalty towards. It is the scope 3 upstream, meaning emissions from raw material suppliers, of the cradle-to-gate target in the carbon policy. Towards this some express less understanding of the target, that it is vague, difficult and not applicable to Eka Chemicals. In this case the persons working closely with sustainability may be considered as being in between strategy awareness and strategy mind share, see Figure 22. The work concerning scope 3 upstream will be further analysed in section 8.5 The Carbon Policy: scope 3 upstream.

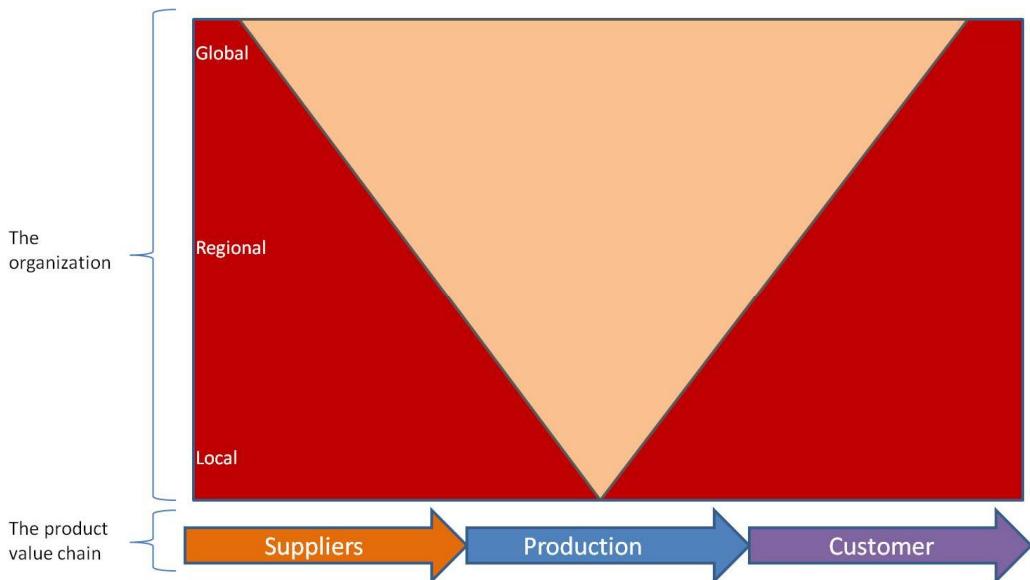


Figure 22: Awareness of Scope 3 upstream in the carbon policy

Some of the personnel working with sustainability are also engaging in strategy missionary, by teaching and motivating others to implement the strategy (39). The strategy missionary is mostly performed by rich communication channels, like face-to-face communication, trainings and presentations within the business unit (39). Rich communication channels are effective for the understanding, but limited in its reach (39). The use of such channels mirrors in the organization of Eka where a few people that work in a close cooperation with personnel closely involved in the sustainability work have a very good understanding of the concepts and targets, whilst other working less close have not. The communication has consequently been effective, but it has not reached very far. An evident example of this is that the respondent in the process RD&I department, who has the sustainability focal point as a manager, had a higher awareness of the concepts and targets, compared to the other functions in the cross-section interviews.

Sustainability and the work with the specific sustainability targets have been communicated intertwined with other messages in the internal communication at Eka. In the interviews with the cross-section of personnel in the business functions not connected to the sustainability workgroups, the awareness of the concepts connected to the sustainability targets varied (39).

One focus of this thesis is the targets in the operational eco-efficiency, which are closely interrelated to the AkzoNobel strategy of being top three in Dow Jones Sustainability Index (DJSI)⁸. The DJSI target has been well communicated across all business functions, and to people both working directly with

⁸ This target changed during 2011, as to be a leader in sustainability.

sustainability and not. The strategy awareness is therefore in place. Strategy mind share is not equally well established, since not all state that they have fully understood the DJSI ranking and how it affects their daily job. When it comes to operational eco-efficiency as one part of the DJSI all respondents are aware of the parameters included, in contrast to the actual concept and targets themselves. The nine parameters included in operational eco-efficiency have been measured and followed-up in the production of Eka during a long time within the HSE-organization. This is probably the reason for why they are more familiar. The concept of operational eco-efficiency as a part of the DJSI has not reached strategy awareness amongst the people working in sourcing, sales, marketing and production, but not directly working with sustainability questions, see Figure 20 and Figure 21. Only the process RD&I respondent, who also has the sustainability focal point as manager, was aware of the concept operational eco-efficiency. For the carbon policy and its targets the awareness was even lower than for operational eco-efficiency. None of the respondents knew the concept of the AkzoNobel carbon policy or its targets, one respondent could recall hearing about it after the interviewer described the policy and its targets.

Within Eka and between for example the different business functions there is not always established communication channels. For example a respondent answered that in theory, but not in practice there is a link between the marketing and sourcing departments. By not having this communication the work in the product chain is obstructed.

Documents concerning sustainability are not widely communicated within Eka. One example of such a document is the AkzoNobel corporate dashboard (internal version) with the KPI:s of sustainability. This is mainly used and communicated to the top management, and is not widely known.

8.2 Motivation

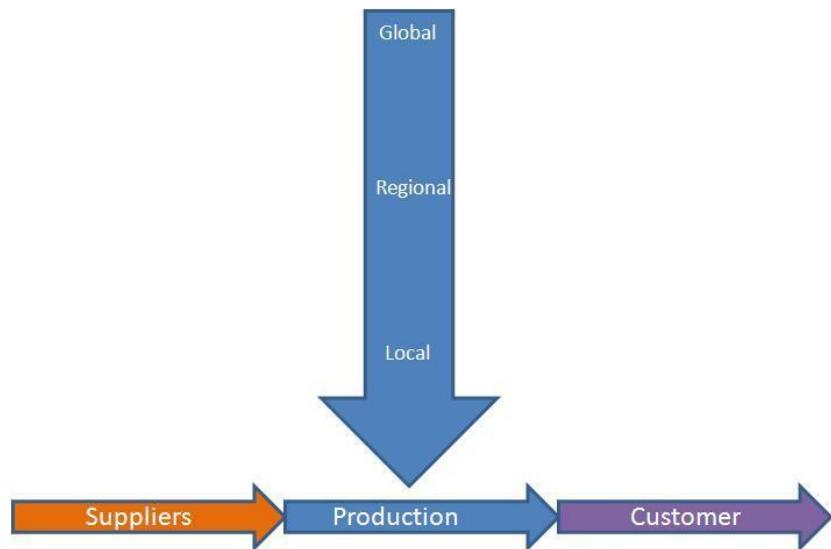
There is a bonus system in place at Eka Chemicals, but it is mainly directed towards the top management. All the respondents did instead mention a strong intrinsic motivation (40) as their main driver for working with sustainability. High intrinsic motivation indicates that the employees feel that their work is interesting, challenging and important (40). Employees at Eka interviewed in this study also state a high belief that Eka is doing good things for society and respondents are proud of the company. All this forms a good foundation for Eka to continue their work towards a full alignment of the corporate sustainability strategy. (6). By having motivated employees, changes will be well received and it will be an easier task to align the sustainability strategy and objectives with the working processes.

Since the awareness of the sustainability objectives is low in the cross-section of employees across the business functions, it was not possible to investigate the attitudes towards the specific targets in detail. The respondents closely connected to the production site had most relevant knowledge and could therefore also elaborate about their attitudes. At site level the attitude towards the targets is not entirely positive, since they perceive a lack of possibility to take action which will lead to reaching the targets. At site level the common perception is that they have been given the responsibility, but not the resources to live up to that responsibility.

To overcome this, more resources are needed, but the management can also complement that with two other actions that help increase the motivation and change attitudes. The first is to involve lower levels of the company in the goal setting process. By doing that more closely, the probability increases that involved departments perceive the goals as reasonable (17). Secondly, managers should communicate how employees contribute to reaching the goals in order to enable a better understanding and subsequently hopefully increase the motivation for working towards these targets (17).

8.3 Targets

There are two main ways to structure the target setting process, the top-down and the bottom-up approach. The top-down approach is more suitable when it is possible to define aggregate goals that can be translated through the organization and by that allocate responsibility. In complex organizations where the relevance of the targets varies by unit, the bottom-up approach is more suitable since the knowledge of the local situation is crucial to the success of the implementation. (6)



As portrayed in Figure 23, Eka uses a top-down approach when translating their goals through the organization. The target setting process for the two sustainability targets are mainly handled through the HSE department. Common targets are set up at AkzoNobel level and translated to BU level within Eka and then further down to sBU level and site level. To collect knowledge of the local situation the HSE department functions as a link between the sites and the BU HSE manager. The local situations vary significantly in Eka, since the sites produce different products their conditions and major impact on the environment differ. Therefore, all targets are not applicable at each site. Today these issues are handled so that the HSE departments at sBU level help with prioritization of the targets for the sites. They also try to communicate the conditions of the sites to the higher levels of the company so that the sites' situation can be taken into consideration in the process of setting the targets. According to Olve et al, if unit specific goals are used, the bottom-up approach is more suitable since deep insight is required of the local conditions (20). Eka could benefit from using more of a bottom-up approach in their target setting process. By doing so, they would include the local conditions earlier in the target setting process and thereby set targets that are more relevant for the sites, which will lead to higher commitment to reaching the targets (20).

At the translation of the targets to the site level, a meeting is organised between product segment managers, the sBU HSE department and the Global technology owners to allocate the targets further down to the site level. In this forum it is beneficial for the results of the targets if more personnel from site level will be included. From site level it has been expressed that some targets delivered from the sBU HSE department are not realistic. If site personnel will be closer involved in the process this gap in perception of the targets may be decreased (39). The gap in perception has arisen due to the fact that the

local situation at each site differs and hence more knowledge and better understanding of that situation is needed to set relevant targets. The bottom-up approach together with a closer involvement of the site personnel will improve the target setting process. During the last years actions for working in this direction have been taken by the sBU HSE department, but there is still room for further improvements.

8.3.1 Lack of targets

When reviewing the target setting process in Eka for the two targets studied, it is visible that the HSE organization manages the target setting in their already established and well functioning structure for environmental and other targets. The targets setting process, through the HSE department, has its focus on the operational side connected to the production sites, and lacks the focus in the value chain, hence there are no targets for operational eco-efficiency and carbon policy in the purchasing, marketing and sales departments, see Figure 23. For operational eco-efficiency the focus in production is understandable, but for the carbon policy there should be a broader set of targets.

Out of three scopes in the carbon policy, only two are included in the targets communicated by the HSE department and this is the scope 1 and scope 2 that are connected to the direct operation of the production sites. Neither scope 3 upstream, nor the full cradle-to-gate process have got a target and is not further mentioned in this communication. This area will be further analysed in section 8.5 The Carbon policy: scope 3 upstream.

As mentioned in section 6.5.4 The target setting process, the translation of the environmental targets is structured through the HSE organization and reaches all the way down to site level. For a successful implementation it is important to link the strategies of the company to concrete team and personal goals of the employees. (6) In the crosscut of the business functions, including the respondents not directly connected to the sustainability work groups, respondents from the sourcing, sales and marketing departments stated that they did not have targets connected to the targets of focus carbon policy and operational eco-efficiency, nor to sustainability in general. There was nothing mentioned in their job description about sustainability and there was no pressure from the management to work with these topics. Without translation of the high-level strategic goals to the individuals of the business functions, there is no incentive for working with sustainability. The lack of alignment of the targets in the organization is mentioned as a common barrier for reaching alignment with the corporate strategy. (20) The major objective will then instead be financial and this trend can be seen within Eka as well (20). The respondents not having sustainability targets mentioned profit and quality targets as their main drivers of their work.

In AkzoNobel safety is very highly prioritized and recently there was a global directive that all employees should have safety targets in their P&D dialogue, this includes every employee from operators in the production to staff within the business functions and top management. To align the sustainability strategy with the objectives of the departments, sustainability should be a target for every employee like the safety target already is (6). This would increase the awareness of sustainability across the organization and imbed sustainability in the thinking of the employees. Since the personal motivation of many employees is high, see more in the analysis part 8.2 Motivation there will probably be little problem incorporating a sustainability target. This will then show that sustainability is prioritized from the management team and enable time and resources to be spent on this.

8.4 Resources

A common barrier to implementation is lack of resources in the form of knowledge, time or money (20). When asked the question about barriers to implementation, no one in Eka answered lack of information. This can probably be connected to the two groups of respondents used in the interviews. The first group

were all closely involved in the work processes surrounding the sustainability objectives and consequently had good knowledge of the subject. In the second group of persons, the cross-section of business functions connected to Eka DR, the knowledge of the concepts were low, but since many did not have targets for working with sustainability, they saw no need for more knowledge in the form of information. Their main barrier was instead not having sustainability targets, which is further analysed in the section 8.3 Targets.

Time and money were often mentioned as barriers to the implementation of the operational eco-efficiency and carbon policy targets. These barriers were mainly mentioned by the cross-section respondents that did have targets connected to sustainability, like process RD&I and the site personnel. Difficulties of getting investments are mentioned as a common barrier. The investments connected to sustainability objectives are evaluated together with other investments in the operations organization within Eka. For some investments connected to environmental improvements the payback time may need to be prolonged, but that is not the case today because there are no criteria defined for such investments. According to the sustainability focal point within Eka, it is possible to approve investments with longer payback times when these are generating a significant improvement to the environmental objectives, but in the interviews performed no evidence has been found that such change in criteria takes place. Instead, there is an indication that the payback time sometimes needs to be even shorter than the recommended for the investments to get funding.

Especially at the production site, lack of personnel and therefore time, is mentioned repeatedly as the main barrier to implementation of the sustainability objectives. According to the personnel at the site, they only have resources allocated to manage the plant's daily operations and their main goal is the production volume target. At the production site of Eka DR there has also been several vacancies leading to an even less amount of personnel and time available. Adding sustainability objectives and reporting demands time that is not always available. More resources have not been allocated to the site for handling new tasks and driving projects for improvements. The site is the main responsible for reaching the targets set up for that site, but they have no extra budget, nor personnel to reach these new targets. Resources are allocated also in support functions like the process RD&I and sourcing departments, but also in these positions there has been change in staff who needs time to learn the job and get into the new position before real changes can be made to the production process. There are several initiatives and research projects, but nothing that has lead to changes of the production site yet.

8.5 The Carbon policy: scope 3 upstream

By having a life cycle thinking and implementing life cycle management (LCM) in business many competitive advantages can be achieved (14). When operating according to life cycle management, a company will manage and organise the environmental work not only in its own company, but along the full product value chain (16). At present, the focus at Eka is mainly on the company's own operations and improving the production process to reduce the environmental impact. However, the life cycle way of thinking is partly in place, mostly connected to the downstream customer perspective and setting the environmental improvements in perspective to avoid sub optimization. Eka has a focus on the customer, and producing products that for example reduce the customer's use of fibre, water and energy.

AkzoNobel's focus area includes the downstream application, but at present the focus is on the scope cradle-to-gate for the environmental measurement and reporting. Since Eka has not managed to implement this scope fully in the organization, the life cycle thinking is somewhat limited.

Although available on the intranet, the carbon policy has not been widely communicated within Eka Chemicals and the awareness is low (39), which became evident when interviewing the business functions' cross-section that is not connected to the sustainability groups. Among the managers in the

sustainability groups, the awareness is high, but the scope 3 upstream is perceived as quite vague and difficult to affect. The predominant opinion among these managers is also that the carbon footprint for Eka is low for raw materials and that the sourcing of these accounts for a very small difference for the customer. In the sBU HSE organization, the carbon policy and its targets is quite new and was just this year added to the agenda. At the site level, this work is also new and they have been asked to map their emissions of green house gases.

When reviewing the internal targets it is apparent that for the absolute emissions of scope 1 and 2, the target for 2020 at present is reached and the main challenge will be to keep that low level of emissions while increasing the production. For the full cradle-to-gate footprint in tonnes CO₂-equivalents per tonne of product, the 2015 target has not yet been reached and more work is consequently needed to reach this target.

After having performed the interviews with the selected key persons at Eka Chemicals, it was clear that the efforts put on the Carbon policy from a life cycle perspective and then especially on scope 3 upstream were limited. The scope 3 upstream represents the emissions that suppliers of raw material contribute to the cradle-to-gate carbon footprint. The other two parts of the cradle-to-gate foot print, scope 1 from own production and scope 2 from energy used in own production, are more naturally included since they are both a part of the operational eco-efficiency program which is highly prioritized and has a structured goal-setting process through the HSE organization.

According to the carbon footprint for Eka from 2009, the scope 3 upstream is the second largest contributor to the total emissions. This should be a good motivation for a focus on this scope, but in the present situation the strategic goals including the cradle-to-gate are not aligned with individual and team goals and not translated into concrete action (39). Within the sBU HSE organization it was explicitly stated that they do not work actively with suppliers due to the fact that there is no pressure on this from a superior level.

The sourcing department at PPE has a close contact with its suppliers and perform for example supplier evaluations. However, the sourcing department does not have any targets or incentives from top management to work with the suppliers from a carbon management point of view. To align the strategy throughout the organization, the concrete goals for the sourcing department need to be specified (39). By engaging in close cooperation, products and processes may be developed to produce a lower environmental impact (24). Since the networks and contacts are already in place between the sourcing department and the raw material suppliers, it would be beneficial for Eka to engage in a closer contact with suppliers also regarding the carbon policy and reduction of emissions. This would be a major step towards reaching the AkzoNobel carbon policy target.

According to Kaplan and Norton (6), if the strategy really should change behaviour patterns there needs to be a link between the incentives and the achievements of the targets. The importance of incentives is apparent in the work processes of Eka Chemicals. The operational eco-efficiency is a part of the DJSI, to which a bonus program is connected for the top management. Therefore, the focus throughout the organization lies also much more on the operational eco-efficiency than on the carbon policy. Also within the carbon policy, it is clear how the bonuses have an effect on the work processes. The scopes 1 and 2 that are included in the operational eco-efficiency, and therefore steered by the bonus program, are in focus for the target setting as well as for the follow-up processes. The scope 3 upstream, which goes outside the range of the bonus program, is subsequently of minor importance even though the scope 3 upstream is significantly larger than the scope 1, as presented in section 6.4.3 Carbon policy targets.

8.6 Operational eco-efficiency

In this text the aim is to describe how the sustainability organization in Eka and its way of working has affected the work with reaching the operational eco-efficiency targets.

The awareness of the nine parameters included in the operational eco-efficiency scheme is high across the whole organization, both amongst employees working directly with sustainability and employees not doing so. The nine parameters included in operational eco-efficiency are common site parameters that have been measured at site level for a long time, hence they are not new measures. Operational eco-efficiency though, is a new concept and this concept is not widely known, even though the parameters included in the concept are.

The parameters within operational eco-efficiency are mainly connected to the activities at the production site, therefore it is also most important that knowledge and targets have been translated to this level. The targets are translated through the HSE-organization which has a well established structure for translating the targets for environmental parameters. The translation of goals connected to the nine parameters function well and relevant units and persons have targets connected to the operational eco-efficiency. To increase the commitment to the targets, more of a bottom-up approach could be used which implicates a closer involvement of the site personnel in the target setting (20). Purchasing, sales and marketing have awareness of the parameters included in the operational eco-efficiency, but they do not have targets connected. This is also not always relevant, since their work is not directly connected to the production site and therefore they cannot directly affect the site's environmental parameters.

According to the respondents, the main barrier to achieving an increased operational eco-efficiency is getting investments approved and lack of personnel. Several of the supporting employees connected to the production of the Eka DR series, which is the case in this description, like purchasing and process RD&I are new in their roles and hence have had little possibility to affect the result so far. Also at site level several changes in personnel and vacant positions have impacted the situation. New targets have also been added to the responsibility of the sites, without adding any extra resources. It is important to point out that resources and clear prioritization, in the form of money for investments and personnel are crucial to achieve results, this was also commonly mentioned by the respondents as their main barrier.

In summary, according to the result of this master thesis there is no organizational barrier to increasing the operational eco-efficiency of the production in Eka Chemicals, since there is a good awareness and targets are allocated to significant sites and employees. To be able to reach significant improvements of the operational eco-efficiency, more resources at site level and funding for investments are instead needed.

9. Conclusion

The awareness of the sustainability objectives is diversified in the organization of Eka Chemicals. From very high awareness, understanding and missionary amongst the personnel working directly with sustainability in the organization, to low awareness amongst personnel from several different business functions, that is not directly involved in the sustainability work. The one concept that is known by everyone is the target of top three ranking in the DJSI⁹, even though all do not have an understanding of what that target means.

Eka Chemicals have a favourable situation with high motivation for working with sustainability. This they should use in the implementation to create a closer alignment of the strategy. At site level they could work to increase motivation towards the specific targets by involving the site closer in goal setting and having better communication of the cause-effect-chains connected to the targets. This would lead to a better understanding amongst the employees of how they contribute to the targets.

Overall the target setting process is well functioning at Eka. It is managed by the HSE organization which has a well established structure for setting and communicating the targets. The process could benefit from a more bottom-up approach and by involving the local site personnel closer in the process of setting the targets. By doing this a greater commitment to the goals can be achieved. A problem for reaching an implementation of the strategies is that several employees from different business functions do not have targets connected to the investigated sustainability objectives and therefore have no incentives to work with these questions.

Lack of resources is commonly mentioned in the interviews as a barrier to reaching the targets. Getting funding for investments is a problem if the payback time is longer than three years. A second resource lacking is personnel to work with improvements, especially at the site level.

In the carbon policy, an area has been identified as to have little focus even though the emissions are large, the scope 3 upstream part of the cradle-to-gate footprint. Targets concerning this part of the key focus area have not been translated into the organization and consequently no common approach has been taken to reduce emissions from scope 3 upstream.

⁹ This target changed during 2011, as to be a leader in sustainability.

10. Recommendations

Based on the areas of special interest and the consequences for the two targets in chapter 8, some areas for improvement have been identified. These areas are presented in this chapter, as recommendations for the continuous improvement of the sustainability work at Eka Chemicals.

10.1 Recommendations for the two targets

The first recommendation is to increase the awareness of the two targets, i.e. of the carbon policy and of the operational eco-efficiency. This can be achieved by means of a communication program, with the purpose of reaching the stage of strategy missionary, as described in section 5.1. It is of great importance to include the question "How will we know that the communication has been received?" (section 5.1.1) when developing the communication plan. To include the follow-up and evaluation of whether the receiver has understood the message is crucial for successful implementation.

In addition to the communication program, it would be advisable to further develop the sustainability training and increase the number of employees that have been trained. The sustainability training should preferably be adapted to the different groups and functions within the company.

Second, it would be recommended to include the sites more in the target setting processes by using the bottom-up approach in the way it is presented in section 5.2. This would increase the commitment to the two targets and consequently induce a better result in the sustainability performance.

To further advance the commitment to the targets, incorporating sustainability goals in the P&D Dialogues for all employees could be the way towards achieving that everyone is working with the corporate strategies. This does not imply that all employees should share the same goals; on the contrary the goals should be differentiated as far as possible.

The third recommendation is to assess the prioritizations between different targets for the production sites and communicate this in a more explicit way than the previous procedures. Once these prioritizations have been made for each site, it is of high importance to provide the corresponding resources that are necessary in order to reach the targets, e.g. monetary funding for investments and an adequate number of personnel, but also assistance and guidelines for how to proceed. Section 5.4 provides further guidance in this matter.

Since Eka Chemicals has an unexhausted asset in the high intrinsic motivation, the fourth advice is to make use of this to a larger extent than before. Due to this, many possible win-win scenarios are to be explored. For example, the recommendation above for increased resources could be balanced with this high motivation so that the output result will probably be larger than the input of resources. The bottom-up approach will also contribute to a further increase of the motivation and consequently a decrease of the need for additional resources.

Based on the reasoning in section 8.5 and 8.6, the main recommendation of this master thesis study is to increase the work with scope 3 upstream at Eka Chemicals. As a starting point, the following key points could be taken under consideration:

- Further develop the sustainability purchasing strategy, with consideration to the analytic results in section 8.5. While doing this, it might be worthwhile to make use of the expertise that is to be found in the AkzoNobel corporate sourcing organization.
 - To emphasize the significance of the raw material purchasing even more, it should be the purchasing organization that owns the targets.
 - It is of great importance that there are targets set up, and aligned, at all levels throughout the purchasing organization.
 - Include the global raw material purchasing function more in the global sustainability work groups.
- Once the sustainability purchasing strategy has been formulated and the appurtenant goals have been assigned, the key to successful implementation is to communicate this to all parties concerned. See the first recommendation above.
- Even though the purchasing organization is in focus for the future work with scope 3 upstream, the outcome of this work also largely depends on other functions within the company such as Process RD&I, Global Technology and Product development. One way to integrate these functions further with the purchasing organization and increase the awareness of the scope 3 upstream situation, could be via directed training for these groups.

However, the increased work with scope 3 upstream is merely for the present situation, it is the theory behind – the life cycle thinking – that is important to include in all the work processes. The aim is to integrate the corporate sustainability targets in the core activities and to establish collaborations between different functions and actors throughout the organization as well as with external stakeholders. This aim constitutes the very essence of sustainability, the integration as a means for continuous improvement, whereas HSE is more of a route for environmental work at site level.

[10.1.1 Pathways for implementation](#)

As a first step for the integration process described above, a more close collaboration between the marketing and sales side on one hand and the purchasing side on the other would be recommended. This is so that the purchasing side is aware of the customer driven demand and that the marketing and sales side is conscious of what improvements that have been made, that are in process and what can be made.

Another route for successful implementation is to establish a stronger connection between the goal setting process and the sustainability expertise, as portrayed in Figure 24 below. The parties which are to be connected could for example be the global function for business development and performance measurement by balanced scorecard at Eka Chemicals and the corporate AkzoNobel sustainability expert team. The link between these two parties would mainly be through the sustainability focal point, but also through the HSE managers, both global and regional, and the different sustainability workgroups at Eka Chemicals.

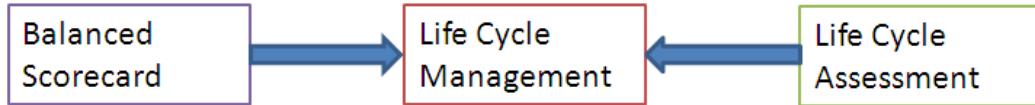


Figure 24 The methodologies that combine to form Life Cycle Management.

Once these pathways for implementation have been established, the journey towards Life Cycle Management may emerge and prosper at Eka Chemicals.

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Sustainability assessment of raw material alternatives for fatty acid in Eka DR

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Abbreviations

GWP – Global Warming Potential

POCP – Photo-chemical Ozone Creation Potential

AP – Acidification Potential

EP – Eutrophication Potential

F.U. – Functional Unit

LCA – Life Cycle Assessment

1. Introduction

This study is one part of a master thesis project. The master thesis project has as its overall aim to map and analyse the sustainability work at Eka Chemicals.

As part of the master thesis a product case study is performed for a product in the paper chemical segment, AKD, Alkylketene Dimer (from here on called its product name Eka DR). The case study investigates the sustainability performance of three feasible alternatives to tallow based fatty acid that is currently used as a raw material for Eka DR. The sustainability performance is investigated from three perspectives; people, planet and profit.

The environmental perspective (planet) is investigated by using Life Cycle Assessment (LCA). The LCA study is an expansion of an already conducted study called *Carbon, Energy and water footprint of three AkzoNobel internal sizing chemicals - A cradle to gate LCA related study*. The study was conducted by Adamantia-Dimitra Triantou in 2009 (1). The conclusion of that study was that Eka DR was the best alternative out of three.

1.1 Goal

The main goal of this study is to be a support for process development of Eka DR. The alternatives to tallow based fatty acids will be evaluated from three perspectives; people, planet and profit. A secondary goal is to prepare for the creation of an eco-footprint leaflet.

The main question for the study is:

- Are there sustainable options to tallow based fatty acids that can be used in the production of Eka DR?

The options that will be considered are palm oil based fatty acid and a fatty acid made from a palm oil and rapeseed oil mix.

A correction of a minor modeling error from the project in 2009 will be made, which includes adding an allocation factor to the LCA-model. The environmental perspective will be quantitatively treated in the LCA study and qualitatively in an assessment of palm oil.

The social part (people) will be discussed qualitatively with focus on palm oil, since this is the most relevant raw material for a social discussion.

Since the economic part of the evaluation (profit) involve confidential information, this part will be discussed in a confidential appendix.

2. Life Cycle Assessment of Eka DR

This study is performed according to the methodology for Life Cycle Assessment described in Baumann and Tillman (2).

The production process of Eka DR is described by Triantou (1). In this section only changes made compared to Triantous system will be described, together with the modeling alternatives.

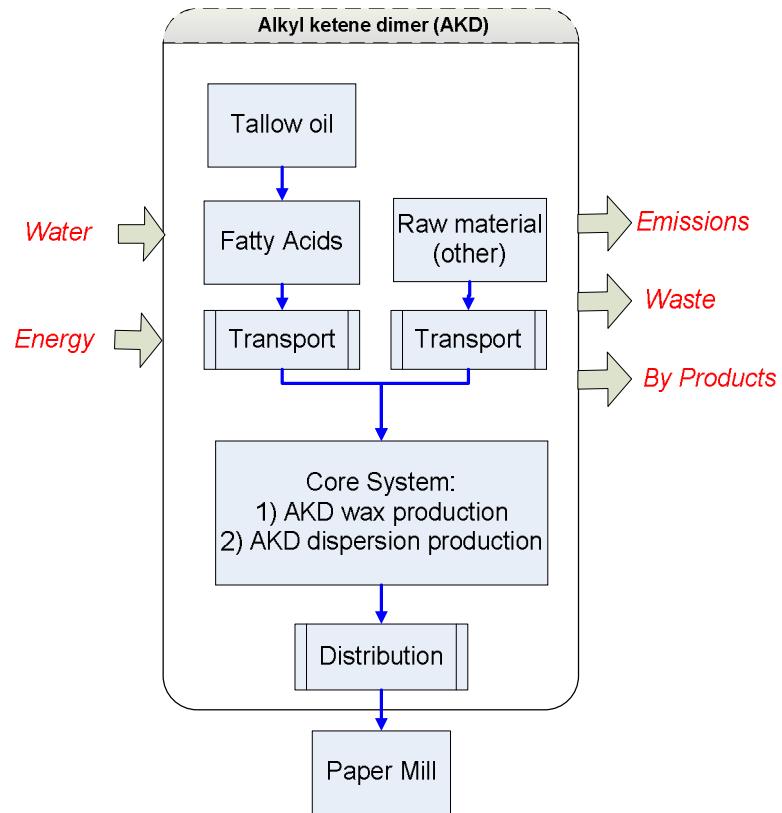


Figure 4: The flowchart from Triantou's thesis. (1)

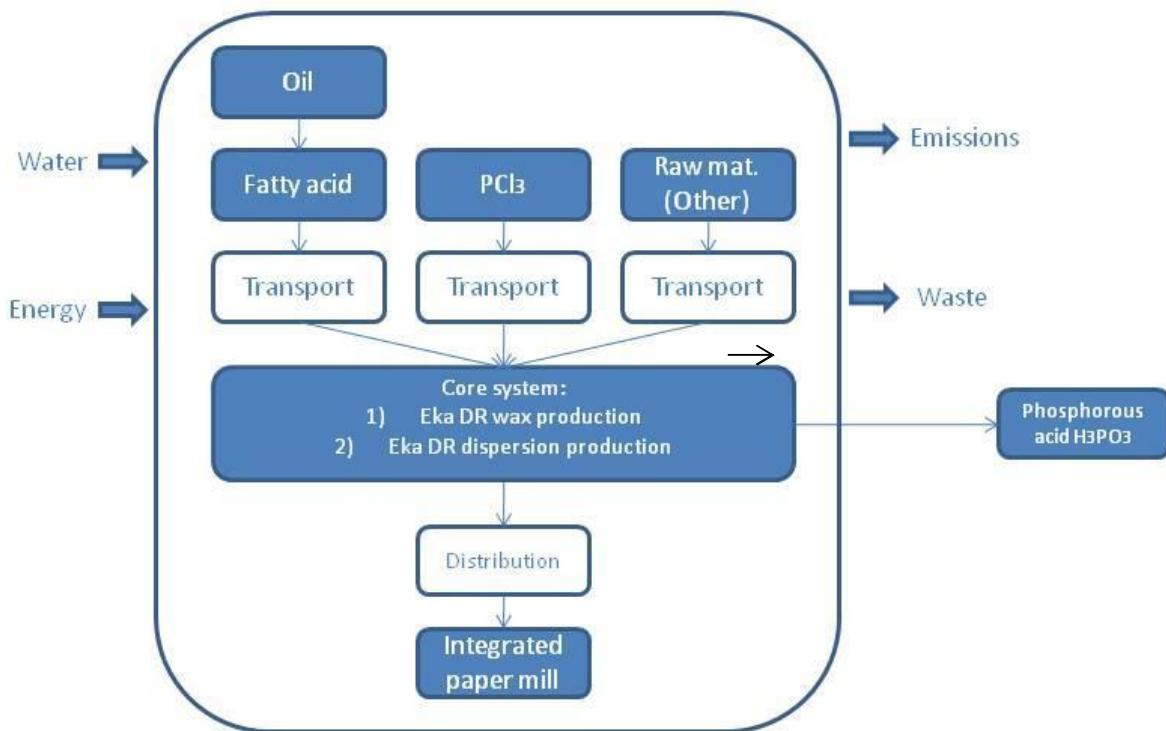


Figure 5: The flowchart for the current LCA study. The flowchart is based on the flowchart in Triantou's master thesis report (1).

The flowchart model has been changed in two aspects.

1. Phosphorous acid has been regarded as a byproduct and an allocation of emissions between Eka DR wax and phosphorous acid has been included in the model. The phosphorous acid is collected at the site by the supplier of PCl₃. In Triantou (1) the allocation was not included, which resulted in that all emissions were allocated to the Eka DR wax.
2. The paper mill has been included in the flowchart to enable better understanding of Eka DRs role in the paper making process.

2.2 Options to model

Three raw material alternatives for fatty acid have been compared in this study. The choice of modeling options was based on an interview with personnel at Eka (3).

1. **Tallow based fatty acid** – This raw material is commonly used today in the Eka DR wax production and was the raw material that Triantou (1) used in her master thesis. Tallow is a waste stream from the butchery process.
2. **Palm oil based fatty acid** – An alternative to tallow based fatty acids is palm oil based fatty acids. Palm oil is extracted from the flesh of the fruit of the palm tree (4).
3. **Palm and rapeseed oil based fatty acid** – The third alternative is a mixture of palm oil and rapeseed oil as raw material for the fatty acids. In the model, the ratio between palm oil and rapeseed oil is set to 76% palm oil and 24 % rapeseed oil. The goal with the ratio is to achieve a chain length distribution similar to tallow.

2.3 Functional unit

The functional unit is the same as in Triantou (1), the amount of Eka DR required for sizing of one tonne of copy paper.

2.4 Assumptions

The following assumptions have been made:

- To produce one tonne of copy paper 0,9 kg of Eka DR is required (1). In reality the amount varies depending on production conditions and paper grade.
- The dispersion contains 20 % active substance which gives that 4,5 kg of Eka DR dispersion is needed to produce one tonne of paper.
- The transport from dispersion to paper plant is assumed to be 500 km.
- The electricity mix for the dispersion and paper plant is assumed to be equal to the European mix. In Triantou the German electricity mix was used. The change was made to model an average product for paper making in Europe.
- Part of the thermal energy used in the dispersion process is delivered as steam from the municipal waste incineration plant. Due to that no data was available no environmental loads have been associated with this steam.
- The Tallow oil is supposed to be produced in Sweden.
- The Palm oil is supposed to be produced in Malaysia.
- The transport of Palm oil from Asia to Europe is assumed to go by boat (15830 km) and truck (500 km).
- The rape seed oil is supposed to be produced in northern Europe.
- The transport of rape seed oil is assumed to go with truck from northern Europe (400 km).

3. Inventory analysis

Most of the data used is collected from Triantou's (1) GaBi models and datasets. The new data collected are:

1. Tallow production – a dataset for tallow production gathered mainly in New Zealand was used, but was modified with a Swedish electricity mix. This dataset is more detailed than the estimated value used in Triantou's study (1). The most significant difference is that cattle breeding are included. It must be noticed that there are differences between the European and New Zealand cattle production, for example the amount of time that the cattle spend outside may vary. The impact that this had on the result will not be further elaborated in this report.
2. Palm oil – data about palm oil production was available in both Ecoinvent and PE GaBi databases, but the Ecoinvent database was used in the calculations.
3. Rapeseed – rapeseed oil data was available from both Ecoinvent and PE GaBi databases, but again the Ecoinvent database was used.
4. Allocation factor for phosphorous acid – interviews was held with a purchaser at Eka Chemicals who shared information enabling calculation of economic allocation factors for phosphorous acid and Eka DR.. The allocation factor was 0,98 to the Eka DR wax and consequently 0,02 to the phosphorous acid.
5. Allocation factor for tallow – less than 1 % of the emission from the beef production process is allocated to the tallow.
6. Eka DR wax production – Primary data was collected from two persons involved in the production of Eka DR wax (5) (6).

7. PCl_3 – The data set for this raw material used in Triantou's report was insecure and an effort has therefore been made to collect site-specific data from the supplier.

4. Sensitivity analysis

A sensitivity analysis has been performed to understand the consequences of using different datasets and parameters. In the sensitivity analysis GWP has been used as the only indicator to evaluate if there are significant differences.

Compared to Triantous (1) system a correction was made considering the phosphorous acid as a byproduct and including it by using economic allocation. 98 % of the emissions were found to be allocated to the original product, the Eka DR wax and only 2 % to the phosphorous acid. Since the change in the system was so small, compared to Triantous (1) system, no sensitivity analysis has been performed on the modeling correction.

In the diagrams the raw material alternatives have been named according to the raw material used in the calculation, but the result represents not only the impact from the raw material, but for the whole functional unit of the product.

4.1 Tallow dataset

In this analysis two different datasets for tallow have been compared with the result that was presented in Triantou 2009 (1).

- 1. Tallow, incl. cattle breeding** – This dataset is more detailed than the dataset used by Triantou (1). Each process for tallow is modeled, all the way back to cattle breeding. The cattle breeding were not included in the dataset used by Triantou, which explains the higher values for dataset 1.
- 2. Tallow, triantous dataset** – this dataset was estimated by Karin Andersson-Halldén in 2009 to be used in Triantous master thesis.

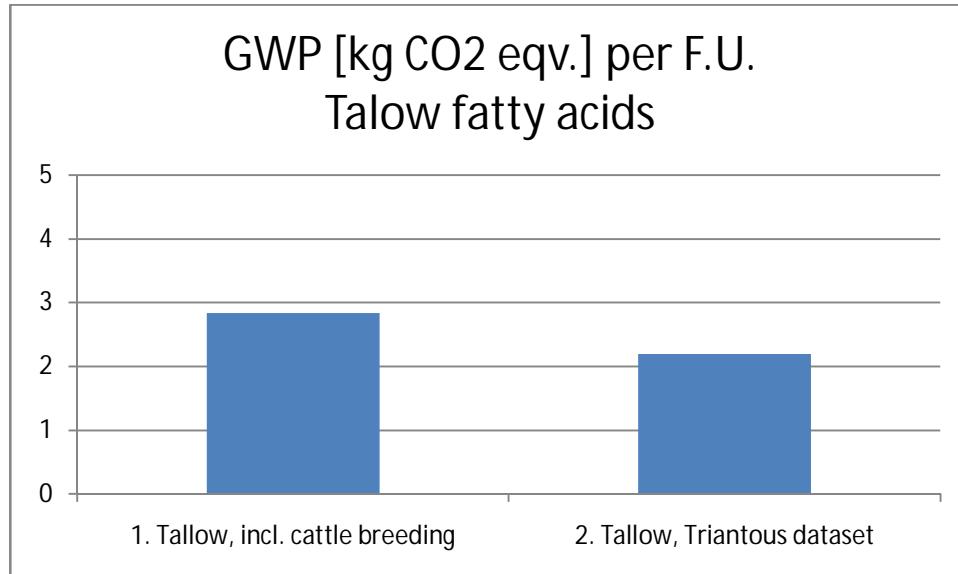


Diagram 1: Sensitivity analysis for tallow datasets.

In the calculations and result of this project dataset 1. Tallow, inc. cattle breeding will be used due to that this dataset is more detailed and therefore generate a more reliable result.

4.2 Palm oil datasets

For palm oil two different datasets have been compared, one from the Ecoinvent database from 2006 and one from PE-GaBi database from 2002. See the result for GWP in Diagram 2.

There is a significant difference in the result for GWP between the Ecoinvent and PE-GaBi datasets. The result for the PE-GaBi dataset is 37% higher than the result for the Ecoinvent dataset. The reason for this could be the fuelmix used in the plant or the allocation between palm oil, palm kernel oil and palm kernel meal in the oil mill. From here on, the Ecoinvent dataset from 2006 has been used, since this is more recently updated.

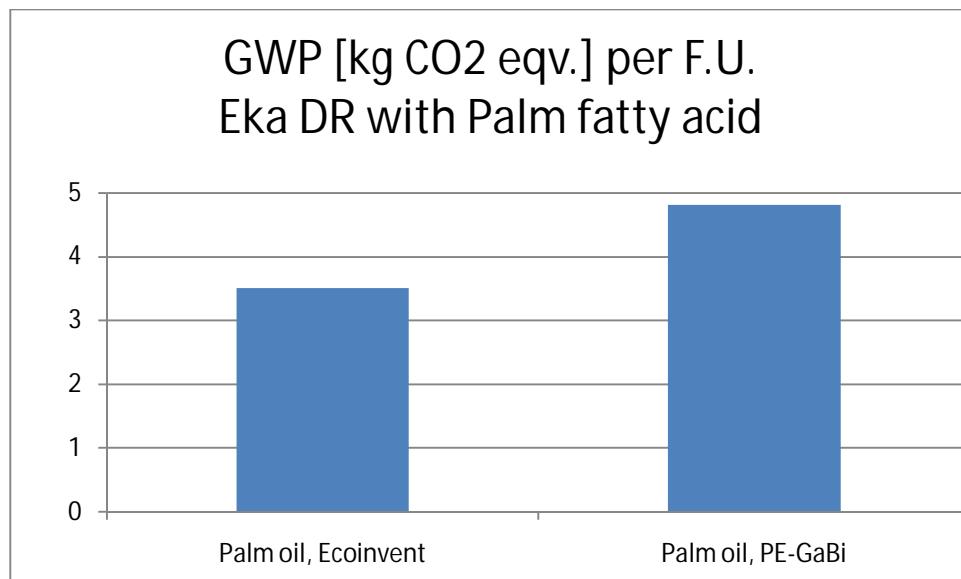


Diagram 2: Sensitivity analysis for palm oil datasets.

4.3 Rapeseed oil dataset

As with the palm oil there is a difference (8%) between the result of the Ecoinvent dataset for rapeseed oil, compared to the PE-GaBi dataset. In the result of this study the Ecoinvent dataset has been used because that data was collected in 2006, compared to in 2002 for the PE-GaBi dataset.

GWP [kg CO₂ eqv.] per F.U. Eka DR with Palm/rapeseed fatty acid

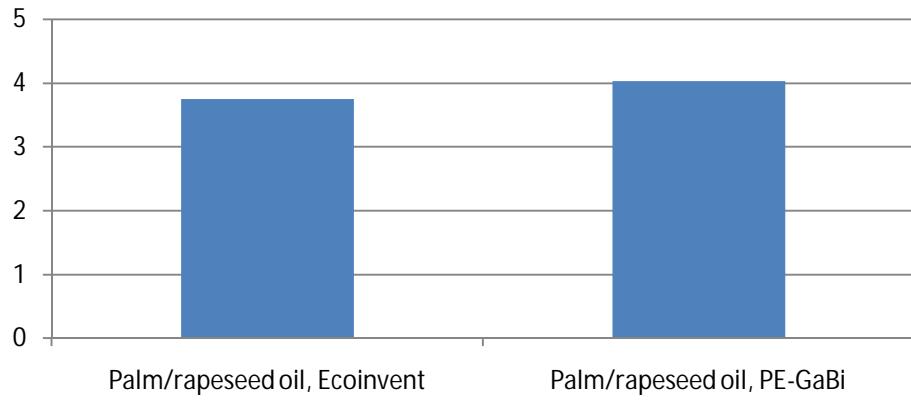


Diagram 3: Sensitivity analysis for rapeseed oil datasets.

4.4 Electricity mix

The secondary goal for this LCA project is to prepare for the creation of an eco-footprint leaflet from the result. An eco-footprint result should be valid for a general Eka DR product and since there are several different dispersion plants an approximation is needed. The Mannheim dispersion plant (used in Triantou's study (1)) is representative for other dispersion plants in Europe (3) and will therefore be used. Since the dispersion plants are spread across Europe it was decided that a European electricity mix should be used for the dispersion plant and paper production.

It is also important that the result of the current LCA is comparable with Triantous result, therefore a sensitivity analysis of the two electricity mixes have been made. In Diagram 4 it is clear that the difference in the final result is not significant.

GWP [kg CO₂ eqv.] per F.U. Eka DR with Tallow fatty acid

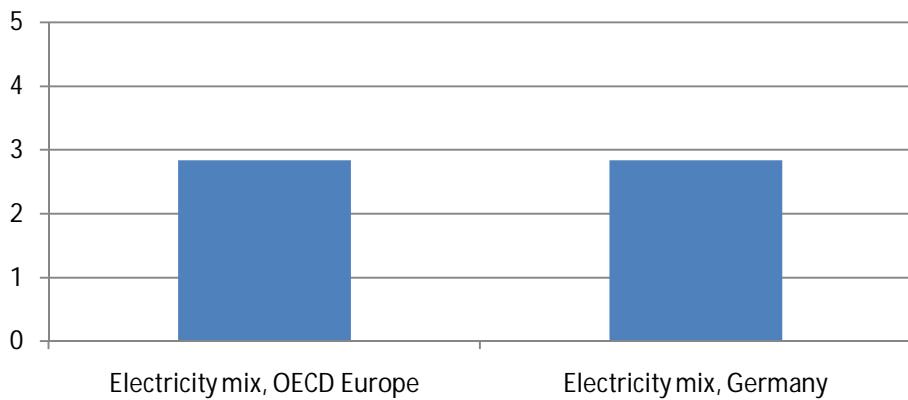


Diagram 4: Sensitivity analysis for electricity mixes.

4.5 Supplier data

A dataset with supplier specific data for phosphorous chloride arrived late in the project process. In a sensitivity analysis it was clear that the new dataset had no impact on the result of the study, hence the calculations were not altered. For one impact category, the eutrophication potential, the contribution of the phosphorous chloride decreased with the new dataset, see Diagram 5.

Sensitivity supplier data EP [kg phosphate eqv.] per F.U.

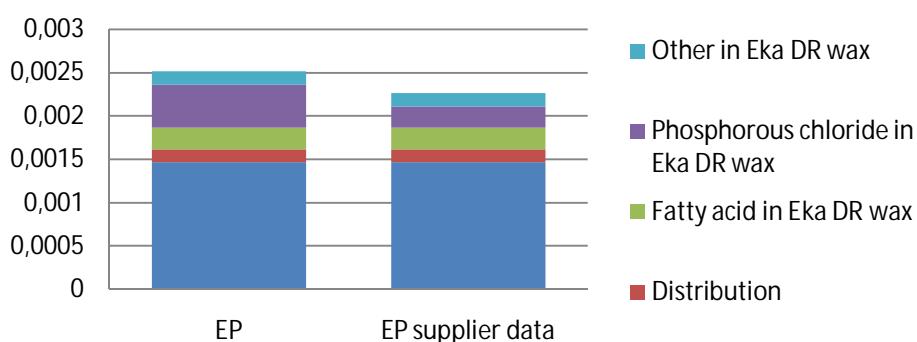


Diagram 5: Sensitivity analysis for supplier data

5. Result

The result will here be presented per F.U. i.e. kg Eka DR that is required to produce one tonne of copy paper. The different alternatives are named according to their raw material source, but represent the total impact per F.U. and not only the impact from the raw material production.

The allocation factors are an important factor in the result. Since tallow is a low-value by product less than 1 % of the emissions are allocated to the tallow, whilst over 80 % of emissions from palm oil production are allocated to the palm oil.

Diagram 6 shows the contribution to the environmental impact from Eka DR production compared to paper production. Be aware that the axis starts at 99% which was necessary to make the contribution from the dispersion and production of Eka DR visible in the diagram. The contributions are less than 1 % for the Eka DR processes and the paper production is, hence the dominating process. Between Eka DR wax production and Eka DR dispersion, the Eka DR wax production is dominant for all impact categories except eutrophication potential, where the dispersion has the highest contribution.

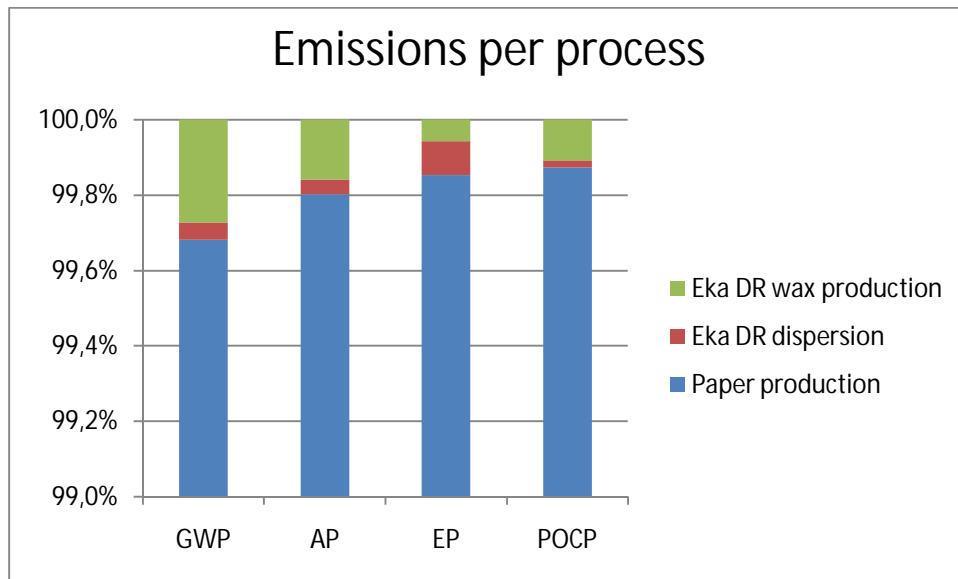


Diagram 6: Emissions per process for the four impact categories, GWP, AP, EP and POCP. Tallow based fatty acids has been used as the raw material for the Eka DR wax.

5.1 Carbon footprint

In Diagram 7 tallow fatty acid as raw material for Eka DR has been compared to palm oil fatty acid and a palm oil/rapeseed oil mix as raw material for the fatty acid in Eka DR. The Eka DR produced from tallow fatty acid has the lowest GWP. The Eka DR from Palm/rapeseed fatty acid creates 32 % more green house gases than the Eka DR from tallow fatty acid.

	Tallow, incl. cattle breeding	Palm fatty acid	Palm/rapeseed fatty acid	Tallow, result from Triantou
GWP [kg CO ₂ eqv.] per F.U.	2,8	3,5	3,7	2,25

Table 4: Carbon footprint for Eka DR for three types of fatty acids as raw material and compared with the result in Triantou (1).

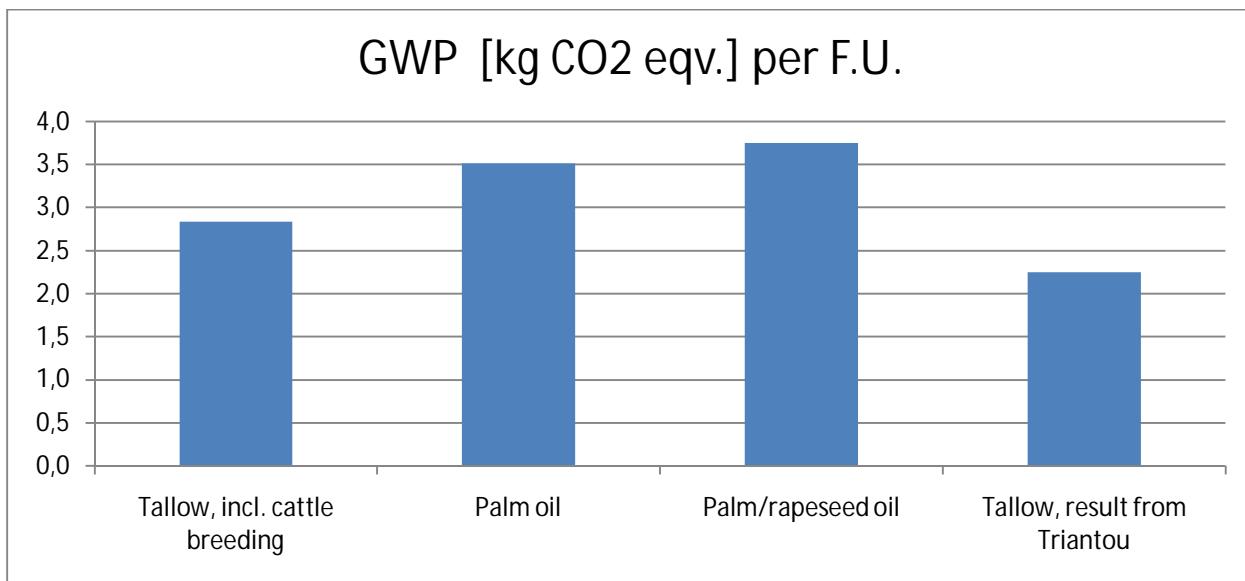


Diagram 7: GWP – Global warming potential measured in kg CO₂ equivalents for kg Eka DR/tonne paper. The comparison is made between the use of three different raw materials for the fatty acid in Eka DR.

As expected, it is apparent in the dominance analysis, that the fatty acid is the biggest contributor to the Global warming potential. The situation is the same for all three raw material types.

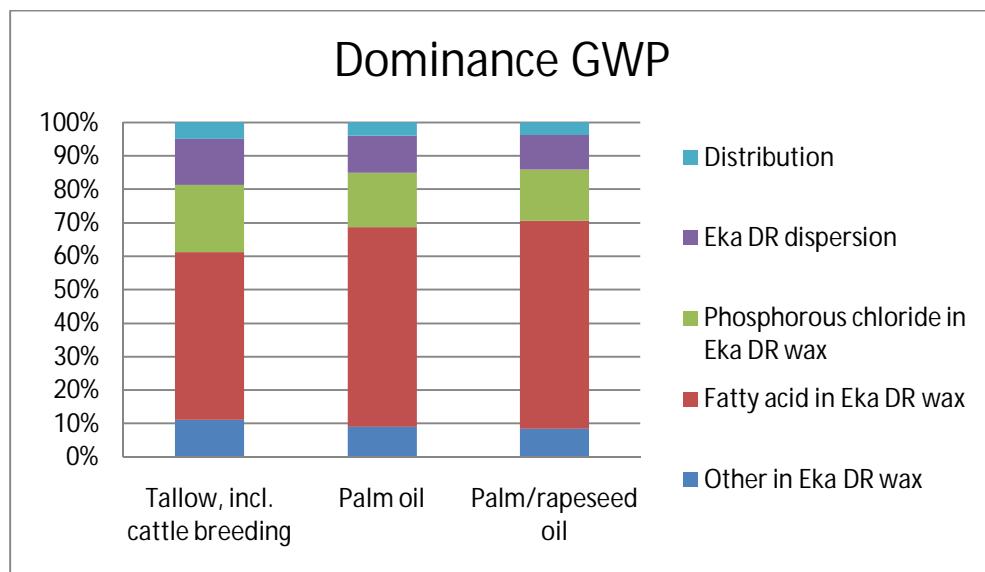


Diagram 8: Dominance analysis of raw materials for Eka DR wax.

5.2 Land use

In Eka DR based on tallow a significant contributor to land use is the maize starch used in the dispersion of the product. Maize starch is one type of starch used in the dispersion step, but also other starches can be used. Because tallow is a low-value by product from the butchery process, the land use for cattle

breeding has not been heavily allocated to tallow. The greatest contributor in the cases of palm and rapeseed fatty acids, is the palm oil plantation and rapeseed cultivation. They contribute with approximately 99 % of the land use in the Eka DR wax production. Rapeseed generates a lower yield than palm oil and because of that, more land is demanded for the palm/rapeseed oil mix (7). In LCA the amount of land is calculated, but the issue is not only about amount, but also about prior type of vegetation on the land considered and whether or not the land use can be regarded as sustainable.

	Tallow, incl. cattle breeding	Palm fatty acid	Palm/rapeseed fatty acid
Land use [m ² *year] per F.U.	0,358	2,045	2,888

Table 5: Land use of Eka DR for the three types of fatty acids as raw material, measured as areatime (a parameter for measuring land use).

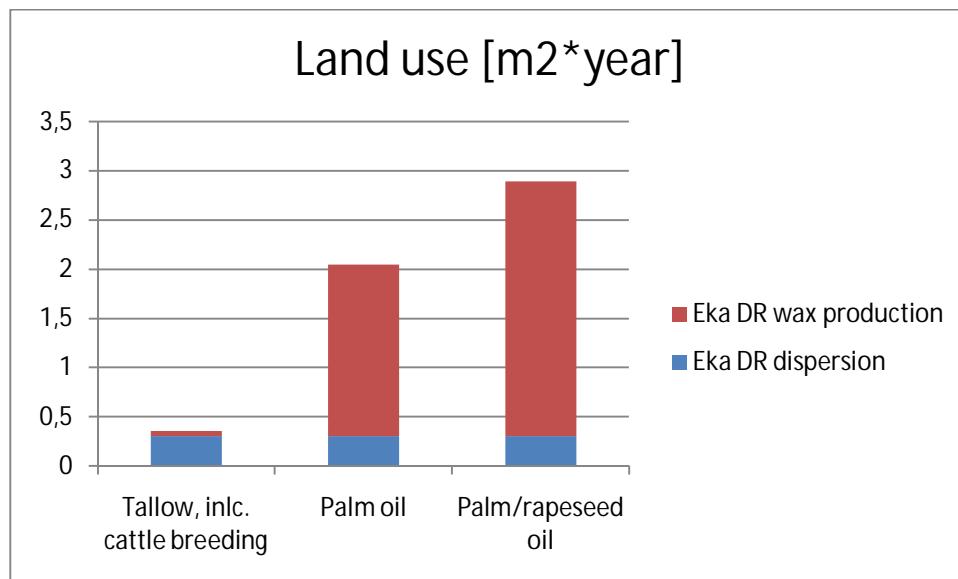


Diagram 9: Land use of Eka DR for the three types of raw material, measured as areatime (a parameter for measuring land use).

5.3 Acidification potential

With regard to the acidification potential, tallow based fatty acid seems to be the best choice as raw material for Eka DR. Eka DR with palm/rapeseed fatty acid contributes twice as much to acidification compared to Eka DR with tallow fatty acid.

	Tallow, incl. cattle breeding	Palm fatty acid	Palm/rapeseed fatty acid
AP [kg SO ₂ eqv.] per F.U.	0,009	0,017	0,018

Table 3: Acidification potential of Eka DR for the three types of fatty acids as raw material.

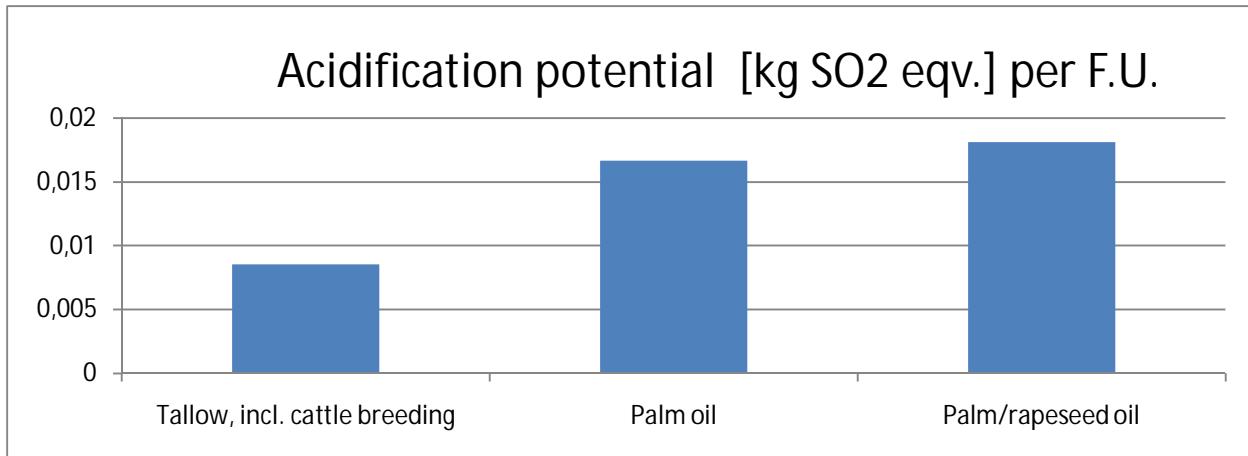


Diagram 10: AP – Acidification potential measured in kg SO₂ equivalents for kg Eka DR/tonne paper. The comparison is made between the use of three different raw materials for the fatty acid in Eka DR.

A dominance analysis showed that the fatty acid is the largest contributor to the acidification potential for all alternatives followed by phosphorous tri chloride.

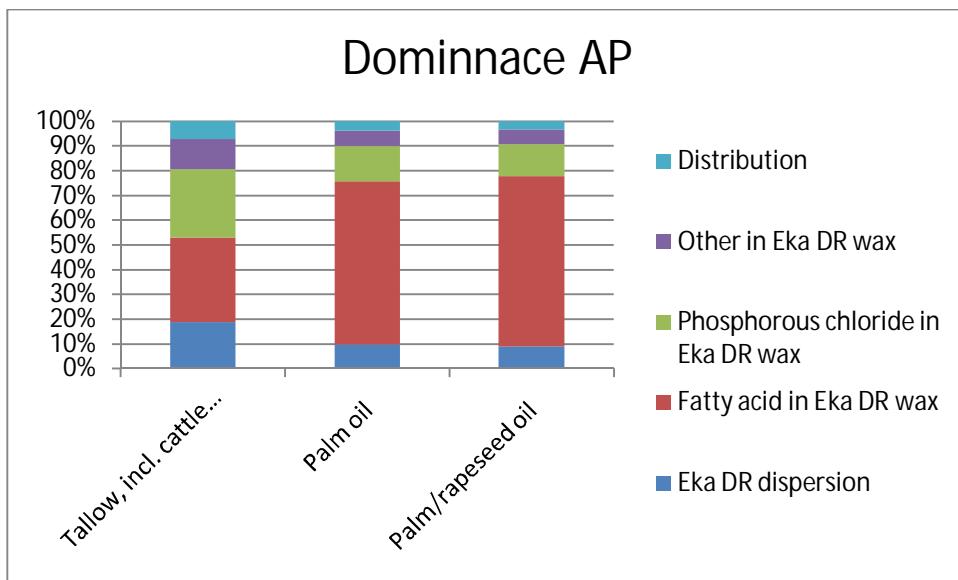


Diagram 11: Dominance analysis for the acidification potential.

5.4 Eutrophication potential

The pattern for the eutrophication potential is similar to that of acidification potential. The difference between the highest and lowest impact increases. Tallow based fatty acid as raw material for Eka DR is the best alternative with regards to the eutrophication potential.

	Tallow, incl. cattle breeding	Palm oil	Palm/rapeseed oil
EP [kg phosphate eqv.] per F.U.	0,003	0,007	0,009

Table 4: Eutrophication potential of Eka DR for the three types of fatty acids as raw material.

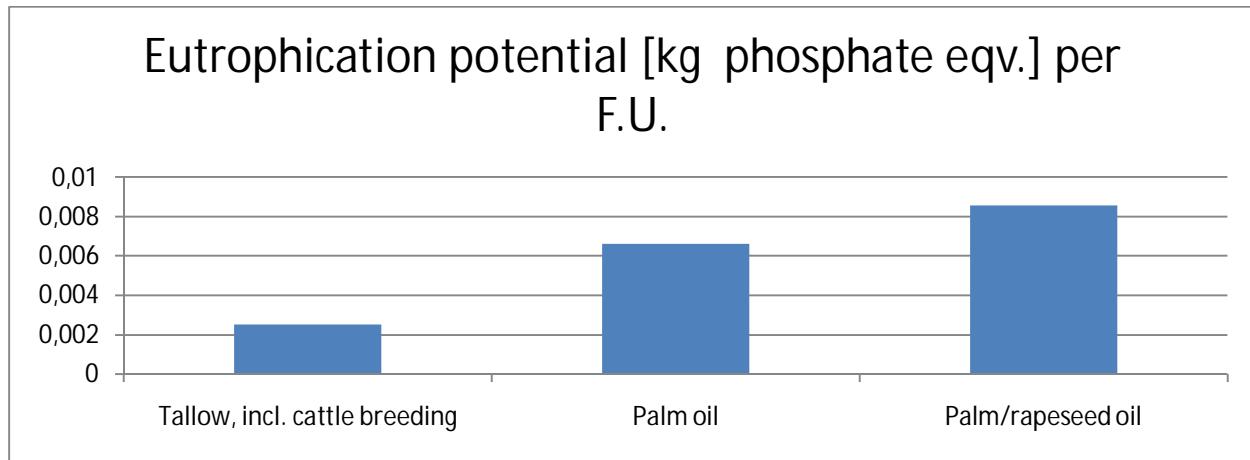


Diagram 12: EP – Eutrophication potential measured in kg phosphate equivalents for kg Eka DR/tonne paper.
The comparison is made between the use of three different raw materials for the fatty acid in Eka DR.

In the case of Eka DR with tallow fatty acid the maize starch in the dispersion process is the most significant raw material, responsible for over 50% of the total emissions. The amount of the other raw materials, such as maize starch, is of course not depending on which type of fatty acid alternatives that is used, but the relative contribution differ.

For the Eka DR with palm or rapeseed based fatty acid, the fatty acid is the largest contributor. The eutrophication potential is connected to the use of fertilizers, therefore the crops maize, palm tree and rapeseed have large impacts. The contribution from farming connected to cattle breeding is only partly allocated to tallow, hence the impact is smaller.

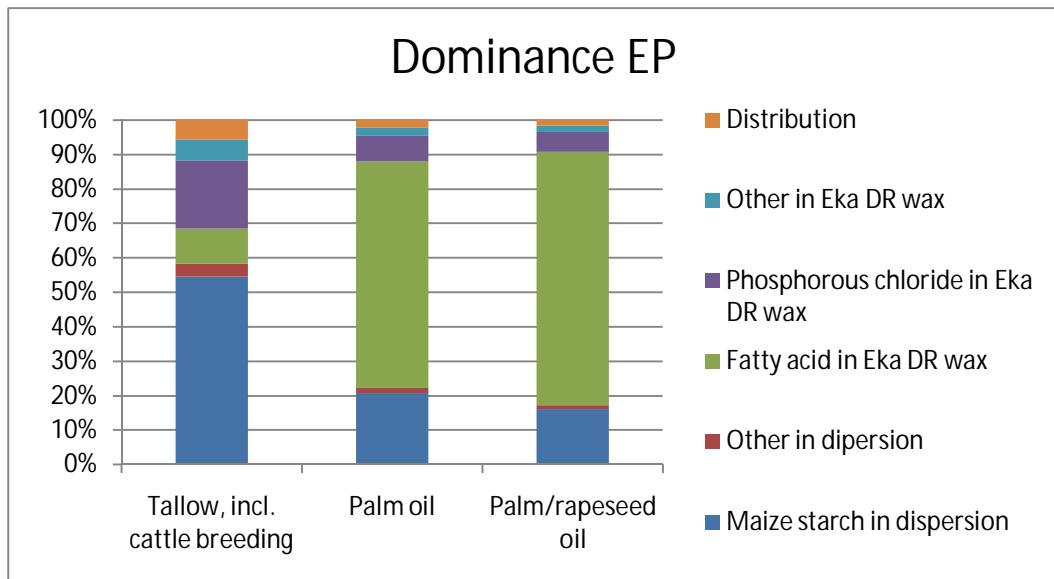


Diagram 13: Dominance analysis for eutrophication potential.

5.5 Photo-chemical ozone creation potential

For the impact category POCP, the pattern of the result is changed. The tallow based fatty acid is still the best alternative but the palm/rapeseed mix is not the worst. Palm oil as a single raw material for the fatty acid has a slightly higher POCP, due to that the palm tree emits VOCs which contributes to the POCP impact category,

	Tallow, incl. cattle breeding	Palm oil	Palm/rapeseed oil
POCP [kg ethene eqv.] per F.U.	0,00136	0,00639	0,00568

Table 5: Photo-chemical ozone creation potential of Eka DR for the three types of fatty acids as raw material.

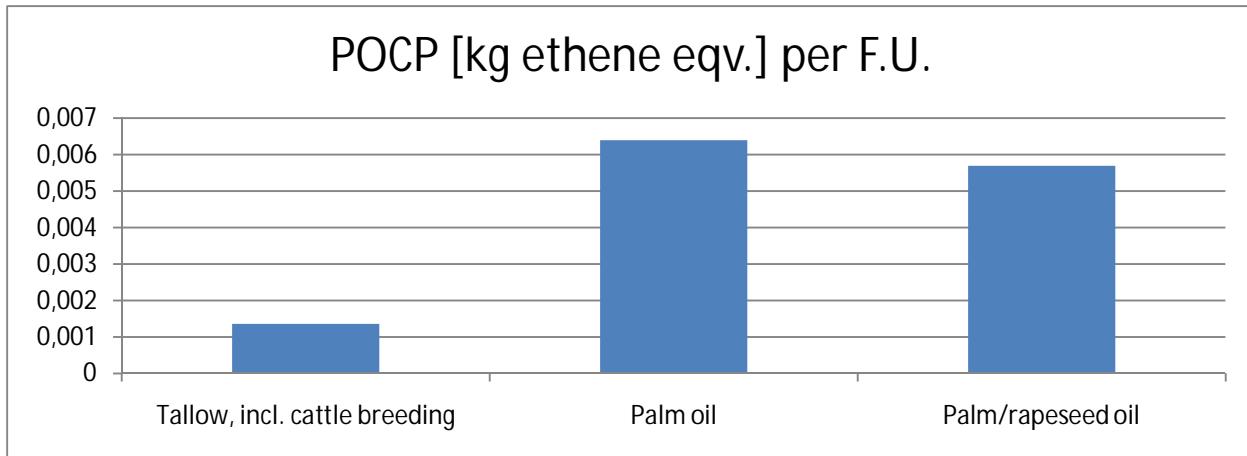


Diagram 14: POCP – Photo-chemical ozone creation potential measured in kg Ethene equivalents for kg Eka DR/tonne paper. The comparison is made between the use of three different raw material alternatives for the fatty acid in Eka DR.

As can be seen in the dominance analysis in diagram 15, again the fatty acid is the largest contributor for Eka DR based on palm and rapeseed fatty acids. For the tallow based alternative phosphorous tri chloride is the most significant contributor.

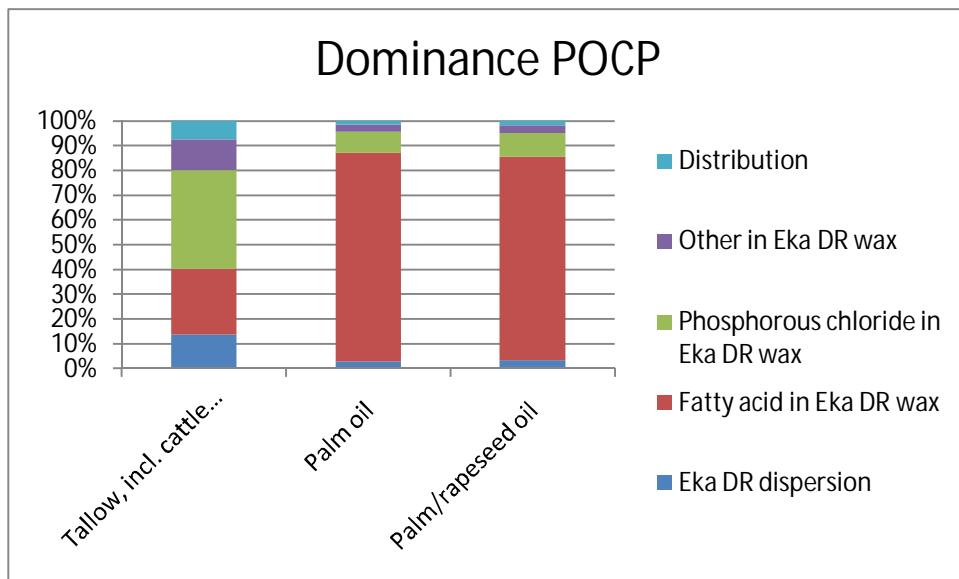


Diagram 15: Dominance analysis for photo-chemical ozone creation potential.

6. LCA discussion

In Diagram 6 it can be seen that the contribution made by the Eka DR sizing chemical to the total environmental impacts of paper production is very small, less than 1 %. The relative significance in terms of environmental impact between different processes should always be kept in mind to avoid sub optimization. Since the paper production is not in Ekas control and the goal of this project is to understand

if there are more sustainable alternatives to the tallow based fatty acid for Eka DR, the focus has been on Eka DR, even though it is a small part of the paper production.

Between the dispersion and the Eka DR wax production, the Eka DR wax production is often the biggest contributor to the environmental impact. There are two exceptions to this statement, one is the land use indicator where the dispersion is relevant for the Eka DR with tallow fatty acid. The second is the eutrophication potential, where the dispersion process for tallow based Eka DR generates just over 50 % of the impact. The dispersion process generates a relatively larger part of the contribution in the tallow based alternative than for the palm and rapeseed based alternatives, since the fatty acid production generates a relatively smaller part of the total contribution.

In the following two paragraphs the focus will be on the comparison of the three raw materials for fatty acids used in the production of the Eka DR wax. It is apparent that Eka DR with tallow based fatty acids is the best alternative for all the impact categories evaluated. Tallow comes out well in LCA studies, because it is a low value by-product from the butchery process and therefore less than 1 % of emissions and land use is allocated to tallow. This can be compared to palm oil where about 80%¹⁰ of the emissions and land use is allocated to the palm oil itself. The situation is similar for rapeseed oil.

Eka DR with palm/rapeseed fatty acid is in general the worst alternative, with the exception of POCP where Eka DR with only palm oil fatty acids is the alternative that generate the highest impact. Rapeseed have a significantly lower yield per acre compared to palm oil, hence more land, fertilizers and machine hours etc. is needed for the cultivation. This increased need for resources generates higher impact for the rapeseed fatty acid than for the palm oil based fatty acid in Eka DR.

In general the fatty acid is the largest contributor to environmental impact. In the case of Eka DR with tallow fatty acid also phosphorous chloride and maize starch in the dispersions process have significant impact for some impact categories. This is due to that the fatty acid in the tallow fatty acid case has a proportionally smaller impact compared with the palm and rapeseed fatty acid cases, which results in that the phosphorous chloride and maize starch impacts get a bigger importance for the product. For the eutrophication potential and land use the maize starch is most relevant and for POCP the phosphorous chloride.

6.1 Further outlook

To further understand the background of the environmental performance of fatty acids it would be interesting to track tallow, palm oil and rapeseed oil backwards and locate where the emissions come from. The uncertainties are big when it comes to renewable materials like palm oil and the footprint can vary depending on different plantations and oil mills, this obstructs the possibility to track the materials up the value chain. For a more detailed study more datasets for tallow, palm oil and rapeseed oil may be included in the assessment.

It would be interesting to further collect data concerning the production of tallow to enhance the accuracy of this dataset. It would also be valuable to do a sensitivity analysis concerning the allocation of emissions to tallow in the production steps, since this allocation has a big impact on the result.

7. Qualitative assessment of palm oil

This is a qualitative assessment of social aspects of palm oil, since it is the alternative which has caused the largest debate about social aspects.

¹⁰ This allocation is set by a fixed dataset from Ecoinvent in GaBi, a LCA software tool.

7.1 Method and sources of information

The focus in coming sections is social aspects of palm oil. Literature to the study was found via Chalmers library and internet sources. An interview has also been made with Sandra van Dingen, a Global sourcing analyst within AkzoNobel working with palm oil.

The qualitative evaluation of palm oil is partly based on a framework developed within AkzoNobel for evaluation of renewable materials. From this framework seven areas of attention have been drawn. Each of these topics will be briefly reviewed to create a broad mapping of the social aspects relevant to palm oil.

1. Water consumption
2. Labour rights
3. Impact on local food supply and indigenous people
4. Sustainability certificates
5. Best agricultural practice
6. Land
7. Use of by-products

Especially when searching for information on the internet it is very important to understand the source of the information. The debate about palm oil today is active and there is information both with a strong positive and a strong negative view of palm oil.

Source	Comment
American palm oil council	Positive lobby group, less trustworthy
Teoh Cheng Hai, WWF	Trustworthy
Malaysian Palm Oil Council MPOC	Positive lobby group, less trustworthy
Muller, Schmidhuber, Hoogeveen and Steduto, FAO	Trustworthy
Jannick Schmidt, Aalborg University	Trustworthy
United States department of agriculture	Trustworthy
Sandra van Dingen, sourcing analyst AkzoNobel	Trustworthy
Unilever	Less trustworthy since they are a company with interest in the palm oil industry.
Andrew Hamilton, All business	Less trustworthy. Hamilton is a palm oil consultant that published an article on allbusiness.com which is a business portal.
RSPO	Trustworthy
United States department of labour	Trustworthy
Meri Orth	Trustworthy

United Nations, department of economic and social affairs	Trustworthy
Charlie Cray, CorpWatch	Less trustworthy
Tinker, R.H.V and Corley P.B.	Trustworthy
Richard Arvidsson, Kristin Fransson, Morgan Fröling and Magdalena Svanström, Chalmers University of Technology	Trustworthy

Table 6: Criticism of the sources

8 General information - Palm oil

Palm oil is produced from the fruit and seed of the palm tree. It is used in a variety of different products such as food products, soaps, cosmetic products, detergents, plasticisers etc. Palm oil account for 26,6 % of the world's total consumption of oils and fats, see Figure 3. (8)

As can be seen in Table 7, compared to other vegetable oils the palm tree has a high yield. The calculated yield for oil per acre is 5 times higher for palm than the second largest crop, which is rapeseed (7). In this aspect the cultivation of the oil palm is more efficient than other crops. The oil palm also has the highest energy content out of the vegetable crops presented in Table 8.

In Table 9 input and outputs from the cultivation of vegetable oil crops are compared. For inputs and emissions to soil and water palm oil is the least demanding crop and generates the least amount of emissions to the surrounding. For the emissions to air sunflower generates less emissions than palm oil. (7)

In 2010 Schmidt published an article of a life cycle assessment comparing rapeseed oil and palm oil. The result shows that palm oil is environmentally preferable for ozone depletion, acidification, eutrophication, photochemical smog and land use. Global warming, biodiversity and ecotoxicology was also evaluated, but for these impact categories the result was not distinguishable. (9)

Chart 4: World Consumption of Oils and Fats in 2008

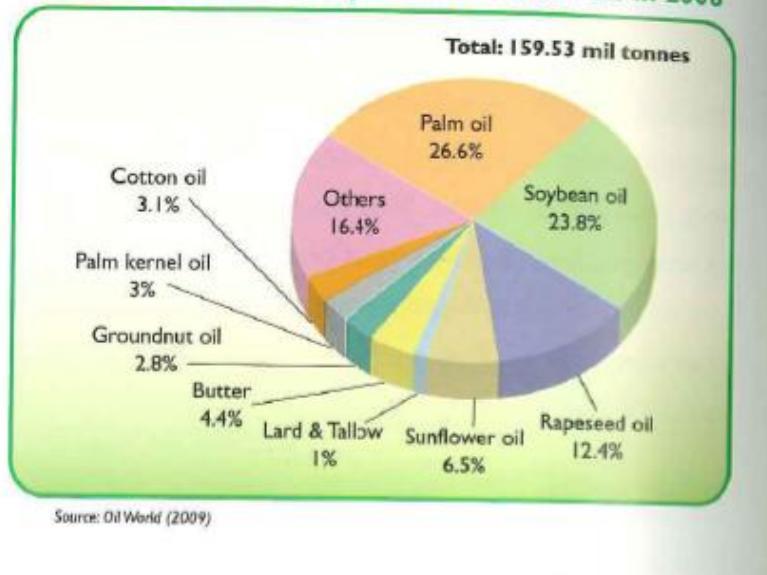


Figure 6: Source (8)

Table 2: Comparative Yields for Vegetable Oils and Oilseeds 1997/98

Crop	Product	Average Oil Content (%)	Potential Oil Content (%)	Average Yield (tonnes/ha)	Calculated Yield of Oil (tonnes/ha)
Oil Palm*	Palm oil	19.1	25	15.96	3.05
Oil Palm	Palm kernel	43.8	49	0.84	0.37
Soybean	Seed	18.5	20	2.28	0.42
Groundnut	Seed	47.5	50	0.94	0.45
Cotton Seed	Seed	19.0	20	1.02	0.19
Rapeseed	Seed	42.5	45	1.42	0.60
Sunflower	Seed	42.5	45	1.20	0.51
Coconut	Copra	66.5	68	0.54	0.36

Source: PORLA

PORIM

Oil World Annual

* Refers to Malaysia Hybrid DxP Variety

Table 7: Source (7)

Crop:	Fuel product:	Annual obtainable yield [l/ha (indicative)]	Energy yield [GJ/ha]
Sugar cane	Ethanol (from sugar)	6000	120
Sugar beet	Ethanol (from sugar)	7000	140
Cassava	Ethanol (from starch)	4000	80
Maize	Ethanol (from starch)	3500	70
Oil Palm	Bio-diesel	5500	193
Rapeseed	Bio-diesel	1200	42
Soybean	Bio-diesel	400	14

Table 8: Energy content of vegetable oil (10)

Table 18: Input–output in Cultivating Oil Palm and Oilseeds

Item and unit	Inputs per tonne of oil by crop			
	Palm oil	Soybean oil	Sunflower oil	Rapeseed oil
Seed/fruit for extraction (kg)	4500*	5000	2500	2500
Inputs				
i. Nitrogen (kg N)	47	315	96	99
ii. Phosphate (kg P ₂ O ₅)	8	77	72	42
iii. Pesticides and herbicides (kg)	2	29	28	11
iv. Others (kg)	88	117	150	124
v. Energy (Gj)	0.5	2.9	0.2	0.7
Outputs				
a) Emission to soil and water				
i. Nitrogen	5	32	10	10
ii. Phosphates	2	23	22	13
iii. Pesticides/herbicides	0.4	23	22	9
b) Emission to air (kg)				
- NOx	0.5	4	0.3	0.8
- SO	0.2	2	0.1	0.2
- CO	32	205	16	50
- Pesticides/herbicides	0.1	6	6	2

Source: FAO (1996) as cited by Pushparajah (1998)

*Fruit bunches

Table 9: Source (7)

8.1 Production countries

The production of palm oil has grown rapidly in the last 30 years. Compared to 1980 the production volumes have increased more than tenfold, see Table 11 and 12 (7) (11). In the last years Indonesia has increased their production and is the biggest producer and exporter of palm oil in 2010 (11). Malaysia is the second largest producer.

Malaysia and Indonesia are situated close geographically and have similar climate. Indonesia is the bigger country, both when it comes to population and land area. As shown in Table 10 Gross Domestic Product (GDP) per capita is different for the two countries, which has an impact on the welfare of the country. Malaysia is the wealthier country and also has a smaller part of the population below the poverty line. (12)

	Malaysia	Indonesia
Population (millions)	28	242
GDP (10^12 \$)	0,4164	1,033
Total land (km2)	328 657	1 811 569
GDP per capita (\$)	14 700	4 300
Population bellow poverty line (%)	5,1	13,3

Table 10: Comparison between the two major production companies of palm oil (12)

Since Malaysia is the wealthier country they have had the possibility to develop their agriculture. The Malaysian yield from oil palm is therefore generally higher than in Indonesia. According to Sandra van Dingenen the yields may be 80 % higher in general in Malaysia than in Indonesia. In Malaysia the agriculture is more efficient since they have worked with natural selection to develop high yield palm oil trees. Also the pest control and soil management is better. The soils are for example fertilized by returning bundles to the plantation after the harvest to decompose. It can also be expected that the wages for the workers are higher in Malaysia. Also, according to Sandra van Dingenen few companies want to do business with Indonesia since the country is corrupted. (13)

The companies owning the plantations become an important part of society in the countries where they operate. Companies stretch their responsibilities to create successful plantations, some plantations have schools, hospitals, labs and retirement homes to take care of the employees. (13)

Table 1: World Production of Oils and Fats ('000 Tonnes)

Commodity	1980	1990	1995	1999
Soybean Oil	13,382	16,097	20,426	24,755
Palm Oil	4,543	11,027	15,477	20,277
Rapeseed Oil	3,474	8,160	10,952	12,936
Sunflower Oil	5,024	7,869	8,572	9,237
Groundnut Oil	2,864	3,897	4,397	4,705
Cotton Oil	2,992	3,782	3,901	3,811
Coconut Oil	2,716	3,387	3,350	2,499
Olive Oil	1,701	1,855	1,888	2,425
Palm Kernel Oil	571	1,450	1,948	2,518
Corn Oil	866	1,477	1,851	1,989
Linseed Oil	764	653	701	721
Sesame Oil	502	612	587	689
Castor Oil	349	438	483	433
Total Vegetable Oils	39,748	60,704	74,535	86,995
Tallow & Grease	6,283	6,813	7,510	8,133
Butter	5,746	6,500	5,717	5,819
Lard	4,691	5,509	8,689	6,609
Fish Oil	1,214	1,378	1,318	1,201
Total Animal Oils/Fats	17,934	20,200	20,234	21,762
Grand Total	57,682	80,904	94,769	108,757

Source: Oil World

PORLA

Directorate General of Estate (Min. of Agri. Indonesia), cited by PORLA.

Table 11: Source (7)

Table 11: Palm Oil: World Supply and Distribution
Thousand Metric Tons

	2006/07	2007/08	2008/09	2009/10	Jan 2010/11	Feb 2010/11
Production						
Indonesia	16,600	18,000	20,500	22,000	23,000	23,600
Malaysia	15,290	17,567	17,259	17,763	18,600	18,000
Thailand	1,170	1,050	1,540	1,345	1,500	1,500
Nigeria	810	820	850	850	850	850
Colombia	755	780	795	770	820	820
Other	2,704	2,867	3,048	3,134	3,142	3,202
Total	37,329	41,084	43,992	45,062	47,912	47,972
Imports						
India	3,650	5,013	6,867	6,603	7,200	7,200
China	5,139	5,223	6,118	5,760	6,250	6,250
EU-27	4,294	4,916	5,425	5,100	5,400	5,400
Pakistan	1,618	2,219	1,949	2,200	2,300	2,300
Malaysia	403	669	1,047	1,250	1,250	1,250
United States	702	952	1,036	994	975	975
Bangladesh	898	724	700	951	965	965
Egypt	768	571	960	850	850	850
Iran	419	610	504	548	620	620
Japan	516	551	531	581	580	580
Other	8,293	9,285	8,938	9,687	10,298	10,448
Total	26,700	30,733	34,075	34,524	36,688	36,838
Exports						
Indonesia	11,419	13,969	15,964	16,573	18,000	17,850
Malaysia	12,900	14,644	15,485	15,530	16,100	16,100
Papua New Guinea	357	439	507	500	438	500
Benin	273	358	348	450	480	480
United Arab Emirates	334	336	228	260	265	265
Other	2,278	2,480	2,151	2,081	2,089	2,089
Total	27,561	32,226	34,683	35,394	37,372	37,284
Domestic Consumption						
India	3,671	5,063	6,275	6,753	7,750	7,750
China	5,138	5,222	5,618	5,930	6,277	6,277
Indonesia	4,520	4,704	4,855	5,430	4,910	5,745
EU-27	4,218	4,717	5,039	5,024	5,388	5,388
Malaysia	3,109	3,170	3,229	3,562	3,800	3,700
Pakistan	1,661	2,027	1,995	2,130	2,250	2,250
Thailand	702	943	1,229	1,290	1,480	1,520
Nigeria	1,155	1,190	1,208	1,232	1,240	1,240
United States	663	948	959	956	1,009	1,009
Bangladesh	880	796	700	911	960	960
Colombia	490	515	615	760	815	815
Egypt	595	560	660	760	815	815
Iran	400	538	570	570	619	600
Japan	521	551	531	581	580	580
Russia	528	705	584	526	560	560
Other	7,993	8,231	8,389	8,937	9,705	9,698
Total	36,244	39,880	42,456	45,352	48,156	48,907
Ending Stocks						
Malaysia	1,565	1,987	1,579	1,500	1,450	950
Indonesia	1,154	488	190	242	1,029	302
China	0	0	499	328	300	300
EU-27	129	190	444	410	272	272
Togo	131	142	145	157	174	174
Other	1,268	1,151	2,029	1,889	987	1,147
Total	4,247	3,958	4,886	4,526	4,212	3,145

Table 12: Source (11)

9 Areas of attention

Bellow seven areas of attention will be reviewed briefly.

9.1 Water consumption

Water is used in the oil mill process and may also be used for irrigation in some cases. Even though many plantations are situated in areas with heavy rainfall, water is still a problem in some areas. For example there are problems with storage and distribution of rain and surface water, which make the use inefficient. There are also problems with pollution of the downstream water, mainly with fertilizers. (14)

Water is included in the RSPO Principle and criteria for sustainable palm oil production, which shows that this issue cannot be disregarded (15). They have a criterion including the maintenance and availability of surface and groundwater, for example a water management plan is demanded.

To produce sustainable palm oil it is important to consider, type and quality of irrigation, minimise factory use of water, make sure that users downstream is not affected by water withdrawal and monitor and avoid emissions (16).

9.2 Labour rights

The United States department of labour issued in 2009, and updated in 2010, a report of countries and crops associated with child labour or forced labour. The Indonesian palm oil production is according to the report associated with child labour. Child labour is defined under international labour standards as all work performed by children under the age of 15 years and work performed by children 15-18 years old, if the work contains slavery or similar practices, child prostitution, illegal activities or if the work may harm health, safety and moral of the children. (17)

The Malaysian palm oil production is according to the same report associated with forced labour. Forced labour is under international standards defined as any work for which the worker does not offer himself voluntarily or that is performed under threat of penalty if the work is not performed. Forced labour is work that is performed under threats of physical harm or restraint for any person. It is work that is performed under any plan or scheme that makes the worker believe that if the work is not performed, that person or another person would suffer harm or physical restraints. It is also work performed under abuse or threats of abuse of law or other legal process. (17)

The report also states that the list is created of countries and goods that the United States department of labour found to display a significant frequency of child labour or forced labour. It is not sure that all plantations in the country suffer under these conditions. (17)

9.3 Impact on local food supply

An oil palm plantation have an impact on the food supply of the region by reducing the amount of available land for cultivation and the amount of forest for collecting food. Also since less land is available the land have to be used more intensely leading to degradation of the quality. This in turn leads to that more food have to be bought which increases the food expenses for the local population. The water quality is also degraded close to an oil palm plantation due to the run-off, of for example fertilizers from the plantation. (18)

One positive effect is that the palm oil is used locally for cooking. In Indonesia 22 % of the production is used within the country compared to 13 % in Malaysia, see table 12 (11). From this aspect the palm oil cultivation contribute to the local food supply.

9.3.1 Indigenous people

For many indigenous people the forest is very important. The forest is vital for their economy, spirituality, culture and it supports them with food and medicinal plants. When forests are being destroyed the possibility for the indigenous people to live in their traditional way disappears and they get no compensation for their loss. The oil palm cultivation and logging of primary forest are contributors to this development. (19)

9.4 Sustainability certificates

The Roundtable for Sustainable Palm Oil (RSPO) is a non-profit organization working to promote growth of sustainable palm oil. The source of this entire text is information found at www.rspo.org (15). In the organization representatives of all parts of the palm oil industry are members, such as producers, traders, processors, retailers, banks, investors, consumer products producers and NGO's with interests in environment, natural conservation, social issues and development.

The RSPO is responsible for the certification of sustainable palm oil. They have developed the RSPO Principles and criteria for sustainable palm oil production (RSPO P&C) together with RSPO Supply chain certification to ensure transparency and traceability of the sustainable palm oil. The audits are made by certification bodies that have been accredited to ensure that they are competent, credible and consistent.

The principles and criteria are summarized in eight major principles.

- Commitment to transparency
- Compliance with applicable laws and regulations
- Commitment to long-term economic and financial viability
- Use of appropriate best practices of growers and millers
- Environmental responsibility and conversion of natural resources and biodiversity
- Responsible consideration of employees and of individuals and communities affected by growers and mills
- Responsible development of new plantings
- Commitment to continuous improvements in key areas of activity

More information about the criteria, indicator and guidance for each principle can be found in the document called RSPO Principles and criteria for sustainable palm oil production (20).

Within the RSPO supply chain certification (21) there are four different models of certified supply chains with more or less control of the certified palm oil.

- **Identity preserved** – the certified sustainable palm oil and its derivatives are uniquely identifiable and physically separated from other palm oil.

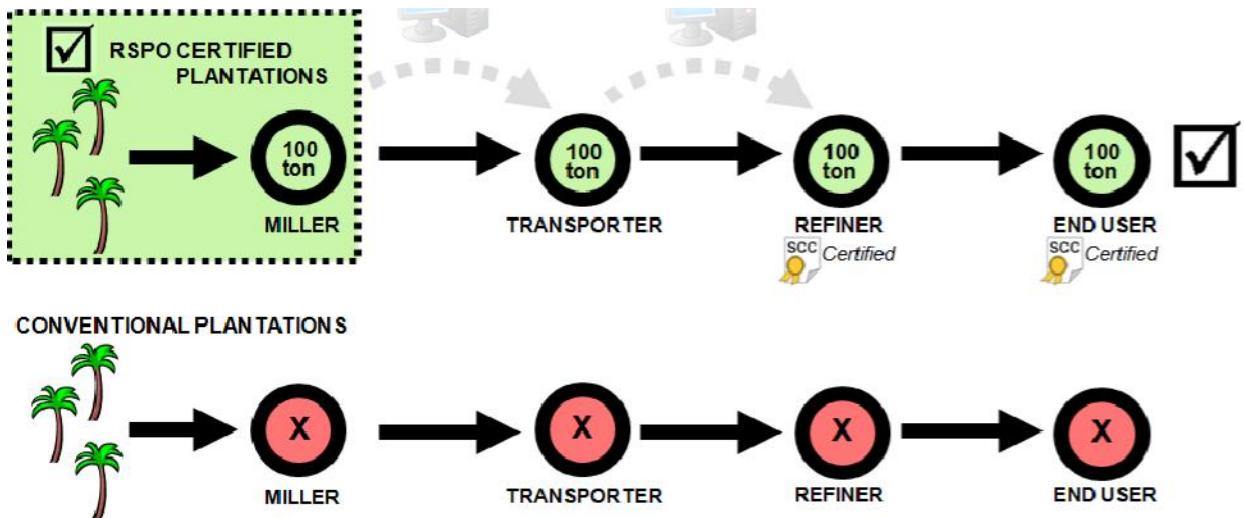


Figure 7: Model for the identity preserved palm oil supply chain

- **Segregation** - the segregation model also ensures that only RSPO certified palm oil and its derivatives are delivered to end users, but the difference from the identity preserved model is that in segregation the RSPO certified palm oil may come from different sources.

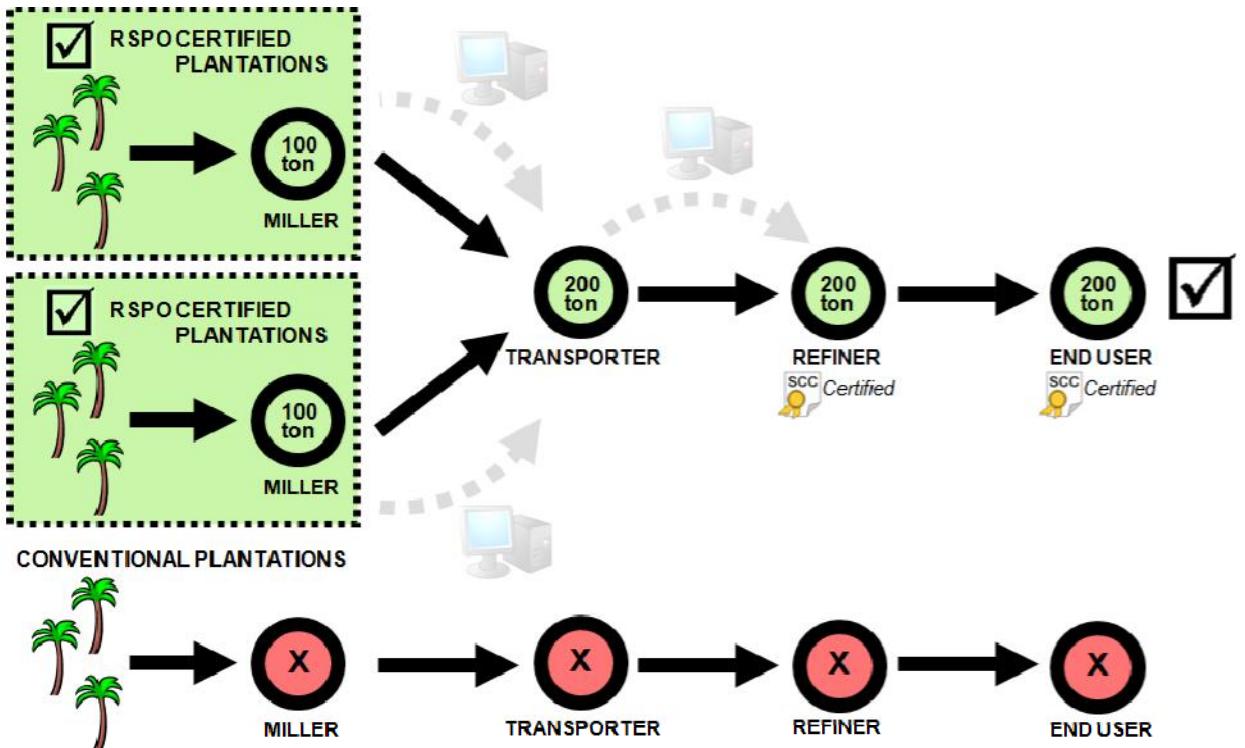


Figure 8: Model for the segregation palm oil supply chain

- **Mass balance** – In this model it is allowed to mix RSPO certified and non RSPO certified palm oil and its derivatives if overall company quantities are monitored. The model supports the production of RSPO certified palm oil, but cannot guarantee that the end users receive the RSPO certified palm oil.

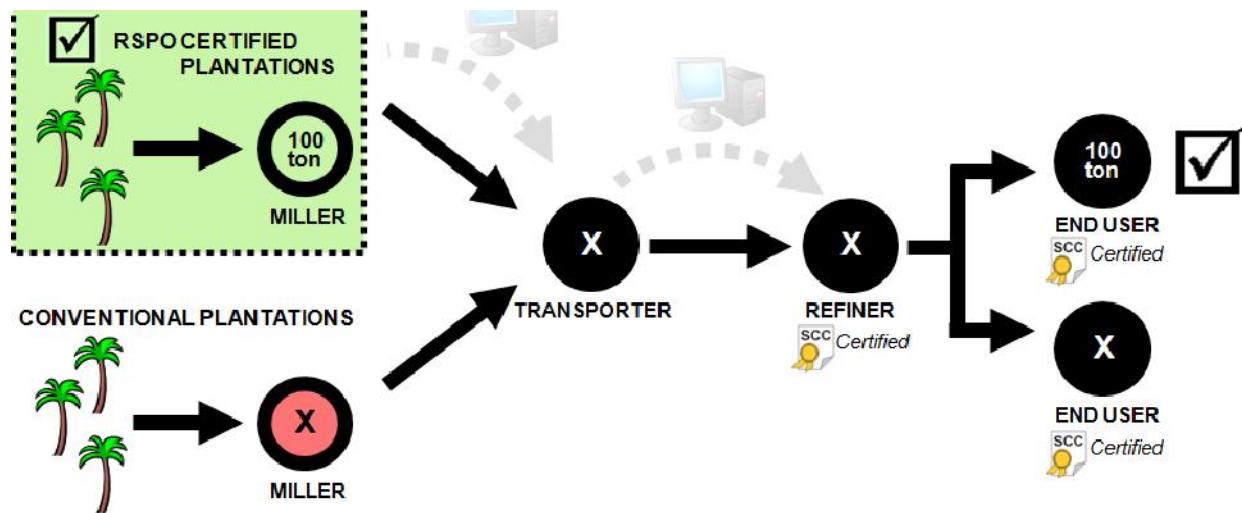


Figure 9: Model for the mass balance palm oil supply chain

- **Book and Claim** – In this model it is possible to buy tradable certificates for RSPO certified palm oil. If a certificate is bought, it means that certified palm oil equal to that volume is sold onto the existing supply chain as conventional palm oil. This is also a model that supports the production of RSPO certified palm oil, but the certificate buyer may receive any palm oil and not specifically RSPO certified.

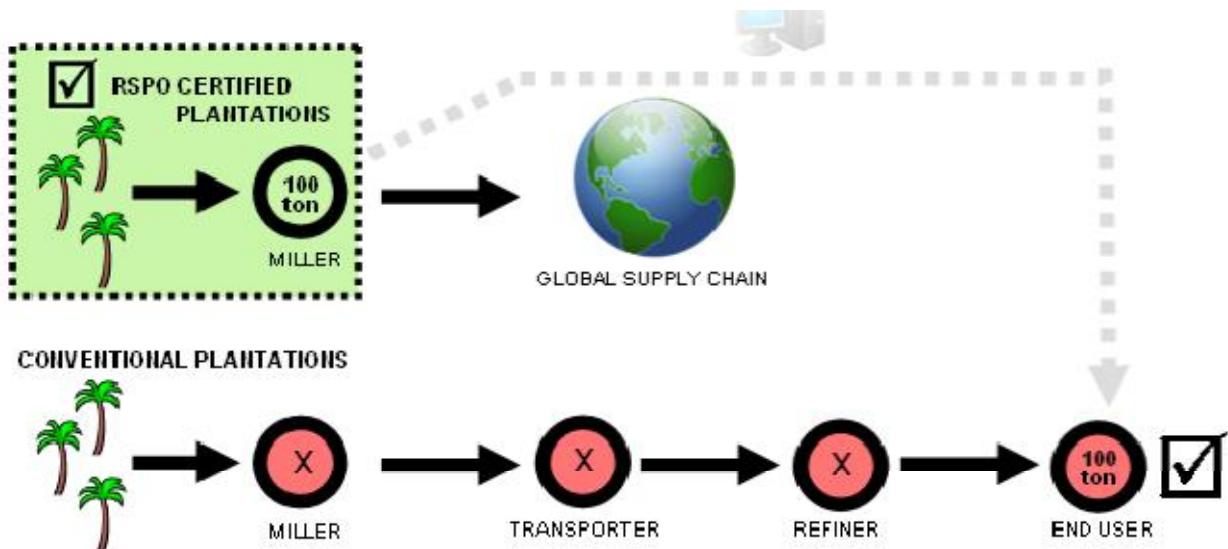


Figure 10: Model for the book and claim palm oil supply chain

[9.4.1 Criticism of Roundtable for Sustainable Palm Oil](#)

The RSPO have been criticized for their slow progress, for example by Greenpeace. Greenpeace claimed in 2007 that the RSPO initiatives have little impact on the sustainability of the palm oil plantations and that large corporations “hide” within the organization (22).

[9.5 Best agricultural practice](#)

The palm oil yields have fluctuated over the years indicating that the maximum yield is not always achieved. The data is collected from Malaysia, which has the most mature oil palm industry in the world. On well managed plantations the yield can be as high as 9-10 tonnes oil/ha per year, but the mean yield of Malaysia is only 3,8 t oil/ha. When comparing year 1975 with 2001 the yield is exactly the same, except for an increase in the 1980's. (23) This leaves a lot of room for further development of the palm oil industry, for example the mechanisation on the field is low, so a lot of the work is done manually (14).

[9.6 Land](#)

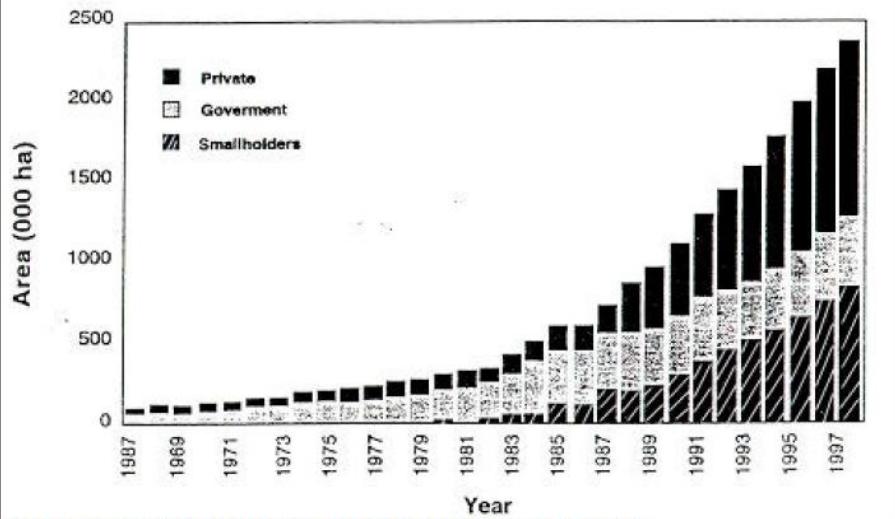
When reviewing Diagram 16-17 it is apparent that the land used for palm cultivation has increased significantly over the years. There is no doubt that land has been transformed to agricultural use, direct from primary forest or via logging from secondary forest. Secondary forest is defined as degraded forest commonly transformed from primary forest to secondary forest by logging. Primary forest is the naturally growing forest, in this case rainforest.

When evaluating land use of palm oil, the occupation of land itself is less interesting and the impact from transformation of land is more relevant. In Schmidt an evaluation have been made of global warming potential and biodiversity connected to transformation of land. In this study it is assumed that the transformation for palm oil is from secondary forest or grassland to oil palm plantations. In the study it is shown that the transformation from secondary forest to oil palm generates an impact on both global warming and biodiversity. A positive outcome is that if the land is transformed from grassland to oil palm plantations it is beneficial for both global warming and biodiversity, since the carbon stock is increased and more species thrive in the plantation. (9)

The impact would be higher if primary forest was used instead of secondary forest. The number of mammals is reduced from 75 to 10 species per hectare if primary forest is transformed to oil palm plantation (24). The transformation process for primary forest is mainly logging. A proof of this is that agricultural land has been expanding slower than the primary forest has been disappearing. (9)

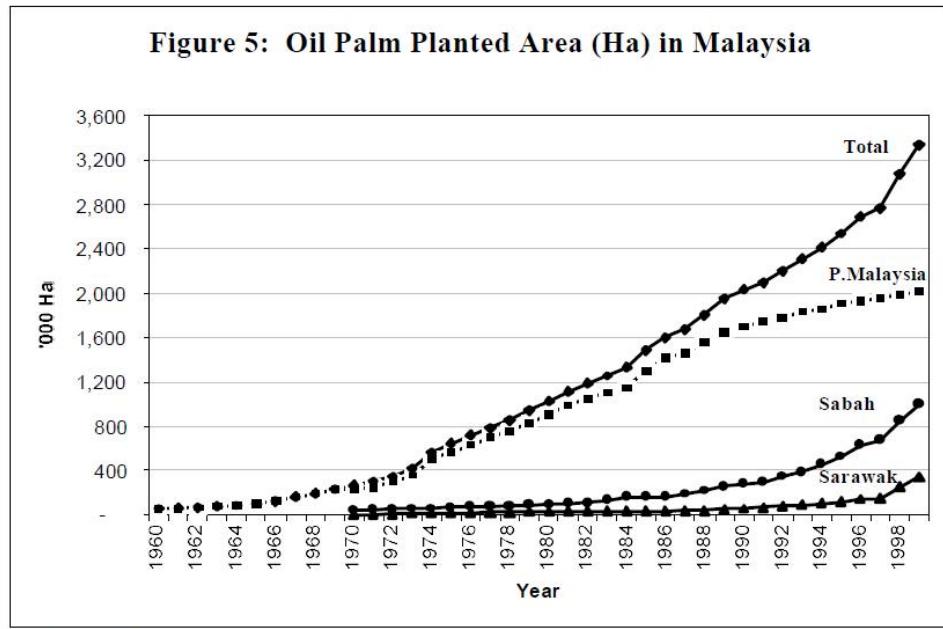
Today 4.1 % of the oil palm plantations in Malaysia are on peat soils. When growing on peat soils the contribution to global warming is increased by 4-5 times, compared to the current mix of soils. The land available for further development of palm oil cultivation today in South East Asia is primarily peat soils. (9)

Figure 3: Oil Palm Area (ha) in Indonesia



Source: Directorate General of Estate (1966) Cited by Potter & Lee (1999)

Diagram 16: Source (7)



Source: PORLA

Diagram 17: Source (7)

9.7 Use of by-products

The sustainability of the palm oil is enhanced if its by-products are used and not treated as waste. From the palm tree the main product is palm oil which is produced in a variety of different forms such as crude palm oil (CPO), neutralised palm oil (NPO), refined, bleached and deodorised palm oil (RBD), palm olein and palm stearin (23). The main by products from the production of palm oil is palm kernel oil and palm meal (9).

Palm kernel oil is used in edible products. It is a source of short-chain fatty acid that has a narrow melting range. The palm kernel oil is used in some dairy products, in chocolate and caramel. (23) The palm meal is used for example as animal fodder.

10 Social aspects discussion

The oil palm has benefits compared to other vegetable oil crops. It has high energy content and yield without demanding much inputs or generating large emissions. It has low environmental impact in categories such as ozone depletion, acidification, eutrophication, photochemical smog and land use. With the increasing lack of resources and food in the world together with increasing population the efficiency of crops is very important.

A major concern regarding palm oil is the transformation of land from primary forest (rainforest) to agricultural land. Schmidt argues that it is not the oil palm cultivation but logging that is the main process for destruction of primary forest. Oil palms are according to Schmidt often planted on secondary/degraded forest areas or on grass land. Even if this argument is valid, the oil palm industry does probably contribute to the loss of primary forest by its expansion. Each plantation must be evaluated to further understand the land transformation required. Another problem is that much of the available land for further development of the oil palm cultivation is peat soils which if planted generates a high impact on global warming. Plantations on peat soil should be avoided to minimise this impact. Best agricultural practices are not used in the oil palm cultivation. The yields are far below what can be achieved in Malaysia and even lower in Indonesia. If the yield of the plantations can be increased it would be possible to expand the palm oil market without demanding more land and losing more primary forest.

Oil palm plantations are often situated in areas with heavy rainfall. Despite this, the inefficient use of the water resources makes water a problem for plantations and irrigation needed. To ensure sustainable plantations water resources should be used efficiently and emissions and run-off should be minimized to avoid impact on the local food and water supply. The food supply is already impacted when land is converted to oil palm plantations and less land and forest is available for food production. Indigenous people are either pushed further into the forest or lose their traditional way of living.

Unfortunately evidence has been found that child labour and forced labour is used within oil palm cultivation. It has not been possible to evaluate how common this is, but the mere risk of it calls for action. Supplier visits are necessary to avoid child labour or forced labour at the plantations.

There is a programme developed by the RSPO for supplying sustainable palm oil. All parties of the industry are involved which creates a foundation for decisions that are respected by everyone. On the other side, strict criteria for the certification may be hard to incorporate since production companies may oppose.

In Table 15 a summary of the result of the evaluation for the areas of attention have been made. For one category it is possible to state a positive outcome, and it is for the sustainability certificates, which are

available. For all other categories it is not possible to purchase palm oil without investigating the source with regard to social issues, hence the category is marked with a negative outcome.

Generally it would be recommended to purchase palm oil from Malaysia since they have better welfare which generates better conditions at the plantations. To be able to have control of the purchase the plantation, oil mill and distribution must be controlled, since each plantation have different conditions. The RSPO certificates are the best available option for purchasing of sustainable palm oil if there is no possibility to evaluate the supplier directly.

Areas of attention	Approved?
Water consumption	NO
Labour rights	NO
Impact on local food supply and indigenous people	NO
Sustainability certificates	YES
Best agricultural practice	NO
Land	NO
Use of by-products	Not complete information.

Table 15: Summary for the evaluation based on the seven areas of attention

11 Conclusions

Based on the data and information at hand the following conclusions have been drawn.

11.1 Environmental aspects – Planet

The tallow based fatty acid used today in the Eka DR wax production is the best alternative when evaluating the environmental impact. There is no reason for Eka to change to palm or rapeseed based fatty acid. If an alternative is needed a prioritization between environmental and social aspects is necessary. If environmental aspects are found most important the palm oil is more suitable, but if the social aspects are most relevant, rapeseed oil should be used for the fatty acid.

The raw material with largest contribution varies depending on the type of fatty acids used and impact category evaluated. If Eka Chemicals want to decrease the environmental footprint of Eka DR further they should focus their efforts primarily on the fatty acid and if tallow based fatty acids is used secondly on the phosphorous chloride and the maize starch used in the dispersion process.

11.2 Social aspects – People

Palm oil is not recommended from a social perspective. There is evidence of both child labour and forced labour and the local food supply is threatened due to land use changes which forces indigenous people to surrender their traditional way of living, often at no compensation.

If palm oil still need to be bought a recommendation is to buy certified sustainable palm oil from Malaysia. Malaysia is a more stable country with a better economic situation, which also supposedly generates

more ethical corporate activities. Even though the certification is still under development and has room for further improvements the certified sustainable palm oil is probably a better alternative than non certified palm oil.

Rapeseed oil and tallow have not been closely evaluated from a social perspective since there is no indication of difficult conditions. Tallow is a by-product from the butchery process and rapeseed is commonly grown in Europe.

Finally from a social perspective there is no reason to change tallow based fatty acid in the production of Eka DR for palm oil based fatty acid. From the social perspective it would be recommended to avoid using palm oil until credible sustainable palm oil can be purchased or until the supply chain is thoroughly investigated to avoid unsustainable methods.

11.3 Economic aspects – Profit

From an economic perspective there are some periods in time when it is beneficial to change raw material from tallow based fatty acid. During around 20 % of the time from 2006 until today the tallow oil was more expensive than the palm oil and only at one occasion the tallow oil was more expensive than the rapeseed oil. The periods are up until now short and it is therefore questionable if a switch is feasible for such a short time periods.

11.4 Final conclusion

Today there is no reason for Eka Chemicals to change fatty acid for the production of Eka DR. They are using the most sustainable fatty acid out of the alternatives evaluated. If the prices for fatty acid change in the future it can be necessary to purchase other fatty acids than tallow based. Depending on the weighting of the factors involved when evaluating sustainability, different options will come out more or less favourable. It is then important for Eka to determine a weighting to be able to make a decision.

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Appendix II Template for semi-structured interviews

Background – open questions

What is your educational and professional background?

What is your role and tasks in your current position?

How are your tasks connected to EKA DR?

How are your tasks connected to the sustainability work in Eka Chemicals?

What have been done the last year on EKA DR and sustainability?

What is your personal definition of a sustainable development?

Operational eco-efficiency

Do you think that it is important that Eka works with reducing emissions from the sites?

Do you know a concept called operational eco-efficiency?

Do you know the goals stipulated for operational eco-efficiency?

Do you think that these targets are formulated in a good way?

Do you know how Eka works to reach the targets within operational eco-efficiency?

Do you work with anything that relates to the nine parameters in operational eco-efficiency? What do you do?

Do you think that the focus is big on operational eco-efficiency?

Is it prioritized by managers?

Is it discussed at group meetings?

Is it discussed among colleagues?

Do you feel that you in your work have the possibility to influence Eka reaching the targets for operational eco-efficiency?

Were there any plans for last years on measures? Can you show them?

What have been done during the last year to improve the parameters in operational eco-efficiency?

The ones that were not realized, why were they not realized?

Carbon policy

Do you think that it is important that Eka works with reducing the emissions of green house gases from their own and upstream applications?

Do you know the concept AkzoNobel carbon policy?

Do you know the targets in the carbon policy?

Do you think that the targets are formulated in a good way?

Do you know how Eka works to reach these targets?

Do you work with anything connected to these targets or the carbon management plan? Can you tell me what you do?

Do you think that there is a big focus on the carbon policy and reducing green house gas emissions in the work group/company?

More/less than operational eco-efficiency?

Is it prioritized by managers? Your manager?

Is it discussed in meetings?

Is it discussed among colleagues?

Do you feel that you in your work have the possibility to influence Eka reaching the carbon policy targets?

Are there any plans from last years on measures that you planned to do last year? Can you show them?

What have been done during the last year to improve the parameters in carbon policy?

The once that was not realized, why were they not realized?

Do you differentiate between the work with carbon policy and operational eco-efficiency?

Target and their follow up

Do you get clear targets on what you should do in your work role so that Eka can reach the targets in the carbon policy and operational eco-efficiency?

Are there any targets that overlap?

How is you work on these targets followed up?

Do you have targets on HSE/Sustainability in you P&D dialog? If yes, do you want to tell in general terms what they are?

To communicate with customers?

To communicate with suppliers?

Do you get feedback on your work? Are you satisfied with the feedback you receive?

Do you delegate work regarding sustainability/HSE to anyone?

Communication

What kind of information do you get regarding sustainable development?

- Meetings, how often?
- Leaflets?
- Mails, how often?
- Educational programs/training
- The intranet?

From whom do you get information about carbon policy/operational eco-efficiency?

To whom do you share information about carbon policy/operational eco-efficiency?

Is the information used in the sale process? Are for example carbon or eco footprint requested by customers?

In contact with the suppliers?

Are you part of any network concerning these questions?

Do you get enough information/education about sustainability?

Motivation

Do you have any motivation or incentives to work with these questions?

Bonus

P&D dialog goals and follow up

Personal motivation

What is your personal motivation in you work with sustainability/HSE questions?

Final questions

What is your opinion about how Eka work with Sustainability/environmental questions?

Is there any specific thing that stops you from working more with sustainability/HSE?

Resources?

Employees?

Money?

Is there any subject or task in your job that we haven't touched upon that you would like to mention?

The Swedish version used at the interviews

Bakgrund – öppna frågor

Vad är din bakgrund?

Vad är din roll/dina arbetsuppgifter?

Hur är de kopplade till Eka DR?

Hur är de kopplade till sustainability arbetet på Eka?

Vad är din personliga definition av hållbar utveckling?

Operational eco-efficiency

Tycker du att det är viktigt att man jobbar med att reducera utsläppen från fabrikerna?

Känner du till operational eco-efficiency?

Känner du till målen för operational eco-efficiency?

Tycker du att dessa mål är utformade på ett bra sätt?

Vet du hur Eka jobbar för att nå målen inom operational eco-efficiency arbetet?

Arbetar du med något som berör dessa mål? Kan du i så fall berätta vad?

Tycker du att fokuset på operational eco-efficiency är stort på arbetsplatsen?

Prioriterat av chefer?

Pratas det mycket om det på möten?

Pratar kollegorna om det?

Känner du att du i ditt arbete kan påverka att Eka uppnår målen för operational eco-efficiency?

Fanns det några planer för åtgärder under förra året som du kan visa mig?

Vilka gjordes?/Vad har gjorts under det senaste året för att förbättra utsläppen av parametrarna i operational eco-efficiency?

De som inte genomfördes – vad berodde det på?

Carbon policy

Tycker du att det är viktigt att man jobbar med att reducera utsläppen av växthusgaser från fabrik/energi/leverantörer?

Känner du till AkzoNobels Carbon policy?

Känner du till målen för carbon policy arbetet?

Tycker du att Carbon policy målet (om de känner till det) är utformat på ett bra sätt?

Vet du hur Eka jobbar för att nå dessa mål?

Arbetar du med något för att nå dessa mål? Kan du i så fall berätta vad?

Tycker du att fokuset på carbon policy är stort på arbetsplatsen?

Större/mindre än operational eco-efficiency?

Prioriterat av chefer?

Pratas det mycket om det på möten?

Pratar kollegorna om det?

Känner du att du i ditt arbete kan påverka att Eka uppnår målen för carbon policy?

Fanns det några planer för åtgärder under förra året som du kan visa mig?

Vilka gjordes?/Vad har gjorts under det senaste året för att förbättra utsläppen av parametrarna i operational eco-efficiency?

De som inte genomfördes – vad berodde det på?

Skiljer du på arbetet inom carbon policy och operational eco-efficiency?

Mål och uppföljning

Får du tydliga mål för hur du ska arbeta för att uppnå målen i carbon policy/operational eco-efficiency?

Överlappande?

Hur följs det här arbetet upp?

Har du mål om HSE/sustainability in din P&D dialog? Om ja, vill du berätta i generella ordalag om dessa mål.

Att kommunicera det till kunder?

Att kommunicera det till leverantörer?

Får du feedback på ditt arbete? Är du nöjd med den?

Delegerar du arbete om sustainability till någon?

Kommunikation

Vad får du för information om hållbar utveckling?

- Möten, hur ofta?
- Broschyr, leaflet?
- Mail-utskick, hur ofta?

- Utbildningsprogram
- Intranätet

Från vem får du information om carbonpolicy/operational eco-efficiency?

Till vem ger du information om carbonpolicy/operational eco-efficiency?

Används information i säljkontakten? Efterfrågas t.ex. carbon eller eco footprint?

I kontakten med leverantörer?

Finns det något nätverk som du är med i rörande de här frågorna?

Får du tillräckligt med information/utbildning inom sustainability/miljö?

Motivation

Finns det någon motivation för dig att arbeta med de här frågorna?

Bonus

P&D dialog-mål-uppföljning/lönesamtal

Personlig motivation

Vad är din personliga motivation i ditt arbete med sustainability/HSE frågor?

Avslutning

Vad är din allmänna åsikt om Ekas miljöarbete?

Finns det något som hindrar ert arbete?

Resurser?

Personal?

Pengar?

Finns det något ämne som du tycker vi inte berört?

Appendix III Template for unstructured interviews

This template was adapted to fit the role of the person who was interviewed.

Balanced Scorecard (BSC)

Have you heard of the concept balanced scorecard?

Is the balanced scorecard used at your department?

Is the name balanced scorecard used?

Does the management use balanced scorecard as a management tool?

Does your closest manager use balanced scorecard?

Do you follow-up your work with the BSC?

When did you start using the balanced scorecard?

Do you think the balanced scorecard is a good way of working?

How often do you get an update of the scorecard?

Do you have any IT support for presentation and documentation of goals and outcomes?

Is it connected to EPM and / or SAP or some other system?

Is there anything else that affects the control of the company?

Communications

Do you receive clear information from your managers on these two objectives (the operational eco-efficiency and carbon policy) and how you will work to achieve them?

How do you get information about the sustainability work on the two objectives (eco-efficiency and carbon policy)?

From whom and how often?

What type of information is it? In what tasks / decisions, do you use the information?

Have you participated in any training regarding the sustainability targets?

To whom do you communicate information about these two targets? Internally and externally?

Do you have the opportunity to influence how the goals will be designed?

Do you feel that you have a dialogue with your boss about these goals?

Do you have any influence when you talk with the boss?

Is the result of the work communicated regularly to the employees?

Do employees receive feedback on their work with sustainable development?

Are people talking about sustainable development in informal settings?

Targets and monitoring

Have targets been broken down by department / product / person?

Have you received goals for your group / service?

How does your group receive information about the scorecard measures and outcomes?

How to delegate the responsibilities you have within your group?

Which ways do you use to disseminate and implement these goals? What are your tools?

Is there a timetable for when objectives should be met?

Is there a strategy from the management for how these goals will be achieved? Which measures to be used?

Enthusiasts?

How do you proceed from your role in the carbon management plan? What are your goals? Are they quantified? How is your performance measured? Until when should you meet the objectives? Are there both long and short term goals for this work?

Are there trade-offs needed that make it difficult to achieve the objectives? Obstacles in any other ways?

Motivation and reward systems

Is there any reward system? What is it based on? Is it at an individual or department level?

Is it based on the right things or is there other environmental work you do that is more relevant?

Do you have any other motivation?

What are your driving forces in the sustainability work?

Who inspires you to work with sustainable development?

Do you get feedback on your work?

Change Management

The corporate sustainability dashboard came in 2008 with the objectives connected to the DJSI, etc.

How did you get information about this? What happened then?

Carbon policy came in 2009. How did you get information about that?

Operational eco-efficiency. How did you get information about that?

Did your job change when the new sustainability scorecard came in 2008? In what way?

How did the sustainability work function at your department before and after the dashboard?

Were you involved in planning the change process?

Do you think it is clear how the scorecard connects to your work?

Did you think it was a good change, or did you have objections?

Environmental Management System

Do you (or someone in your department) use data from EPM to anything else than reporting? Eg identify and categorize problems, examine cause-effect relationships, make improvement and action plans?

In what way is EPM linked to Eka's sustainability targets and action plans?

What do you see as the biggest challenges for achieving the sustainability goals of Eka?

Lifecycle Management

How do you work with Lifecycle Management?

How will you contribute to reduction of emissions from scope 3 upstream?

Do you cooperate in any way with suppliers?

Other

Challenges for the future?

How do you define sustainability?

The Swedish version used at the interviews

Balanced Scorecard

Har du hört talas om begreppet balanced scorecard?

Används metoden balanced scorecard på din avdelning?

Används beteckningen balanced scorecard?

Följer ledningen upp verksamheten med hjälp av BSC?

Följer din närmaste chef upp verksamheten med hjälp av BSC?

Förljs ditt arbete upp med hjälp av BSC?

När började ni använda med balanserade styrkort?

Tycker du att balanced scorecards är ett bra sätt att arbeta på?

Hur ofta får du en uppdatering av styrkortet?

Har du något IT-stöd för presentation och dokumentation av mål och utfall?

Är det kopplat till EPM och/eller SAP eller något annat?

Finns det något annat som påverkar styrningen i företaget?

Kommunikation

Får du tydlig information från dina chefer om de här två målen (operational eco-efficiency och carbon policy) och hur du ska arbeta för att uppnå dem?

Hur får du information om hållbarhetsarbetet kring de två målen (eco-efficiency och carbon policy)?

Från vem, vilka och hur ofta? Vilken typ av information är det? I vilka arbetsuppgifter/beslut använder du informationen?

Har du deltagit i någon utbildning om hållbarhetsmålen?

Till vem kommunicerar du information om de här två målen? Internt och externt?

Har du möjlighet att påverka hur målen ska utformas? Upplever du att du har en dialog med din närmsta chef om de här målen? Har du något inflytande när du pratar med chefen?

Kommuniceras resultatet av arbetet regelbundet till medarbetarna? Får medarbetarna uppföljning på sitt arbete med hållbar utveckling?

Pratas det om hållbar utveckling i informella sammanhang?

Mål och uppföljning

Har målen brutits ner per avdelning/produkt/person? Har du fått nedbrutna mål för din grupp/tjänst?

Hur får de i din grupp del av styrkortsmått och utfall?

Hur delegerar du ut de ansvarsområden du har inom din grupp?

Vilka sätt använder du för att sprida och förverkliga de här målen? Vilka är dina redskap?

Finns det tidsplaner för när målen ska vara uppfyllda?

Finns det en strategi från ledningshåll för hur det här målet ska uppnås? Vilka åtgärder som ska till?

Eldsjälar?

Hur går du vidare från din uppgift i carbon management plan? Vad har du för mål i hur mycket som ska ha gjorts? Är målet kvantifierat? Hur ofta mäts ditt resultat? Till när ska du uppnå målen? Finns det både lång och kortiktiga mål för detta?

Finns det några målkonflikter som gör att det är svårt att uppnå målen? Hinder på andra sätt?

Motivation och belöningssystem

Vad finns det för belöningssystem? Vad baseras det på, vilka mått? Är det på individ eller avdelningsnivå?

Baseras det på rätt saker eller finns det annat miljöarbete du jobbar med som är mer relevant?

Vad har du för annan motivation?

Vad är dina drivkrafter i sustainability arbetet?

Vem blir du inspirerad av till att jobba med hållbar utveckling?

Får du feedback på ditt arbete?

Change Management

Dashboardet kom 2008 med målen om DJSI etc.. Hur fick ni information om det? Vad hände då?

Carbon policy kom snarare 2009 om vi uppfattat det rätt? Hur fick ni information om det?

Operational eco-efficiency: hur fick ni information om det?

Ändrades ditt arbete när det nya sustainability styrkortet kom 2008?

På vilket sätt i så fall?

Hur såg hållbarhetsarbetet ut på din avdelning före och efter styrkortet?

Var du delaktig i att planera förändringsarbetet?

Tycker du att det är tydligt hur styrkortet kopplar till ditt arbete?

Tyckte du att det var en bra förändring eller hade du invändningar?

Environmental Management System

Använder du (eller någon på din avdelning) datan i EPM till något mer än rapportering? T.ex. identifiera och kategorisera problem, undersöka orsak-verkan samband, göra förbättrings- och handlingsplaner?

På vilket sätt är EPM kopplat till Ekas hållbarhetsmål och handlingsplaner?

Vad ser du som de största utmaningarna för att nå Ekas hållbarhetsmål?

Life Cycle Management

På vilket sätt arbetar du med Life Cycle management?

Hur bidrar du till att minska miljöpåverkan i scope 3 upstream?

Samarbetar du på något sätt med leverantörer?

Övrigt

Utmaningar för framtiden?

Hur definierar du hållbar utveckling?