Waste management at Electrolux
- Proposals for a New Waste Management- and Waste Reporting System

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Abstract

There has been an increased trend and awareness, during the past two decades, for global companies to assess their environmental impact. And when it comes to waste management, there are at this point few disarmaments that an increased awareness of companies’ resource-, and waste streams can have positive financial outcomes, if actions are taken.

A lot of these ideas have already been implemented within Electrolux. By developing an energy and water management plan, Green Spirit, they have successfully improved their operations with reducing their energy intensity with 17% (2011-2015) and water intensity with 35% (2011-2015) (Electrolux Sustainability, 2016).

This study has the main objective how to improve and reduce waste in Electrolux’s production facilities, and to help Electrolux understand their waste streams. By assessing the waste performance at Electrolux, and by comparing environmental KPIs between Electrolux and a selection of competitors, a basis for decision was developed.

Literature studies of legislative frameworks in geographical regions where Electrolux have a strong presence have helped to understand how companies can work with regulatory entities to solve greater issues. By joining forces with other companies and governments, Electrolux will be able to set an example of how waste performance and profitability can be achieved. By sharing best practice, and engaging with stakeholders and developers, Electrolux can help improve waste performance and save natural resources.

This thesis has lead to the development of a new management system, a new reporting system, and a transparent way to rank and keep track of waste performance at Electrolux factories. A way to understand and address issues related to zero waste is also presented.
Acknowledgment

Despite the fact that the fundamental idea and principles of waste management is relatively easy to understand, it has a much more complex structure when considering the complete system. Aside from limited academic background in this field, it was to me an unfamiliar territory. I’m therefor grateful for all the help I’ve received during this thesis, and honoured to have worked and interviewed people with considerably more experience in the field.

I would like to thank my supervisor at KTH, Larsgöran Strandberg, for his remarkable dedication to advice and support me towards my goal. I’ve received countless constructive feedback which has shaped my thesis to what it is today, and in my opinion he sets an example of the role of an academic supervisor.

I would also like to thank my supervisors at Electrolux, Henrik Sundström and Jan Johansson. Both for the opportunity to be a part of Electrolux Sustainability Group during my thesis, but also for all the time and devotion from their side to help me reach a viable and useful result.

During my thesis I’ve had the opportunity to meet and interview a number of people, to whom I’m very grateful. First, thank you Rune Ek and Christer Ågren for allowing me to visit the Electrolux factory in Ljungby, and thank you Karl Edsjö for the interview in Brussels. Thank you Jorge Diaz del Castillo for introducing me to the work of the Directorate-General for Environment at the European Commission, and for introducing me to waste management from a political perspective. Thank you Colton Bangs at Umicore in Hoboken for broaden my perspective on industrial waste management. And thank you Julie S. Woosley, at the hazardous waste section of NC DEQ, for taking your time to be interviewed and discussing waste management in the United States.

Finally, I would like to express my gratitude to all of the people at Electrolux Sustainability Group and the people I’ve worked with on a daily basis.
Abbreviations and definitions

AHAM – Association of Home Appliance Manufacturers
CDP – Carbon Disclosure Project
CECED – European Committee of Domestic Equipment Manufacturers
EC – European Community
EEC – European Economic Community
EHS – Environment Health and Safety
EMA – Electrolux Major Appliances
EMEA – Europe, Middle East, Africa
EMS – Environmental Management System
EPR – Electrolux Professional Alliances
ERP – European Recycling Platform
ERP system – Enterprise Recourse Planning
ESA – Electrolux Small Appliances
EWC – European Waste Catalogue
GRI – Global Reporting Initiative
ISO – International Organisation for Standardization
KPI – Key Performance Indicators
MA – Major Appliances
OEM – Original Equipment Manufacturer
RCRA – Resource Conservation and Recovery Act
WEEE – Waste Electrical and Electronic Equipment
WMS – Waste Management System
WTE – Waste to Energy

EMEA is a business area which is limited to geographical regions Europe, Middle East and Africa.

ERP or Enterprise Resource Planning is a way to integrate and manage information related to a company’s core business.

OEM or Original Equipment Manufacturer is a company that produces products for another company.

KPI or Key Performance Indicators are used to measure the performance in various categories. From a financial perspective this can be the net margin or the dividend yield. From an environmental perspective it can be the waste intensity per product. I.e. total waste divided by the number of products.

NGO or Non-Governmental Organization is an organization that often has idealistic goals and is funded by donations.

SMART is a method for establishing objectives and targets, based on five criteria’s. These are Specific, Measurable, Assignable, Realistic and Time-related.
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1. Introduction

This thesis is a collaboration between the faculty of Industrial Ecology at the Royal Institute of Technology (KTH), and Electrolux. It was conducted during the second half of 2016 in Stockholm, Sweden.

The field of study is industrial waste management, and the research question being how to improve waste performance at Electrolux. Empirical studies together with literature reviews, case studies, and interviews have contributed to the development of the thesis.

Electrolux have for the past years received several acknowledgments for their work in sustainability, and they have successfully improved both their water and their energy programmes. As a way to improve their sustainability work even further, they have decided to assess and improve their waste management as well. This thesis can be seen as a pilot study, where the background study and the results will be used as a decision support.

With 51 factories world wide, Electrolux produces a lot of waste. And if the number of materials that come into the process are compared to the output, we find that the input outweighs the output. This is one aspect that companies, including Electrolux, need to address, since it reduces the productivity and the potential profit. However, with larger companies acting on a global market, it is very difficult to have an understanding of all waste stream. It will require a long term commitment from both companies and investors to address the issue. In this thesis, empirical studies of waste streams will play an important role.

My expectations for this thesis is to have a better understanding of problems and possibilities that exits within the field of waste management. I hope to get a fundamental understanding of the legislative frameworks that guide and support companies and governments towards a sustainable culture, and how to give decision makers and stakeholders the incentives they need to invest in improved waste performance.

I’m also interested in understanding the problems, if there are any, that occur between factories and group management, and find out how these can be solved.

My final expectation is to increase my knowledge about the relationship between environmental and financial sustainability, and waste performance. What is the common dominator that allows companies to improve both waste performance and profitability?

This thesis should be seen both as an evaluation of Electrolux waste performance, and as a guidebook for other companies who also wish to improve their waste performance and profitability.

1.1 Aims

Operational efficiency is a key area for Electrolux, and a part of this is the reduction of waste. To improve this area, Electrolux have defined three tasks that they wish this thesis to address. These are to:
1. Define a world-class standard in waste management;
2. Assess the status in Electrolux operations;
3. Propose a global waste program for Electrolux;

To develop Electrolux’s waste management system even further, a suitable definition of what constitutes a “world-class standard” in waste management is presented. By looking at different companies’ waste performance in the same business area, or other measurable companies/entities, key features that are needed to reduce waste and improve overall waste streams can be found and be part of such a standard. It will also require an understanding of different legislative framework, requirements from financial analysis’s (such as Dow Jones Sustainability Index), and to map waste organisation in regions that are of key importance for Electrolux.

The second aim, to assess the status in Electrolux operations, is to investigate what has been done internally. To evaluate different policies that already have been implemented to improve waste management, and to analyse e.g. waste streams from their factories, studies by employees, and questionnaires from relevant suppliers.

As a result from these investigations (aim 1 & 2), a proposal for a global waste program will be presented. This program should include a management-, and a governance structure, and features that help Electrolux to collect data, both internally and externally, and to take decision that will support continued improvements.

1.2 Objectives

- Propose how waste should be reported.
- Identify examples of best practice cases in the industry
- Propose a management and governance structure.
- Propose tangible global waste targets.

1.3 Scope

The study focuses on waste performance at Electrolux. Only materials that are currently being reported will be investigated. Empirical studies will be performed for the 51 factories located all over the world, but no focus will be put on offices and warehouses. Waste streams from suppliers and Original Equipment Manufacturers (OEM) are also excluded from the empirical studies. The only geographical limitation is related to legislation. Due to Electrolux’s strong financial position in the European and North American market, only legislation in these geographical areas have been investigated. Only data from 2015 have been used to empirically analyse Electrolux performance, if not stated otherwise.

1.4 Methodology

1.4.1 Literature study

Different examples of industrial waste management systems have been studied, with the purpose to provide examples and perspectives on how a waste management system can be
structured. Best practice scenarios from both industry and governments have also been studied to support the objectives of the thesis.

1.4.2 Case Study

The main objective of the case study was to study and evaluate waste streams in Electrolux’s factories. Visits to both factories and recycling plants were done. Further knowledge and understanding regarding contracts between the waste producing company and the recycling company were also gained.

The factory visited was located in Ljungby (Sweden) and is a part of the sector Electrolux Professional. They produce laundry equipment that are meant for heavy use and durable conditions. The main waste output from this factory is different kinds of metal, cardboard and plastic.

With the objective to study other another company’s waste management, a visit to an Ericsson factory was made. The production techniques were different from the ones used at Electrolux in Ljungby, which was known in advance. The focus of this meeting was to study their waste management system, and to discuss various waste scenarios and solutions.

Visits to two different recycling plants have also been done. These were to Stena Recycling plants in Veddesta and in Ljungby. The objective of these case studies were to understand how waste management works from the perspective of the recycler, and understand the professional relationship between Electrolux and them.

1.4.3 Data analysis

An extensive empirical study of waste streams at Electrolux was done. It accounted for a majority of the time spent for the thesis, and the results have lead to the development of the result. With access to performance data from Electrolux’s internal ERP system, and with information from competitor’s sustainability report, data have been measured and analysed with the objective to evaluate the performance of Electrolux and its competitors. The results will be presented and discussed in the thesis, also included in the appendices.

1.4.4 Interviews

Due to the broad spectrum of the thesis, interviews with companies, NGO’s, and politicians have been made to gain a profound understanding of waste management from different stakeholders’ perspective. The questions where the same or similar to those presented in Appendix VI, and they were discussed in an open dialogue with the interviewee. Answers from the interviews will not be presented in Appendix VI, due to the long dialogues or if the answers didn’t reflect the result of the thesis.

The following persons were interviewed:

1. Karl Edsjö – Electrolux, Brussels
2. Jorge Diaz del Castillo – Directorate-General for Environment at the European Commission, Brussels
3. Colton Bangs – Umicore, Hoboken
4. Julie S. Woosley – Hazardous waste section of NC DEQ, North Carolina
2. Background – Benchmark and the global “Waste State”

2.1 Waste defined

There are many definitions of the waste concept. One of the most frequently used is the one set by the European Council in 2008. It states that “‘waste’ means any substance or object which the holder discards or intends or is required to discard” (The European Parliament and of the Council, 2008, p.7). This definition is derived from the Waste Framework Directive 75/442/EEC 1975 and it has been accepted by several states and organisations. I have in my thesis primarily focused on legislative frameworks in the European-, and the North American market. These regions accounted for 66 % of Electrolux Group sales in 2015 (AB Electrolux, 2015).

Even though the definition has been redefined several times, it has always had a subjective nature, depending on if you consider waste as a resource, or something which holds no further value. This makes it important for companies to define waste within their organisation, to differentiate waste from resource.

2.1.1 Waste as a resource

An example of a residual resource in an industrial production line, is the metal remaining after a stamping machine has punched out a desired shape. If the residual contains the right specifications it can be reused or reshaped to produce another product, without no extra material needed. A second example which is very common in all manufacturing industries is the production waste which will be sent for recycling. Even though it might not hold the same value as when it was purchased, it still contains a value which can be measured in monetary terms. By making sure that waste is sorted and handled in a sustainable way, companies can improve their profit by getting more paid for their waste (European Commission, 2016).

2.1.2 Hazardous waste

It is important to distinguish what type of waste it is, and if it contains any properties which could be harmful for humans, wild life and nature. These harmful waste types are often referred to as hazardous waste, and defined in the directive 2008/98/EC as “… waste which displays one or more properties listed in Annex III” (The European Parliament and of the Council, 2008, p.7). Examples of properties are substances which are easily flammable, or substances which can penetrate the skin and cause sickness or even death.

There are several regulations controlling the handling and disposal of hazardous waste. Many countries and regions define their framework depending on its own interest, but they are usually an adaptation of an overall legislation policy, such as the one defined by the European Parliament, or the US Environmental Protection Agency. A careless handling can result in both expensive fines and accidents (US Environmental Protection Agency, 2016; European Commission, 2016).

To determine whether a material or liquid should be classified as hazardous waste, the content properties need to be determined. A specific type of liquid or material can have the same properties in the end of the production line as it has in the beginning. If so, the classification of the waste type will require less resources. However, it is also possible that hazardous waste is
the result of combining various types of hazardous and/or non-hazardous liquids or materials (see Figure 1). This can make it difficult to determine the exact properties of the hazardous waste. Guidelines on waste determination can often be required from academic institutions, or via local and national authorities (Introduction to Hazardous Waste Identification (40 CFR Parts 261), 2005).

Figure 1: *The figure describes how hazardous waste be created within the factory.*

2.1.3 Waste categorization

Waste categorization is a way to determine and list waste in different groups, based on the properties of each waste type. The purpose of waste categorization is often to ease the labelling and handling of waste for companies, and to facilitate governmental tracking and regulation. Both the European Parliament and the US Environmental Protection Agency has set up vigorous waste list, and they are publicly available (EPA, 2016; European Parliament and of the Council, 2014).

The European List of Waste (2014) is a modernized adaptation on directive 2000/532/EC and Annex III in the directive 2008/98/EC, and it lists 20 main categories (two-digit code). Each category is then divided into subchapters (four-digit code), and thereafter the respective waste category (six-digit code). All 20 chapters are available in Appendix I. If the six-digit code is followed by an asterisk (*), it should be considered as a hazardous waste (European Parliament and of the Council, 2014). A sample of five main chapters are presented in Table 1.

*Table 1: The table is a sample of chapters in The European List of Waste (European Parliament and of the Council, 2014, p.4).*

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Wastes resulting from exploration, mining, quarrying, physical and chemical treatment of minerals</td>
</tr>
<tr>
<td>08</td>
<td>Wastes from the manufacture, formulation, supply and use (MFSU) of coatings (paints, varnishes and vitreous enamels), adhesives, sealants and printing inks</td>
</tr>
<tr>
<td>11</td>
<td>Wastes from chemical surface treatment and coating of metals and other materials; non-ferrous hydro- metallurgy</td>
</tr>
<tr>
<td>13</td>
<td>Oil wastes and wastes of liquid fuels (except edible oils, 05 and 12)</td>
</tr>
<tr>
<td>16</td>
<td>Wastes not otherwise specified in the list</td>
</tr>
</tbody>
</table>
The European commission has also specified recommendations for how The European List of Waste (2014) should be used to identify and categorize waste (European Parliament and of the Council, 2014, p.3):

1. Determine at what source the waste is generated, by looking at chapter 01-12, and 17-20. When the correct main chapter is identified, locate the correct subchapter, and eventually the respective waste category (six-digit code).
2. If the waste can’t be identified with any of the main chapters listed above, chapter 01-12 or 17-20, then explore chapter 13-15.
3. If still not found, examine chapter 16, “Wastes not otherwise specified in the list”.
4. If non of the categorizes in chapter 16 is equitable, then the waste should be listed with the waste code 99.

The European List of Waste (2014) developed by the European Parliament and of the Council, specify waste depending on its source, rather than the chemical components. Therefore it is possible that a waste can have more than one waste code (European Parliament and of the Council, 2014).

2.1.4 Hazardous Waste Classification

The European List of Waste (2014) also includes categorization of hazardous waste. As stated above, if a waste code is followed by an asterisk, it has hazardous properties. However, before assigning a waste code, its hazardous properties must be determined. In Annex III of the Directive 2008/98/EC, the European parliament and of the Council has listed 15 properties of waste which render it hazardous (The European Parliament and of the Council, 2008). Table 2 shows a sample of four waste properties.

*Table 2: Four examples of hazardous waste properties.*

<table>
<thead>
<tr>
<th>H1</th>
<th>‘Explosive’: substances and preparations which may explode under the effect of flame or which are more sensitive to shocks or friction than dinitrobenzene.</th>
</tr>
</thead>
<tbody>
<tr>
<td>H2</td>
<td>‘Oxidizing’: substances and preparations which exhibit highly exothermic reactions when in contact with other substances, particularly flammable substances.</td>
</tr>
<tr>
<td>H4</td>
<td>‘Irritant’: non-corrosive substances and preparations which, through immediate, prolonged or repeated contact with the skin or mucous membrane, can cause inflammation.</td>
</tr>
<tr>
<td>H5</td>
<td>‘Harmful’: substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may involve limited health risks.</td>
</tr>
</tbody>
</table>

When the correct hazardous waste properties have been assigned, the equitable waste code from The European List of Waste (2014) shall be assigned (European Parliament and of the Council, 2014).

In the United States it is the federal law Resource Conservation and Recovery Act (RCRA) which sets up the framework for the appropriate management of hazardous and non-hazardous waste (EPA, 2016). This framework is followed by The Environmental Protection Agency, which has listed a large amount of specific hazardous waste streams commonly seen in the industrial sector. This list is called "Part 261 – Identification and listening of hazardous waste", and can be found in the Code of Federal Regulations, Title 40 – Protection of Environment (US
In Subpart D – Lists of Hazardous Wastes, four categories of hazardous waste have been listed. These are:

- **F List** - Hazardous wastes from non-specific sources.
- **K List** - Hazardous wastes from specific sources.
- **P List** - Discarded commercial chemical products, off-specification species, container residue, and spill residues thereof.
- **U** – List Deletion of certain hazardous waste codes following equipment cleaning and replacement.

A waste determination is done once it has been determined that an item can’t be used for its intended purpose. It is determined whether it is a solid waste, and if it shows any of the hazardous waste specific characteristics listed in Subpart D (EPA, 2005).

Each category is assigned one unique “Industry and EPA hazardous waste No.”, and one “Hazard code”. The unique hazardous waste numbers are equivalent to the six-digit codes defined by the European Parliament and of the Council. The F-, and the K List also specifies what type of hazardous properties each waste has (US Environmental Protection Agency, 2016). Table 3 shows the six different hazard codes.

**Table 3: Six hazardous waste properties listed by the US Environmental Protection Agency.**

<table>
<thead>
<tr>
<th>Hazard code</th>
<th>Property</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Ignitable Waste</td>
</tr>
<tr>
<td>R</td>
<td>Corrosive Waste</td>
</tr>
<tr>
<td>C</td>
<td>Reactive Waste</td>
</tr>
<tr>
<td>E</td>
<td>Toxicity Characteristic Waste</td>
</tr>
<tr>
<td>H</td>
<td>Acute Hazardous Waste</td>
</tr>
<tr>
<td>T</td>
<td>Toxic Waste</td>
</tr>
</tbody>
</table>

Below is a sample of available information in the F-, and the K List.

**Table 4: Source specific waste listed by the US Environmental Protection Agency.**

<table>
<thead>
<tr>
<th>Industry and EPA Hazardous waste no.</th>
<th>Hazardous waste</th>
<th>Hazard code</th>
</tr>
</thead>
<tbody>
<tr>
<td>F007</td>
<td>Spent cyanide plating bath solutions from electroplating operations</td>
<td>(R, T)</td>
</tr>
<tr>
<td>F011</td>
<td>Spent cyanide solutions from salt bath pot cleaning from metal heat treating operations</td>
<td>(R, T)</td>
</tr>
<tr>
<td>K111</td>
<td>Product washwaters from the production of dinitrotoluene via nitration of toluene</td>
<td>(C, T)</td>
</tr>
</tbody>
</table>
Below is a sample of available information in the P-, and the U List.

Table 5: A sample of source specific waste listed by the US Environmental Protection Agency.

<table>
<thead>
<tr>
<th>Hazardous waste No.</th>
<th>Chemical abstracts No.</th>
<th>Substance</th>
</tr>
</thead>
<tbody>
<tr>
<td>P023</td>
<td>107-20-0</td>
<td>Acetaldehyde, chloro-</td>
</tr>
<tr>
<td>U034</td>
<td>75-87-6</td>
<td>Acetaldehyde, trichloro-</td>
</tr>
</tbody>
</table>

Waste determination can often be very hard and time consuming. If done incorrectly, it can be the cause of environmental noncompliance. According to EPA, it is important to know where the waste comes from, how it was generated, and how it is treated (US Environmental Protection Agency, 2016; Introduction to Hazardous Waste Identifi cation (40 CFR Parts 261), 2005).

2.1.5 Waste hierarchy

The waste hierarchy is a frequently used idea and illustration in the field of waste management. These basic principles help to distinguish waste from by-products, and it is derived from the Waste Framework Directive 75/442/EEC. It describes a top-down approach for how to best prioritize waste minimization activities, and it has been adopted by governmental entities, NGOs, and companies around the world. The top of the pyramid presents the most favourable activities, while the bottom describes the least favourable (European Commission, 2016). The Waste Hierarchy is illustrated in Figure 2.

![Waste Hierarchy](image)

Figure 2: Waste Hierarchy (European Comission, 2016).

The most favourable option, prevention, is at product stage. This is when no product yet has been produced, and thus where no physical waste exists. Preventing the existence of waste can be done by e.g. designing for dematerialization, using materials that are easy to recycle, designing them for a longer product life, and hence using them for the entire product life (Econation, 2016).

It is important to keep in mind that it is best to reduce the amount of waste as early as possible. The longer time it takes for implementing waste reducing measures, the more likely is it that cost will increase. If actions are taken prevent the existence of waste in the first place, there will be no cost/investments bound to the various refining processes which produce waste.
Reusing products is preferred over recycling, since it requires less energy, reduce pollution, and save natural resources. A product can be reused in its present form, or by slightly altering its design or performance. By doing these changes the by-product can easily become a new product suitable for new customer groups (EPA, 2016).

By recycling one refers to collecting, sorting, and processing products into new raw materials. It aims to save the amount of natural resources, and reducing the need for landfill/disposal. Depending on what material is being recycled, the cost can very significantly. From a long-term perspective, this stimulates the development of new greener recycling methods (EPA, 2016). However, many investments are from a short-term perspective, and due to e.g. high price volatility on the commodity market, the profit for recycling companies can be turned to losses in a very short period. Figure 3 shows the development for Metal prices in dollar terms, from 2011 to 2015. In this time frame the prices have had a negative development, and this will have a financial impact on companies who are supplying recycled materials. Lower prices reduces the margin and can lead to fewer investments (SCS Engineers, 2016; Ensia, 2016).

Figure 3: Development for metal prices from 2011-2015 (Metal prices, 2015).

Recovery, often referred to as recycling for energy recovery, is essentially another form of recycling. By incinerating waste, it is possible to capture the energy that is bound into the materials. This is done in a number of processes called Waste to Energy (WTE). The benefits are that waste, who otherwise would have gone to landfill, is producing energy with less carbon emissions that fossil fuels. However, this method does not save natural resources, and by looking at long-term forecasts for natural resource deposits, recycling for energy recovery is not a long-term solution to waste problems (Mining, 2014; EPA, 2016).

The least favourable option presented in the waste hierarchy is disposal. Disposal means that waste goes directly into landfills, without reusing the materials or capture the energy. Updated directives, legislations, and better recycling technologies have reduced the amount of waste going into landfills in many parts of the world. The directive put forward by e.g. The Council of the European are striving to reduce long-term negative effects on the environment. The landfill directive 1999/31/EC focuses primarily on protecting surface water, groundwater, soil and air, and human health from landfilling of waste (The Council of the European Union, 1999; EPA, 2016).
2.2 Legislations, policies, and financial stakeholders

Legislations and policies pay an important role in the field of waste management. They formulate the framework which companies can act and do long-term profitable business within, and they act as a bridge between other sovereign nations, universities and various other entities. Both the Basel convention in 1989 (Basel Convention, 2011) and the Bamako convention in 1991 (United Nations Environment Programme, 2017) are examples of international treaties where states come together to address issues related to the management of hazardous waste.

Within each nation there are environmental laws that regulates the management of both industrial and municipal waste. For companies that have a presence on a global market this means that policies formulated by the company must be adaptable to be able to comply with local regulations. In this thesis focus are put on regulations formulated by the European Commission and the US Environmental Protection Agency. More detailed examples of these regulations are presented in Chapter 2.1.

In the European Union there are regulations that are directly applicable and binding to all member states. However, general standards and objectives are often presented in different directives, which are implemented and interpreted in the member state’s own legislative frameworks. Examples of directives are 75/442/EEC from 1975, including the purpose to establish an authority for waste disposal, and the landfill directive 1991/31/EC with the purpose of prevent or reduce the negative environmental effects from the landfilling of waste (Williams, 2005; European Commission, 2016).

The Environmental Protection Agency is a federal government, with local administrative offices spread out over the United States. Their mission includes protecting human health and the environment, and to enforce federal laws, that aim to protect the environment, in a fair and efficient way (EPA, 2016).

From a financial perspective, there has been an increased awareness about company’s environmental footprint, and investment firms and financial analysts are including company’s environmental performance in their assessments. RobecoSAM and Sustainalytics are two analyst firms who focus on Sustainable Investing (SI). RobecoSAM provides an intuitive tool for comparing companies’ environmental performance in the same sector, and they follow the GRI guidelines (RobecoSAM, 2016). Sustainalytics announced in 2016 that they will collaborate with Morningstar to include a sustainability rating fund analysis (Morningstar Sustainability Rating). By doing so, both institutional and private investors will have a powerful tool to choose a financial sustainable alternative (Morningstar, 2016; Sustainalytics, 2016).

Electrolux largest shareholder is Investor, who owns 15,5% of the company (AB Electrolux Group, 2016). They state that their direct environmental impact is limited, but they have according to the EU directive starting to map their energy use, and in a period of time propose improvement. They do also follow up on Electrolux sustainability performance annually (Investor AB, 2016).

Due to Electrolux´s strong financial presence in Europe and North America, only legislations in these geographical areas have been studied.
2.2.1 Global Reporting Initiative

GRI is an organization, founded in 1997, who helps companies’ to understand and communicate important impacts which their businesses can have on sustainability issues. These impacts are identified and reported in accordance with their guidelines. The latest one adopted by Electrolux is G4 Sustainability Reporting Guidelines. This guideline was presented in 2014, and has until October 2016 been the latest one available. The G4 reporting guidelines will be accepted until the 30 of June 2018. From the 1 of July 2018, company’s who wish to comply with GRI standards, must report in accordance with new GRI Standards (Global Reporting Initiative, 2016).

In the new reporting system presented in Chapter 3.3 (illustrated in Appendix III), a requirement has been that it shall comply with the guidelines from GRI.

A compliance summary of GRI and ISO is presented in Appendix V.
2.3 Performance – Benchmark

A benchmark has been made to measure the performance of Electrolux. It has been compared with its major competitors, identified by sector and market share, and other comparable company’s with similar manufacturing processes. Examples for similar manufacturing processes are bending sheet metal, stamping, and injection moulding. The benchmark can represent a support in proposing a suitable management structure, identify best practice, and set tangible goals.

All information from competitors are based on sustainability reports, annual reports, and other available resources online. If specific information is missing, it has been estimated based on available data, and communicated in the report. The information has been collected through the thesis, and it is possible that the companies have updated the information after it was retrieved.

2.3.1 Competitors

The competitors chosen in this thesis are Whirlpool, BSH Hausgeräte, General Motors (GM), and Bayerische Motoren Werke (BMW). Both Whirlpool and BSH are two main competitors to Electrolux in the European and North American market. As stated above, these regions accounted for 66 % of Electrolux Group sales in 2015 (AB Electrolux, 2015). Other competitors are Haier, LG Electronics, Samsung, and GE (acquired by Haier in 2016). These companies have been investigated for best practice, but this information is excluded from the background analysis, due to the large amount of business areas and ambiguous data (AB Electrolux, 2015).

GM and BMW have also been analysed. They both have a significant market share in the automotive sector, and very accessible data. Many of the manufacturing processes in the automotive industry are similar to the those in the home- and professional appliances sector. This makes it justifiable to compare their environmental data, and identify best practice. They have also been recognized for sustainability achievements, such as reducing landfill waste.

General KPIs

Table 6 shows a sample of important KPIs (Key Performance Indicators) for the benchmarked companies, regarding their financial performance and number of employers. Attention must be made to absence of information from BSH. Since BSH is a private owned company, they are not obliged to disclosure the same amount of information to the public. However, there is detailed information regarding BHSs environmental performance.

<table>
<thead>
<tr>
<th>Name</th>
<th>Net Sales (Revenues)</th>
<th>Operating Income</th>
<th>Net Income (Net Profit)</th>
<th>Operating Margin</th>
<th>Net Income Margin</th>
<th>Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrolux</td>
<td>13 338,82 €</td>
<td>296,02 €</td>
<td>169,34 €</td>
<td>2,22%</td>
<td>1,27%</td>
<td>58 265</td>
</tr>
<tr>
<td>Whirlpool</td>
<td>19 163,65 €</td>
<td>1 178,81 €</td>
<td>718,29 €</td>
<td>6,15%</td>
<td>3,75%</td>
<td>97 000</td>
</tr>
<tr>
<td>BSH</td>
<td>12 600,00 €</td>
<td>- €</td>
<td>- €</td>
<td>0,00%</td>
<td>0,00%</td>
<td>56 500</td>
</tr>
<tr>
<td>GM</td>
<td>139 765,30 €</td>
<td>4 492,31 €</td>
<td>8 820,42 €</td>
<td>3,21%</td>
<td>6,31%</td>
<td>215 000</td>
</tr>
<tr>
<td>BMW</td>
<td>92 175,00 €</td>
<td>9 224,00 €</td>
<td>6 396,00 €</td>
<td>10,01%</td>
<td>6,94%</td>
<td>122 244</td>
</tr>
</tbody>
</table>

Environmental KPIs

This thesis focuses primarily on the industrial waste, but to provide an indication of the general environmental performance by the companies, Table 7 provides a guidance to the current state of both waste-, energy-, water-, and CO2 footprint intensity. The intensity is measured by a company’s total input or output, divided by the number of products. The less intensity, the less impact each product has on each category e.g. waste production.

Table 7: Environmental performance, measured in intensity per product. Source: (BMW Group, 2016; Whirlpool, 2014; BSH Hausgeräte GMBH, 2016; General Motors, 2016; BMW Group, 2016).

<table>
<thead>
<tr>
<th>Intensity - Impact per product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nr of products</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>Nr</td>
</tr>
<tr>
<td>Electrolux</td>
</tr>
<tr>
<td>Whirlpool*</td>
</tr>
<tr>
<td>BSH</td>
</tr>
<tr>
<td>GM</td>
</tr>
<tr>
<td>BMW</td>
</tr>
</tbody>
</table>
* Data from 2014

Based on the information in Table 7, BSH produces the largest amount of products, compared to Electrolux and Whirlpool. The water consumption from BSH compared to Electrolux is 79% lower. This likely depends on the location of Electrolux factories in northern Italy, where the supply of water is very rich, and therefore no urgent need for recirculating the water within the factories.

Looking at the Net sales in Table 6 from BSH, compared to Electrolux, we can notice that they are approximately 5,5% lower than Electrolux’ s. Still they produce 76% more products. This could lead to a conclusion that Electrolux is more financially efficient, however the number of products is likely to be calculated in different ways for the different companies. An explanation could be that BSH produces a larger amount of small appliances, like blenders and irons,
compared to Electrolux. Small appliances at Electrolux only accounts for 7,3% of their total Net Sales (AB Electrolux, 2015).

In Table 8 I have used the information above and calculated the differences in percentage between Electrolux, Whirlpool, and BSH. By doing so, it is possible to understand the difference in performance between the companies. We notice that the number of products from both Whirlpool and BSH are exceeding the number of products from Electrolux. The difference between the companies also show that Whirlpool have a higher intensity in all categories, compared to Electrolux. BSH produces 76% more products than Electrolux, while the intensity is 52% to 79% lower compared to Electrolux.

Table 8: Product based comparison between Electrolux, Whirlpool, and BSH.

<table>
<thead>
<tr>
<th></th>
<th>Nr of products</th>
<th>Waste intensity</th>
<th>Energy intensity</th>
<th>Water intensity</th>
<th>CO2 footprint intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whirlpool/Elux</td>
<td>120%</td>
<td>209%</td>
<td>167%</td>
<td>115%</td>
<td>172%</td>
</tr>
<tr>
<td>BSH/Elux</td>
<td>176%</td>
<td>48%</td>
<td>38%</td>
<td>21%</td>
<td>47%</td>
</tr>
</tbody>
</table>

Based on the data above, the conclusion could either be that BSH have successfully been able to improve their waste intensity (and all other as well), or that the intensity better reflects the reality if it is measured against a financial KPI. By using Net Sales, the reality might be better reflected. The results are shown in Table 9.

Table 9: Product based comparison between Electrolux, Whirlpool, and BSH. Based on Net Sales.

<table>
<thead>
<tr>
<th></th>
<th>Nr of products</th>
<th>Waste intensity</th>
<th>Energy intensity</th>
<th>Water intensity</th>
<th>CO2 footprint intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whirlpool/Elux</td>
<td>144%</td>
<td>175%</td>
<td>140%</td>
<td>97%</td>
<td>145%</td>
</tr>
<tr>
<td>BSH/Elux</td>
<td>94%</td>
<td>89%</td>
<td>72%</td>
<td>38%</td>
<td>87%</td>
</tr>
</tbody>
</table>

By comparing the two tables we can see that the biggest difference between them are in CO2 footprint-, and waste intensity. The CO2 footprint intensity is now 13% lower, compared to 53% lower (i.e. 40 percentage points difference). For waste intensity it is 11% lower, compared to 52% lower (41 percentage points difference). Due to the fact that very little information from BSH are available, we can only make qualified guesses and put these in perspective to other available data. If the assumption above is correct, it might be because small appliances have a higher impact on their Net Sales than it has on Electrolux.

The targets proposed by BSH show that they achieved successful results in reducing energy and waste consumption. However, they missed their target in reducing their waste consumption by 10% from base year 2010 to 2015. Their waste consumption increased with 2%, and was therefore 12% percentage points of target. This can support the assumption made in Table 9 that the intensity should be measured from Net Sales, rather than the number of products.

As one of the objectives are to identify best practices that can be applied to Electrolux, comparative data shown in the tables above, and from various company reports, can be used to
guide the search amongst a selection of companies. This methodology has been applied throughout the thesis.
2.3.2 Targets - Competitors

Table 10 show different environmental targets from Whirlpool, BSH, GM, and BMW. This information gives an indication of how the industry expects their sustainability work to be in a 5-10 year perspective. By looking at the targets we find that a majority of them are related to measuring and reducing the intensity. I find this to be a reasonable approach, since it allows the companies to invest in growth, while reducing the environmental pressure per product. We also find that Whirlpool are dedicated to achieve zero landfill by 2020.

The table below gives a guidance to what the industry is aiming for in the next decade, and it can be used to evaluate if proposed targets by Electrolux are realistic. Proposed targets will be presented in Chapter 3.5.

*Table 10: The table lists targets proposed by the benchmarked companies. Source: (Whirlpool, 2014; BSH Hausgeräte GMBH, 2016; General Motors, 2016; BMW Group, 2016).*

<table>
<thead>
<tr>
<th></th>
<th>Whirlpool</th>
<th>BSH</th>
<th>GM</th>
<th>BMW</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Base year</strong></td>
<td>2014</td>
<td>2015</td>
<td>2010</td>
<td>2006</td>
</tr>
<tr>
<td><strong>Target year</strong></td>
<td>2020</td>
<td>2020/2025</td>
<td>2020</td>
<td>2020</td>
</tr>
<tr>
<td><strong>Waste</strong></td>
<td>By 2020, Whirlpool aims to achieve zero landfill waste from manufacturing. This includes packaging waste.</td>
<td>To reduce waste intensity with 10% from 2010 to 2015, was not achieved. A new strategy is under development.</td>
<td>Reduce waste intensity to 186 kg/vehicle by 2020</td>
<td>Reduce waste volume with 45% by 2020, from base year 2006. This target has already been achieved.</td>
</tr>
<tr>
<td><strong>Water</strong></td>
<td>From 2014-2020 Whirlpool aims to reduce water intensity by 15%.</td>
<td>Reduce water intensity (m^3/ton of product) with 10% by 2020, and 20% by 2025, from 2015 years level.</td>
<td>Reduce water intensity by to 4,09 cubic meters/vehicle by 2020.</td>
<td>Reduce waste water by 45% by 2020, from base year 2006. This target has already been achieved.</td>
</tr>
<tr>
<td><strong>Energy</strong></td>
<td>From 2014-2020 Whirlpool aims to reduce energy intensity by 15%.</td>
<td>Reduce Energy intensity (KWh/ton of product) with 10% by 2020, and 20% by 2025, from 2015 years level.</td>
<td>Reduce energy intensity to 1,97 MWh/vehicle</td>
<td>Reduce energy consumption with 45% by 2020, from base year 2006. By 2015, they have reduced it with 36%.</td>
</tr>
<tr>
<td><strong>CO2 &amp; VOC emissions</strong></td>
<td><em>Committed to continue to reduce</em></td>
<td>Reduce CO2 emissions from goods transportation with 20% by 2020.</td>
<td>Reduce carbon intensity to 0,74 metric tons/vehicle by 2020.</td>
<td>Reduce VOC emission with 45% by 2020, from base year 2006. This target was achieved in 2015, with a reduction of 51,6%.</td>
</tr>
</tbody>
</table>
2.4 Performance - Electrolux waste data

A key objective of this thesis is to investigate Electrolux waste performance in detail. This work has been the most comprehensive, and gives a detailed view of how they report, what they report, and what they need to do to improve their waste performance. All data in Chapter 2.4 are from 2015, if not stated otherwise, but data from the past decade is available in their ERP system. Data from previous years have been excluded to limit the scope of study. Data have been collected and organized in a large data bank. The objective was to identify if the data is a true representation of the reality and if the data was sufficient enough to identify financial and environmental weaknesses in their waste performance. If not, why is this the case and how can it be achieved?

Electrolux have 51 factories world wide, and environmental data from each factory have been investigated. The factories vary in size, sector and product line, which will have an impact on the benchmark. However, there are gaps in the data quality which can be identified in all sectors and product lines, regardless of size. This will be presented in Chapter 2.4.2 and in Appendix VII, Table 17 and Table 18.

The sectors are listed below, and gives an indication to the size of each sector and the geographical presence Electrolux have in the world. The sectors EMEA (European, Middle East, Africa) and North America are the largest area, and contributes to 66 % of Electrolux Group annual net sales in 2015 (AB Electrolux, 2015).

The sectors are:

- Electrolux Major Appliances – Asia Pacific – 5 factories
- Electrolux Major Appliances – EMEA – 19 factories
- Electrolux Major Appliances – Latin America – 7 factories
- Electrolux Major Appliances – North America – 9 factories
- Electrolux Professional – 7 factories
- Electrolux Small Appliances – 4 factories

Data is collected on a yearly basis, and reported by a person at each facility, to Electrolux Sustainability Group. The person reporting is not required to have a certain position (work title) at the factory, and they do not take any yearly samples confirming the data accuracy. The data is reported directly into a ERP system used by Electrolux Sustainability Group, and from there analysed and compiled to meet requirements from GRI and Electrolux Group.

When the data is collected it could come from various resources, such as an invoice from a recycling company. During a field study at one of the factories, I learned that the recycling company used by the factory sends them an invoice containing type, weights, and prices for each material. This was reported by the accounting department at the factory to Electrolux Sustainability Group.

The data is compiled into two output spreadsheet. The first documents contain information related to what type of outgoing material it is. The data reported in this spreadsheet are weights for metal, plastic, cardboard, paper, wood, glass, and other (seven output categories). They do also collect the outgoing prices for the same materials. The second document contain information related to destination of the outgoing material. Electrolux follows the reporting guidelines from GRI, and compile the information into hazardous waste, and non hazardous
waste. The non-hazardous waste is then categorized into composting, recycling, incineration, and landfill. Electrolux sums up hazardous waste, composting, incineration, and landfill, and categorize this as “Waste”. Recycling is not included, since they do not consider this as a loss of a natural resource. The total amount of output categories is therefore 11.

Electrolux compile their input data into one spreadsheet, which lists the amount of materials that are purchased by each factory during one year. However, since the incoming material category does not match the outgoing exactly, we have to allocate and connect them in a way that best reflects the reality. Following bullet points describes the connection.

- Raw material for products – Metal → Output Metal
- Raw material for products – Plastics → Output Plastic
- Raw material for products – Semi-manufactured goods → Output Other
- Raw material for products – Process materials → Output Other
- Raw material for products – Other → Output Other
- Packaging material for finished products → Output Packaging
- Suppliers' packaging material → Output Packaging
- Reused suppliers' packaging → Output Packaging
- Reusable Packaging → Output Packaging

There is no input material allocated to the output categories cardboard, paper, wood, and glass. There was also no output category for packaging, so this was created later in my benchmark. This also means that I could not calculate a material yield for these categories. A material yield is the output divided by the input, and can be used to see how much of the incoming materials ends up in the main product, and how much is being discarded. It can be seen as a way to measure the material efficiency. If the yield is low, it means that most of the material ends up in the product, and doesn’t turn into waste. However, it is important to be critical regarding how well the yield reflects the reality. If the quality of input and output data is poor, the yield will provide an inaccurate assumption, which doesn’t reflect the reality. The yield should be put in perspective to the quality of the data.

Table 11: Describes what input and output categories that were available. Both an input and output category is needed to create a yield.

<table>
<thead>
<tr>
<th>Input - Output flow</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Materials</strong></td>
</tr>
<tr>
<td>Metal</td>
</tr>
<tr>
<td>Plastic</td>
</tr>
<tr>
<td>Cardboard</td>
</tr>
<tr>
<td>Paper</td>
</tr>
<tr>
<td>Wood</td>
</tr>
<tr>
<td>Glass</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td>Packaging</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Destination</th>
<th><strong>In</strong></th>
<th><strong>Out</strong></th>
<th><strong>Yield</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazardous waste</td>
<td>N/A</td>
<td>Yes</td>
<td>N/A</td>
</tr>
<tr>
<td>Composting</td>
<td>N/A</td>
<td>Yes</td>
<td>N/A</td>
</tr>
</tbody>
</table>
Incineration  N/A  Yes  N/A
Landfill  N/A  Yes  N/A

It is also important for companies who are trying to identify and track waste streams to allocate input and output data in a way that best reflects the reality, even though it is not an exact science supported by theoretical models.

2.4.1 Metal yield

Throughout this thesis, metals have shown to be an important category to focus on to improve the Electrolux’s waste performance, and to create a financial incentive for waste reduction methods.

Based on available information from their ERP system, the yield for metals are close to 10%, meaning that 10 % of the purchased metal doesn’t go into the main product. Metals are also responsible for 47% of the total output in weight, and 61 % in total input. Due to metals high density compared to the other materials, this is expected, but they hold a higher monetary value, making it more desirable to reduce metal waste as much as possible.

2.4.2 Validity of available data

There are 51 factories analysed in this thesis. The data have also in some cases been categorized into sector and product line to enable a wider perspective of waste management within each category. By looking at the data from a factory level, we see that there is very large spread between what is being reported by the different factories. The spread consists of both values, where there is a large difference between factories in the same region and sector, and cases where the value is zero. An example of when there is a large difference between values in similar factories could be the outgoing metal in weight or monetary value. The validity of these values could be questionable, and further research has been carried out.

The total amount of output categories that are being reported are 11 in number. Seven of them are described above, and represent a type of material. The remaining four are destination based, such as incineration and landfill.

To determine the validity of available data, a calculation for each factory have been made to measure the amount of times a category is missing a value, or reported as zero. As described in Chapter 2.4 the output and input categories does not match each other exactly. We have output categories cardboard, paper, wood, and glass, which are not available as an input. Packaging is another category where we have an input value, but not an output value. So when we sum up the amount of times a factory is missing a value, or report it as zero, we need to subtract the column “zero-input” with four, and the column “zero-output” with one. This might seem complicated, but it was necessary to evaluate and compare the factories reporting quality towards each other.

The result of this investigation is presented below, and it shows that every factory reports zero in at least one category. It is important to understand that it is possible that some factories don’t use a specific type of material in their process, which means that it is correct if they report zero of that specific category. However, the table below shows that there are many factories who report zero on more than half of the available categories, and it is my assumption that this
doesn’t reflect the reality. This data strengthens my assumption that a new reporting system is needed.

![Bar chart](image.png)

**Figure 4: Number of factories (x-axis) that reports a specific amount of zeroes (y-axis).**

In Figure 5 I’ve looked at the categories for which both an input and an output value is available. It shows how many of the factories that reports zero, of the total 51 factories available. The table also includes the average yield, to give an indication of how well the factories manage to materialize the raw material. As we can see the yield for the categories other and plastic are quite low, approximately 2%. However, they have a considerably high number of zero values reported, especially for outgoing materials. If we assume that a majority of these factories do have plastic and other types of waste, the number of zeroes reported would be much lower. This could result in a higher yield.

The metal yield is, as reported in Chapter 2.4.1, close to 10%. The number of zeroes reported is close to half of the one for plastic and other, both for ingoing and outgoing materials. This is an indication of that factories have a better waste management for metal, than plastic and other types of waste, and due to metals high monetary value I consider this to be a good. However, there are still more than 30 % of the factories that don’t report metal at all, and the yield is higher than for both plastic and other, so it is the Electrolux’s interest to improve their waste management and reporting structure for all categories.
As stated above, it is possible that a factory has a zero output of a certain category. If this is the case, the correct value to report is indeed zero. Based on the three categories in Figure 5 the factories have a better reporting structure for ingoing materials than outgoing, and I think it is reasonable to assume that if a factory has an input of a specific category, then there will be some sort of a residual product to report as waste.

The reason for why zero value reporting is treated and analysed extensively in this thesis, is because it has frequently been indicated that there are flaws in the reporting system. I have identified four different meanings of zero (as reported value) in the reporting system, and these will be presented and treated in Chapter 2.4.4. A solution is also presented for a new reporting system, Chapter 3.3.

When looking at Electrolux’s waste performance, all factories have been included. However, they have also been categorized into its specific sector, and product line. The result of this investigation, which includes material categories, have not been presented above, since it is my judgement that the tables above better reflects the reality. This is the case for Electrolux, and could be different for other companies. A summary of the number of zeroes for each sector and product line are presented in Appendix VII, Table 17 and Table 18.

2.4.3 Material Efficiency

To understand how much materials are going into a main product is important for any company to understand. The by-product will either be something that is sent for recycling, or disposed of. One of the most common disposal destinations are landfills, which are explained in Chapter 2.1.5. According to the waste hierarchy, this is something that should be avoided as much as possible. For disposal I’ve included everything which isn’t sent for recycling, including incineration. Incineration is described in Chapter 2.1.5, and is sometimes considered as a sort of recycling. However, it should be avoided as much as possible, since it releases by-products in form of pollutants, and it doesn’t save natural resources.

In Figure 6 below I’ve presented the Total Waste Yield Including Disposal, and Total Recycling Yield. Total Waste Yield Including Disposal measures how much of the input that doesn’t end up in the main product. The Total Recycling Yield is the amount of by-products that is collected and sent for recycling.
Figure 6: The histogram describes how many factories (x-axis) that have a specific amount of output of total input (in %). Total Yield Including Disposal includes recycled and disposal waste.

In Figure 6 we see that 17 factories only produce 0-2 % waste. This value is considered good, but by investigating which factories it is, we find that the majority of these factories have a very high number of zeroes reported. As discussed in Chapter 2.4.2, I believe that this decreases the validity of the data. Of the 17 factories, 14 have more than half of the available reporting categories missing.

It is also interesting to study the Total Material Efficiency. It measures how much of the input that ends up in the main product, and it can be seen as a way to measure and understand how effective a factory is at minimizing by-products. It is the opposite to the Total Waste Yield Including Disposal, and will therefore not be presented here, since results can easily be derived from Figure 6.

The average yield is 7,7% for Total Yield – Recycling, and for Total Yield Including Disposal 8,7%. The average Total Material Efficiency is 85,4%.

**Double accounting**

Double accounting is something which should be avoided as much as possible, since it distorts the presented view of the reality. In the case of incineration, it is important to understand that double accounting could occur. Since it is referred to as recycling for energy recovery, it can be accounted for both as a recycled waste (plastic, other, etc.), and as incinerated material.

In Table 11 (Input-Output flow, p. 17), material categories and the destination categories are described. The material categories are seen as recyclable, and the destination categories are seen as pure waste, where natural resources are not saved. However, the factories only report how much is sent to incineration in total, and it is at the moment not possible to see what type of material it is. Therefor, it is possible that a residual product is reported both as recycled plastic, and as a part of a factory’s incineration amount. This is double accounting, and I’ve not been able to either confirm or dismiss that this occurs.
In Chapter 2.4.3, where I present the Total Waste Yield Including Disposal, I’ve added both the residual products from the recyclable material categories and the residual products which go to any of the destination based categories. Double accounting could be found for some factories here, and in the new reporting system I’ve tried to avoid this possibility in the future.

2.4.4 Types of zero waste

My judgement is that there are four different kinds of zeroes in the current reporting system.

1. When the actual amount of a specific waste type is zero.
2. When the amount is zero, based on what is being defined as zero (see Chapter 3.1)
3. When the value is unknown. There is a difference between stating that no waste of a specific type exists, and that the amount is unknown. This must be separated.
4. When no value is reported at all, and when the ERP system interpret this as zero.

The new reporting system will strive to avoid confusion regarding zero as reported value.

2.4.5 Financial study

To better understand what effects a new and more transparent reporting system could have, I’ve studied the financial impacts on a selected factory. This factory is located in Asia, and goes under the business sector Professional. The factory was chosen due to its large number of reported zeroes, which were one for input categories, and nine for output categories. No material output categories were reported, and only plastic, metal, and packaging were reported as an input category.

The purpose of the study was to see what the expected output for each material could be, and what the expected financial results are. This factory was compared to a reference factory, were the amount of data where more available. Only four output zeroes were reported. The reference factory is located in northern Europe and goes under the business sector Professional.

The sector Professional produces home appliances from professional use, such as for restaurants and public laundries. The sector contributes to 5% of the Electrolux Group net sales, it showed strong results for the fiscal year 2015, and is from a financial perspective the smallest business area at Electrolux (AB Electrolux, 2015).

Table 12 shows a summary of output prices for metals and plastic for the two factories. They are named Europe, and Asia. The green marked cells show information that can be derived from Electrolux ERP system, and the yellow cells are assumptions regarding yields and prices. Since there is no output information for either metal or plastic from the Asian factory, it was not possible to calculate a yield. The yield and price per kg have therefore been assumed to be the same. From available data, and the assumptions above, it was possible to calculate the total output from both metal and plastic, and the assumed monetary value.

The results are presented below, and indicate that there could be a very high monetary value bound to the factories that have a low performance or reporting rate. It is from this data not possible to know if the assumed output represents the reality, or if the factory located in Asia actually have zero output from both metal and plastic. If so, no action needs to be taken. If not, it is wise to investigate how their management system is structured. One possibility is that they have similar outputs as presented below, and that these materials are handled according to the
waste hierarchy, and sold to market prices. A second possibility is that the factory have similar outputs as presented below, and that the material is discarded without a monetary compensation.

Table 12: Displays assumed value from factory with poor reporting results.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe</td>
<td>348 000</td>
<td>11,8%</td>
<td>553 414 kr</td>
<td>7 400</td>
<td>0,3%</td>
<td>4 470 kr</td>
</tr>
<tr>
<td>Asia</td>
<td>415 591</td>
<td>11,8%</td>
<td>660 902 kr</td>
<td>494</td>
<td>0,3%</td>
<td>298 kr</td>
</tr>
</tbody>
</table>

The example above only represents a small fraction of potential values that are not reported by the factories. In the example below a similar study was performed, and in this example metal data from all factories were investigated. The study measures the total input and output in thousand kilogram (tkg) from all of the 51 factories.

The top row in Table 13 shows how many factories that are reporting both an input and an output value. In the first column we find that 35 factories report both an input and an output value. In the second column, only input values are reported. Based on the average yield for the 35 factories in the first column, we can calculate the expected output weight for the 11 factories who have an input value reported, but not an output value. This can be translated into a monetary value by multiplying the total output with the 1,6 kg/kg (from Table 12). As shown in the table below, there are potential values of approximately 2,4 MSEK that are not reported. This does not mean that these factories don’t sell their residual metal waste, or even that they have any. It should only be considered as an estimation of how much metal waste, in monetary terms, that are not being reported.

The final column uses the average input for all factories who reports an input value, and calculates an estimated total input value for the remaining 5 factories who does not have either an input or output value reported. The yield is 9,4 %, and it is based on the average output from all factories who reports an output value, divided by the average input for all factories who reports an input value. The assumed monetary value is 13,3 MSEK. However, I believe this assumption to be very uncertain, since it assumes that all factories use metal in their production. I believe the previous calculation to be more reliable, since it is based on the assumption that all factories who have an input of metal, also have an output.

Table 13: Describes the potential monetary value of unreported data. Green cells represent data where the data is known. Red cells have no reported value, and the data is derived.

<table>
<thead>
<tr>
<th>Factory</th>
<th>1 - 35 (68,6 % of the factories)</th>
<th>36 - 46 (21,5 %)</th>
<th>47 - 51 (9,8%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Σ In [tkg]</td>
<td>889 595</td>
<td>15 914</td>
<td>88 775</td>
</tr>
<tr>
<td>Σ Out [tkg]</td>
<td>84 845</td>
<td>1 518</td>
<td>8 318</td>
</tr>
<tr>
<td>Yield [%]</td>
<td>9,5%</td>
<td>9,5%</td>
<td>9,4%</td>
</tr>
<tr>
<td>Value</td>
<td>2 428 473 kr</td>
<td>13 308 988 kr</td>
<td></td>
</tr>
</tbody>
</table>

These calculations represent a method that describes potential values for data that are not being reported. It does not present any solution for how to improve reporting, or how to reduce
waste. It is only a way to understand and measure uncertainties in the reporting system. My earlier assumption showed that the unreported data is related to issues with zero reporting (see Chapter 2.4.1). In the new reporting system, presented in Chapter 3.3, a solution to avoid these issues are presented.

**Other financial issues in the reporting system**

In the current reporting system, factories are reporting the monetary values in different currencies. This is not a problem in itself, but in the data there are values which are very unrealistic. There are two problems that occur in more than one case. First, values are reported in, what I suspect, another currency than the one stated. One factory reports that they pay over 300 MSEK for residual metal collection, and based on the weight from the same factory, this corresponds to more than 400 kr/kg metal. My assumption is that the factory is reporting in another currency than the one stated.

The second problem in the financial reporting is that companies often report revenues as a cost. For many categories waste is often referred to as a cost, but for e.g. metal it should be reported as a revenue, or a negative cost. However, in the majority of the cases the reported value is still a positive cost, without a minus sign in front of the reported value. This problem is treated in the new reporting system.

The problem with values reported as zero is also occurring in the financial data. By looking at all output categories and all factories, 65 % of all possible cells are reported as zero.

**2.4.6 Summary of Electrolux waste data**

Electrolux has a very ambitious collection of waste data. The data showed that metal are responsible for a majority of the waste, in terms of both weight and monetary values, compared to e.g. plastic and packaging. To be able to measure and compare the efficiency, it was necessary to allocate different input and output categories. This implied that there are potentially large issues in the quality of data which primarily is related to the reporting of zero values, which makes it difficult to analyse Electrolux waste performance and improve both the environmental and financial perspective. The recommendation is to implement a new waste management system and a new waste reporting system.

**2.5 Best practice in Waste Management**

As a way to understand how other companies’ waste management are structured and how they are presenting successful methods for improving their waste performance, different cases of best practice have been studied. These are presented below, and in the following subchapter named “General Motors – 9 steps to landfill-free”.

BMW have successfully reduced their waste volume with 45 % from base year 2006, with the target year being 2020. They also track and present results for how much waste for disposal per vehicle produced (kg/vehicle). From 2011 to 2015 they reduced it by 53 %. The results are presented in a 5-year diagram in their sustainability report 2015. They don’t specify in detail how they have managed to reduce their waste intensity, and their waste for disposal per vehicle produced, but acknowledge two successful best practices methods for a full life cycle
management system. These are waste separation, and finding new use for residual materials (BSH Hausgeräte GMBH, 2016).

To introduce waste separation early in manufacturing process can improve the financial statement and improve the waste quality, and thereby improving recycling. Both recycling and finding new use for residual waste are at a high level on the waste hierarchy, which reduces the need for landfill and incineration.

The European Commission is working close with Member State competent authorities and stakeholders to address the main waste management issues. In an interview with Jorge Diaz del Castillo, who’s responsible for the implementation of the Waste Framework Directive, he states that even though they work primarily with the Member States, they benefit majorly from the ‘know-how' and experience of the waste management industry to develop policy and legislation in line with state-of-the-art technology, primarily in the field of recycling. He also addresses the importance for companies and member states to meet in different forums and at conventions, to discuss the current state, and progress, of waste management in Member States. By implementing the circular economy action plan, the European Commission is reaching out to relevant companies, often through their umbrella organisations, to ensure that the EU policy and legislation can help them improve their waste performance.

The European Commission also acknowledge the importance of sharing best practices by publishing various reports on how different entities and initiatives have successfully improved waste management. These reports can be found or their website (European Commission, 2016). To share knowledge between companies and entities has throughout the thesis been identified as a successful and important part in improving waste management from a greater perspective.

The Environmental Protection Agency (EPA) have developed guidelines that aims to inform and educated companies in waste management and best practice. It’s called “Guide for Industrial Waste Management”, and address the management of non-hazardous industrial waste. EPA (2016) states that the purpose of the guide is to:

1. Provide facility managers, state and tribal regulators, and the interested public with recommendations and tools to better address the management of land-disposed, non-hazardous industrial wastes,
2. Help facility managers make environmentally responsible decisions while working in partnership with state and tribal regulators and the public,
3. Serve as an accessible implementation reference tool for regulators to complement existing programs and help address any gaps, and Help the public become more knowledgeable and informed in addressing waste management issues in the community.

Sharing best practice is acknowledge as an essential part in moving waste management and waste performance forward. However, there are very few concrete suggestions on how this can be done. In this thesis I’ve primarily focused on the benchmarked companies in Chapter 2.3, but also moved out from these boundaries. Unfortunately, there are very little information disclosed by the companies on how this is being done. It is understandable that techniques and costs are kept within the company sphere, since this can give them a financial edge towards competitors, but very little information is being published on how they are actually working with issued related to waste separation, reporting, responsibility, legislation, and waste streams. This will be elaborated further in the Chapter 4, Discussion.
The most frequently referred company in the background and literature study was General Motors, much through their extensive and well performed work in waste management (General Motors, 2016). Their model to reduce landfill is presented in the next subchapter.

In 2015 Samsung held an event with suppliers that rewarded innovation activates and best practice. I believe this to be a great way to strengthen the partnership with suppliers, and promote waste reductive activities (Samsung Electronics, 2016).

**General Motors – 9 steps to landfill-free**

In 2005 General Motors started their work towards landfill free production sites. The model is named “9 steps to landfill-free”, and has been acknowledge as successful by both companies and other entities. The model is build on nine steps of best practises, and are according to themselves applicable for both small and large enterprises (Environmental Leader, 2013).

By integrate waste reducing goals into a business plan, and by combining financial and environmental benefits, General Motors estimates that they receive annual revenues of approximately 1 billion USD per year. They initially invested 10 USD for every tone waste produced, but over time they have manage to reduce the cost by 92% and the waste by 62%. This is approximately 20% of the initial cost per waste, so consequently their long term revenues help to offset the initial investment. This is a financial incentive which is important for companies like Electrolux to be able to invest in waste reductive activities.

The nine steps to achieve landfill-free sites is briefly explained below (General Motors, 2015):

1. **Track waste data**: This is acknowledged as the backbone of the model. To be able to reduce, or improve one’s position in the waste hierarchy, waste tracking is needed to measure what the current state is, and to set tangible goals. By having one resource management system it will be possible to collect resource data from all sites and act accordingly to site specific situations.

2. **Define zero waste**: To define zero waste, and landfill free, within the organization is important to report and account waste in a way that reflects an organisations reality. A common mistake is to assume that zero waste always means that no waste is sent to landfill. In the case of General Motors it means that <1% of their waste by weight goes into landfill. There are often specific kinds of waste that can not justifiably be treated in any other way than landfill at the moment. Examples could be smaller amounts of waste that occurs in very isolated and unfrequented periods, or waste that has properties which cannot be treated in any known way.

3. **Prioritize waste reduction**: This is the first step of the waste hierarchy explained in Chapter 2.1.5. Prioritize activities according the most preferable option.

4. **Build a sustainability culture**: By engaging employees, and building a sustainability culture, creative waste reduction ideas can be realized. To target specific waste streams and engaging people in various ideas and project, a sustainable culture can be implemented in all levels.

5. **Strengthen supplier partnership**: To have suppliers and contractor’s activities aligned with a company’s long term goals and objectives, will help keeping track of resources and build a network with each other. This can be facilitated by having a resource manager at the production site.
6. **Resolve regulatory challenges:** By joining forces together with governments and regulatory entities, new ways for reducing the disposal of waste can be achieved.

7. **Achieve landfill free status:** When a majority of waste have been diverted disposal, make sure to inventory and create a plan together with employees and experts to find and divert the remaining waste streams that goes to landfill.

8. **Improve efforts:** To continue to reduce all kinds of waste, and continuously making the waste management more efficient, continue to set new goals, foster new ways of improvement, and always have a cohesive mind-set amongst management and employees regarding the sustainability work.

9. **Share best practice:** Have open discussions and share new creative ideas with other companies and entities. Sharing best practices help building a sustainable culture outside the company, and supporting and encouraging the community and university to various ideas and problems, long term goals can be successful much faster.

More information about this model can be found at [http://www.gmsustainability.com/](http://www.gmsustainability.com/). Go to “Learn”, and then “Making your company landfill free”.

The 9 steps to landfill-free model have been studied extensively in this thesis, and the proposed reporting-, and management system are taking inspiration from these suggestions.
3. Result – Industrial Waste Management

The results presented in this chapter are developed and derived based on the conclusions drawn from the background study. The results are meant to put Electrolux in a long term sustainable path to improve their waste management and create excellence in performance. Solutions are derived both from problems in their own, and competitors, current management system, and inspired by examples of best practice from the industry.

During the background study, a lot of time was spent with interpreting and understanding the data. The data itself didn’t always give a clear answer, which often was the result of low reporting quality. To improve reporting quality, the new management system is structured in such way that prevents, or clarifies data even better, and reducing problems related to zero values in reporting.

3.1 Zero Waste – Defining zero waste

This chapter is meant to give Electrolux and other companies a better understanding, and a defined view of how to define zero waste. During the literature study, a mixed understanding regarding what zero waste is emerged and also if it is possible to achieve.

The concept of sustainability is well known, and often illustrated with a venn diagram. To have a sustainable company, both economic, environmental and social concerns need to be sustainable.

![Figure 7: Sustainable Development (Conceptdraw, 2016).](image)

Zero waste can be derived from the same appreciation. By differentiating and acknowledge that waste can have both a social, financial, and environmental perspective it will be easier for companies and stakeholders to understand, address, and communicate what they mean by zero waste.

Unlike sustainable development, where sustainability is achieved in the intersection between the tree units, zero waste should in this case be seen as three separate units.

![Figure 8: Zero waste as three separate units.](image)
Environmental waste should be considered as a utopia where there is no physical waste. All residual material can either be reused or remodelled with 0% material and energy loss, and where 100% of natural resources are saved. From a practical point of view environmental zero waste will be near impossible to achieve. The complexity of products and services makes it near impossible to assess the full life cycle, and to reuse or remodel the product after it has been discarded.

Economical zero waste can as be seen as the equilibrium in a demand and supply graph, where the y-axis is in monetary values, and the x-axis is the level of waste reduced (total amount or in percentage). The equilibrium can be regarded as the optimal waste level, which is the optimal amount of that can be produced, while still maintaining a sustainable financial performance. The environment zero waste can be found in the right bottom corner, where the level of recycled or reused waste is 100%. As described above, this is near impossible, and the costs will likely be increasing exponentially, which creates a deadweight loss, seen as the red field in Figure 9.

The demand curve (marked as D) is in this model named “Marginal value of residual value” and can be controlled by market prices. The impact companies can have on this is very limited, which makes it important to work close with regulatory entities to promote feasibility and profitability. The supply curve (S), is named “Marginal cost of residual value”, and it consist of the costs companies have on matters related to waste management. An example is cost for waste separation.

To better understand how waste performance can be improved from a long term sustainable perspective, the optimal level, the equilibrium, has to shift closer to the right (Figure 10). This can be done either by moving the marginal value of residual waste in the direction of the arrows, or by moving the marginal cost of residual waste in the direction of its arrows. The result is that the equilibrium, or optimal waste level, will be at $Q_b$ instead of $Q_1$. By doing this waste performance can be improved and a financial sustainability can be maintained.
In reality this curves will likely not be linear, but the principles are the same. By differentiating the different types of zero waste, companies will be able improve waste performance and set feasible targets. This understanding will excite, rather than retighten, companies to invest and improve waste performance.

Social waste is not treated extensively in this thesis. However, an example could be poor utilization of innovative-, and creative ideas from employees, due to poor engagement with employees from management. Another example is if employees get sick due to poor working conditions, and if poor working conditions leads to carelessness in production. Improved engagement between management and employees is included in General Motors model “9 steps to landfill-free”, and will also be included in the Electrolux model.

3.2 Waste Management at Electrolux

The main objective for Electrolux’s new waste management system, is to continuously reduce waste in production. Based on current performance by Electrolux, and to some extent its competitors, the new model will incorporate all essential steps needed to achieve this objective.
The model is structured in three main categories. These are:

- Implement individual waste plan
- Reduce Waste
- Communicate

Each category houses subcategories, which all together makes up the model, which is illustrated below in Figure 11. The model is inspired by examples of best practice, but the main functionality is based on empirical studies.

![Diagram of Electrolux New Waste Management System](Figure 11: Electrolux New Waste Management System)

### 3.2.1 Implement individual waste plan

During this thesis, I’ve had the opportunity to gain perspective from main different stakeholders, such as professionals working in the European waste community, factory managers, and recycling companies. It has often been pointed out that waste management is a very complicated issue, and one reason for why a unified management system is rare is because each national, company, or factory are unique. To have a management system one most consider both the long term company goals, which often is decided on the group level, and the possibilities from each subunit, such as a factory.

By implementing an individual waste plan, it will be possible for Electrolux, and other companies, to address and decide on what direction to move in, based on their own situation. This is done from a group level, together with each factory.
**Reporting system**

The first thing needed is a reporting system. It can be build either into an existing ERP system (Enterprise Resource Planning), or for smaller enterprises, an excel document. The reporting system is one of the most vital tool for assessing waste performance, since all actions that are taken are built on the assumption that the data is correct. By not having a reporting system that fully complies with necessary requirements, companies might end up taking decisions and investments that are built on a distorted reality. In the case for Electrolux, a suggestion for a new reporting system will be presented in Chapter 3.3.

**Define waste**

As described above all factories can be seen as an individual unit, and it is important to allow themselves to assess and make judgement on what waste is produced in their manufacturing process. By doing so they will be able to spend their time more efficiently and not work with things that doesn’t comply with them. However, from a group level it is important to suggest various actions and to enforce requirements that fulfil a greater purpose. A common example is creating a target that states that in 5 years no waste will be sent for landfill.

By defining waste you are stating what type of waste to look for and what quantity should be considered as zero waste. The reason is that in some processes it is know that a certain amount of residual material of a specific type exists. However, the quantities are small, the financial and environmental impacts are low, and there is no clear material stream to follow (meaning that it will often be sent for incineration). It is then possible, and justifiable to state that quantities below e.g. 500 kilograms per year can be considered as zero. The amount can be estimated based on purchasing volumes or by taking samples in production.

**Track waste**

By tracking waste, it will be possible to identify waste streams, and to assess financial-, and environmental impacts. It is the direct result of the reporting system, and it is likely here where Electrolux can identify what needs to be improved. If so, adjustments to the reporting system can be taken.

When tracking waste streams, it is important to look at it from various time intervals (month, quarter, year), which reflects periodic patterns in production. By doing so it will be possible to detect or dismiss anomalies. It is a key element in improving waste performance, since it continuously adapts to new production patterns, and it is therefore important that it will be a continuing process taking place over several years.

**Assess impact – Financial & Environmental**

As described in Chapter 2.1.5, and confirmed by General Motors in Chapter 2.5.1, it is desired to always move up in the waste hierarch, while maintaining financial sustainability.

However, to ensure that focus is put on the waste streams where most benefits can be found, we wish to assess the environmental and financial impacts that a specific waste type have. From an environmental perspective we wish to ensure that as little waste as possible is sent for
landfill, and incineration, and that only materials that comply with regulations are used. By assessing environmental impacts we wish to transcend waste for a low state to a high state in the waste hierarchy.

To ensure a long term financial sustainability, it is desired to invest in resources which reduces costs. As described in Chapter 2.4.5 there are large amounts of monetary value bound to the residual products, and it is from a shareholder perspective very desirable to improve profitability.

How this shall be assessed is not included in this thesis, but suggestions for further research are relationships between financial and environmental impacts, long term vs. short term effects, and acceptable pay-off periods.

3.2.2 Reduce waste

The objective of implementing an individual waste plan is to ensure that all tolls need to reduce waste are in place. The second step is to reduce waste, and this is an ongoing process which repeats itself throughout the entire step process.

Reduce waste according to the waste hierarchy

Depending on the results from the environmental-, and financial impact assessment, various actions are taken to improve waste performance. These can be related to a new and more material efficient design, better production techniques, improved waste separation, and strengthen collaboration with recycling companies.

Strengthen supplier partnership

This originates from “General Motors – 9 steps to landfill free”. It has been proved successful and acknowledge by various stakeholders in the industry. By strengthen supplier partnership it will be possible to align contractor’s activates with Electrolux’s long term objectives. It will also create a more transparent culture where one can share best practice.

Resolve regulatory challenges

This also originates from “General Motors – 9 steps to landfill free”. By working close together with regulatory entities and governments, it will be possible to foster new ways for reducing the disposal of waste.

By joining forces with various entities, it will be possible to enforce simulative measures that can stimulate growth in new waste reducing technologies, and impact market prices for recycled materials. These are just examples, and whether these measures would be the most sustainable once are left for further research.

3.2.3 Communicate

By communicating both progress and fallbacks, both internally and externally, companies can nurture from feedback and maintaining continues improvements. This promotes innovation, creativity, and to rethink what has been done in the past.
Engage

By engaging employees and managers in the same questions and strategies, it will be easier for everyone to get the same comprehensive view of what the objective is. During a field study to one of Electrolux’s factories this was discussed as a key element in implementing new strategies. By not communicating new objectives and strategies in a way where all involved (regardless of where in the life cycle) are included and where a common understanding of the fundamental principles is achieved, implementation gaps are likely to occur. One way to engage employees is through competitions, seminars, and bonuses for ideas that solve specific questions.

Other ways to engage external stakeholders, and people who can contribute to a sustainable development, are to make appearances in the academic world. By hosting seminars, and engage in bachelor-, and master’s thesis, companies can get a direct link to the academic world in a variety of fields. Examples are new production technologies like nesting and waste separation, new intelligent design, sustainable materials and e.g. social health.

Share best practice

Throughout this thesis there has been an ongoing quest for examples of best practices. The search field have stretched through Electrolux major competitors, and to companies acting in industries where production techniques can vary. There is either a lack of knowledge in the field of waste management, or a struggle to maintain knowledge within the company sphere. It is understandable, since there is a financial profitability to waste management, but it creates an unnecessary obstacle to save natural resources, and prevent improvements. General Motors have been a role model, and there “9 steps to landfill free” have inspired and contributed to the development of my thesis. Another contributor has been BMW, who has created a sustainability report that has a clear transparency about the environmental data.

Electrolux can decide either to keep best practice within the company, or to become a role model and industry leader in waste management. My model acknowledges the last alternative, which promotes sharing best practices to companies within the same umbrella organisation, and to its competitors. Hopefully, Electrolux will receive both positive and negative feedback, which they can use to improve themselves.

As seen in the model, there is a loop from sharing best practices, back to the second category, reduce waste. The reason is that reducing waste, and transcending from one level in the waste hierarchy, to another, is a dynamic process where small steps and improvements can lead to long term sustainable profits. I therefor acknowledge that Electrolux always must search for new ways to improve waste streams. Both for waste streams that already have been improved, but also to find new waste streams which are next in line to be treated.

The main objective for Electrolux’s waste management system, is to continuously reduce waste in production. Based on current performance from both Electrolux, and the industry, Electrolux has defined targets which shall be met before a specific deadline. These targets will be based on certain principles, which are defined from case of best practice in the industry, and legislative frameworks. All targets that have been defined comply with the SMART model, with the extension that they will strengthen Electrolux sustainability profile.
3.3 Electrolux’s new waste reporting system

The purpose of the new Electrolux’s new waste reporting system is to increase knowledge about waste streams, and its potential impact to the environment, and the profitability. The new reporting system has two functions. The first being the Electrolux Waste Catalogue, which can be seen as a knowledge bank where material properties are stored. The second function is the new reporting system itself, which acts as a tool to collect and sort information that reflects the reality.

The new reporting system is illustrated in Appendix III.

3.3.1 Electrolux Waste Catalogue

The idea behind the Electrolux Waste Catalogue, is to create a database where materials that has a significant impact on waste performance can be stored. In the reporting system, which is described in detail in Chapter 3.3.2, we see how the catalogue can be used, and how it interacts with the system.

The waste catalogue will store materials, or waste types, based on various properties. These can be related to materials, hazardous or non-hazardous, rare earth metals, organic, etc. The functionality will be based on a tag system, meaning that a material can be listed in several categories.

From a legislative standpoint this has many benefits. First, by tagging a material or waste type with the correct waste code from The European List of Waste, it will be possible to retrieve quantitative information from waste types which are tagged with this specific code. The purpose could be new legislations stating that all waste types with code XX-XX-XX need to disclosure information related to country of origin (this is an example where the realistic nature is not investigated).

It will also be possible to tag a material with waste codes from other legislative frameworks, such as the one from EPA, or one developed by any other country where Electrolux has a strong presence.

The tag system can also be related to manufacturing process, which has the benefit that other factories can search for the same manufacturing processes and implement other successful measures to improve waste performance.

The Electrolux Waste Catalogue will be created continuously by adding new materials. I do not recommend that all materials which have a presence in the factories (regardless of quantity) are added from start, since this would be very time and resource consuming. My recommendation is that materials are added gradually after identifying new waste streams, and after assessing the financial and environmental impact.

3.3.2 The new waste reporting system

The new waste reporting system is constructed in three collaborating units: Waste ID, Waste Stream, and Waste Treatment. They will be described in detail below.
**Waste ID**

The waste ID is structured around the identification of a specific waste. Information related to the material properties need to be reported, such as the material itself, material properties (ferrous or non-ferrous), and respective waste code from e.g. The European List of Waste.

The Waste ID will sync with the waste catalogue to find, list, and add information. If a material isn’t listed in catalogue the user is recommended to add information. This will become particular important when dealing with hazardous waste.

**Waste Stream**

In this function information related to a specific stream or pattern of waste. This is primarily weight or volume, correct unit (kilogram, pound, etc.), what the weight or volume is, currency, and the cost or revenue.

It is important to make sure that the correct units are used. Since Electrolux and many other companies have a presence in many markets around the world, where different units and currencies are used, it is important that all values are reported in the correct unit. In the current reporting system, several errors related to wrong currency have been detected.

The second functionality of the waste stream is to add information related to the character of and dimension of the waste.

- **Waste Structure** – adds information related to the character of the waste
  - Small scrap, large scrap, Grinded waste, Dust, Liquid, mixed, other, unknown
- **Waste Source** – adds information related to the source of the waste
  - Cutting, stamping, painting, washing, packaging, mixed, other, unknown

**Waste Treatment**

The third unit is related to the treatment of the waste. The first functionality is information related to the disposal method. The options comply fully with the guidelines from GRI (Chapter 2.2.1), which are: composting, deep well injection, incineration, landfill, on-site storage, recovery, recycling and reuse.

The second functionality is information about the company who treats the waste. Available options are company name, if they are ISO 14001 certified, available transport policy, and if they are a certified recycler. The purpose of this information is to understand and strengthen the relationship between Electrolux and its suppliers and partners.

General information will be added, which is factory, sector, product line, reporting period, and the full contact information to the person who reports, and how the information was retrieved.

To avoid that the new reporting system creates a discouraging perception, due to multiple questions, it is recommended that the system can access a lot of the standard questions and contact information.
Waste Treatment – Sharing Best Practice

The final functionality of the waste treatment unit, and the reporting system as a whole, is related to sharing best practice within the company, and to make use of. To reconnect to the objective of this thesis, waste in production should be reduced. The best way to do this will neither be to let each factory find new solutions all be themselves, or to have Electrolux Group finding solutions for each factory. These will be to resource demanding, and likely not be the most sufficient solution.

The new reporting system should act as a support function, to help share best practice between the factories. Most of the identification stated in the Waste ID, Waste Stream, and Waste Treatment have the purpose of, not only track waste streams, but also to identify the unique character of the waste stream. Depending on the answers giving, the new waste reporting system will give suggestions for how to transcend higher up in the waste hierarchy and to improve financial profitability. Based on all the various properties of the waste stream, the new waste reporting system will match it to other waste streams, where the environmental and financial impact have been improved, and acknowledge successful by the factory who reported it. The factory who desires to improve its waste performance can then contact the factory directly to get the necessary information. The same factory will also have to report the final outcome.

Electrolux Group will act as a support group and give consultation when needed. The main purpose is to give factories the tools to improve their waste performance, and an incentive to achieve better profitability.

The complete new waste reporting system is presented in Appendix III – Electrolux new waste reporting system.

3.4 Risk Assessment

To be able to assess the benefits and downsides to the new waste management model, and the new reporting system, a SWOT analysis has been conducted. It aims to present both potentially positive and negative aspects to the systems.

3.4.1 Strength

The new waste management system and the new reporting system both have the benefit of decentralizing the control from Electrolux Group. The control will be at the factories, and Electrolux Group will only act as a support group. This will strengthen their possibilities to improve waste performance, profitability, and strengthen Electrolux’s sustainability profile.

Identifying waste streams that have a substantial environmental- and financial impact will be easier. The model is build in a way where the waste streams that have the most impact will be managed first, and subsequently the remaining waste streams.

Another strength with the new model is that it is easy to understand, and can be used to communicate the objectives and targets that are set. Since all 9 steps are divided into 3 different categories, it presents itself in both a simplistic and complex way.
The Electrolux Waste Catalogue, EWC, plays a vital role in the new waste reporting system, and it has the benefit of helping factories to find materials that are present in their production. Since factories will be able to add new materials to the catalogue, it will build itself and increase the knowledge within Electrolux. It will also be a powerful tool to tag materials depending on their various properties. An area of use is for legislative purposes.

The information in the EWC can also be used as a decision support when developing new products. By identifying materials that often are a subject for legislative matters, Electrolux can choose to use materials that have less legislative costs bound to them, and thus improving profitability and assuming also the environmental impact.

### 3.4.2 Weaknesses

A weakness with the new waste reporting system is that it can create an internal competiveness that prevents progress for Electrolux as a group. A major benefit with the possibility to share best practice within Electrolux is that factories can learn from each other and collectively strive to improve waste performance. However, there is a possibility that factories also see this as a way to not only perform well, but also to perform well in relation to other factories within the same sector or product line. This can be avoided if Electrolux Group acts as a support and control unit, which tracks and detects waste streams. If they identify great progress for a factory, compared to previously measured time period, they can do a follow up to find out what has been done.

Another weakness is that if there is a poor understanding of waste management, and the possibilities to improve waste performance and profitability, employees and facility managers might take a resistant approach to introducing a new system. This can be avoided by engaging employees in the purpose and possibilities with waste management.

A third weakness is related to how the information is collected at the factories. There is currently a wide spread between how and who collects the information that is being reported. It will be up to each factory to determine how information shall be collected in the implementation of their waste plan.

### 3.4.3 Opportunities

As described above, it is a great internal strength if Electrolux manage to introduce a management system that improves their profitability. This will also give a better financial return to shareholders and attract new investors. This relation between environmental profitability and increased shareholder value is a great opportunity for Electrolux to attract both financial- and environmental attention.

If proven successful, Electrolux will also be a role model for other companies who wish to improve their waste performance. This recognition, together with engaging universities, can help foster new technologies that subsequently improve waste performance.
3.4.4 Threats

As described in the background study, the validity of the data that currently is available can be questioned. Indications show that it doesn’t reflect the reality as much as wanted. Whether there is a big difference between what is currently reported, and what might be the reality is also very uncertain. However, if there is a big difference, it means that KPIs related to waste management will be higher than what has been reported, and this might be perceived in such a way that creates a negative attitude towards Electrolux’s sustainability group. If the KPIs turns out to be bigger than they are today, it would be recommended to have an optimistic attitude, since this means that Electrolux have been able to introduce a system that detects more waste streams than before, and consequently increasing the possibilities for improvements.

By sharing best practice publicly, Electrolux provides the tools for other companies to do the same, and therefore decreasing a potential advantage that Electrolux could have towards their competitors. However, by looking at General Motors model, we find that sharing best practice have been a successful method in improving waste performance.

3.5 Targets

Setting targets is an efficient way to inspire and achieve specific priorities. In Chapter 2.3.1, Table 10, we find some of the targets, related to environmental sustainability, set by competitors and measurable companies. An objective for this thesis is to propose tangible targets for Electrolux.

Many of the targets set by competitors are very specific, and often aimed to reduce an intensity by a certain amount by 2020-2025. For Electrolux, another approach will be taken. The number one priority is to introduce the new management system and the new waste reporting system to all factories. This will allow for more accurate data, which provides the incentive for investments that improves waste performance and profitability.

51 factories from 6 different business areas have been investigated in this thesis. By comparing the reporting quality from the different factories we find that the European factories have in general a better reporting quality than the others. As stated earlier in the thesis, the European and the North American market together account for 66 % of Electrolux Group net sales. Therefore it would be more appropriate to introduce the new management system and the new waste reporting system in these markets first. Electrolux Major Appliances – EMEA consist of 19 factories, with a Total Material Efficiency of 93 %, and has on average 6,1 reported zeroes per factory. Electrolux Major Appliances – North America consist of 9 factories, with a Total Material Efficiency of 89,4 %, and has on average 8,2 reported zeroes per factory.

To be able to follow the progress of the different factories, a ranking system is proposed that ranks the progress of all factories in three different categories. The categories are related to the new waste management system (WMS), the new waste reporting system, and zero waste to landfill. The grading is set from A to C, where A is most successful. The criteria are presented below.
• For A
  o The new WMS has been implemented in the factory.
  o The new waste reporting system has been implemented and successfully followed.
  o Zero landfill has been achieved. (A definition of zero has to be defined)
• For B
  o The new WMS has been introduced and is expected to be fully implemented within a specified number of months.
  o The new waste reporting system have been introduced and is followed to some extent. Within a specified number of months it is expected to fully comply.
  o Zero landfill is expected to be achieved within a specific number of months.
• For C
  o The new WMS is not introduced but is expected to be introduced within a specified number of months.
  o The new waste reporting system is not introduced but is expected to be introduced within a specified number of months.
  o No assessment regarding zero waste to landfill has been made, but is expected to start within a specified number of months.

The reason for why the targets are structured and presented in this way, is because it allows for each factory to identify and measure their own progress towards other factories within Electrolux. It will also increase the transparency towards stakeholders, and it can easily be illustrated in the sustainability report. In Appendix IV an example of the ranking system is visualized. Note that the sectors North America, Professionals, and Small Appliances are left out.

3.5.1 Targets – Summary

1. By 2025 zero waste shall be sent to landfill. The current data shows that 29 out of 51 factories have no waste sent to landfill.
2. Before 2020 all factories shall have received grading B for the new WMS and the new reporting system.
3. By 2025 all factories shall have received grading A in all categories.
4. Discussion

The new waste management system is the result of both empirical studies of available data, literature reviews, and interviews with people working in the field of waste management. By looking at cases of best practice from companies which have been acknowledged as successful by various people and entities, it has been possible to get a comprehensive view of what is needed to create a working model.

If the model will work efficiently can only be proved in practice. There is a balance between the elegance of simplicity, and the powerfulness of complexity. While something being too simple, it might not cover all the needs we have today, and requirements that we need to fulfil tomorrow. A too complex model can also be perceived as deterrent. During field studies it was revealed that implementation gaps are not only possible, but also occurring, and this can be a direct threat to any model. Such implementation gaps could be when a major decision is taken from a group level, and then enforces in various divisions and subdivisions. By not making sure that there is fundamental understanding at all levels of what needs to be done, there will be an impending risk for implementation gaps. I believe that the purpose of something is greater than that of knowing what to do and how to do it. The reason is simply that by making sure that we develop in our way of thinking and working towards specific tasks, we can foster new creative ideas of how to improve something in a way where we achieve a higher purpose. This is not discovered by me in this thesis, it is rather something that has been confirmed in other successful situations. I believe that one of the major reasons for why the “9 steps to landfill-free” model by General Motors have been so successful is because their way in engaging with employees and stakeholders and by spreading best practice. It is a value which I think Electrolux should welcome and it is something I believe can prevent implementation gaps in a model where complexity is present.

Early in the thesis I expected to present targets that were more in line with the SMART-model (Specific, Measurable, Assignable, Realistic, and Time-related). The problem was that throughout the thesis there was evidence that suggested that the data didn’t reflect the reality. My main objective was to create something that reduces waste in products and improving profitability, not setting targets that might not reflect the reality. Therefor I did the judgement that the focus on Electrolux needs to be on defining and understanding exactly how their waste performance is managed. The WMS and the reporting system created will allow for targets that are more in line with the SMART-model in the future, but for the next years I believe it to be important for the factories to implement a coherent tool for improving waste performance.

I have from the very start received a god perception regarding Electrolux’s work in sustainability, both from people who are working in the sustainability group and in other areas. There seem to be a good understanding amongst employees that efforts in improving sustainability will only have a positive impact on the company, and they have always been interested in both sharing, and receiving new findings. I believe this to be a strong indication for that the company is ready to take another important step in improving efficiency and sustainability profile.

I believe that it is important for companies who have a major impact on the environment and society to have a clear understanding of long-term global agreements and scientific fact. This will make the transition easier between trends, while maintaining focus on the core operations and core values.
Another matter that I find important, which is also included in Chapter 6 Recommendations, is to establish a method for how the data is reported. Data concerning material output is reported by Electrolux in both weight and in monetary values. However, when comparing the data there are large inconsistencies concerning the quality and the frequency. For the monetary data there are a lot of values that are not reported and in some cases the values are with a high probability reported in the wrong currency, which for example make it difficult to compare data and calculate average prices for specific factories during certain time periods. This is something which the new waste reporting system prevents. However, what needs to be decided on a factory level is who will be responsible for reporting the data. If waste data is reported by the financial office at the factory I assume that it is likely that they have a better understanding of the costs and revenues related to waste, rather than the weights and the unique properties of a specific waste stream. I find this to be a threat to high quality data reporting and it is matter that companies need to address.

The new waste management system and the new reporting system both have the benefit of decentralizing the control from Electrolux Group. The control will be at the factories, and Electrolux Group will only act as a support group. This will strengthen their possibilities to improve waste performance, profitability, and strengthen Electrolux’s sustainability profile.

The decision to decentralize the control from Electrolux Group and move this to the factories is an advantage which I believe will strengthen each factories possibilities to improve their waste performance. By allowing Electrolux Group to act as a support function they will be able to monitor, assist and educate the factories, when needed to fulfil obligations and expectations to Electrolux Group’s financial and environmental stakeholders. The support group will also require minimum human resources to coordinate the work, compared to a centralize control for waste management. I recommend that the implementation of the new waste management system and the new waste reporting system is coordinated by the support group and that it is implemented in different phases, e.g. starting with a specific sector, product line, geographical area, etc. This strategic control of the implementation is something which I believe will ease and ensure that the strategic purpose of waste management is properly coordinated and communicated to each factory.
5. Conclusion

My conclusions are that it is vital for companies to investigate and understand which waste streams that exists within the company. By not knowing what exits, it will be impossible to get a comprehensive view of the environmental and financial impact that one can be accounted for. Looking only from a financial perspective there are possibilities to improve the financial profitability and to attract more investors and acknowledgment.

A fully compliant reporting system, and its interaction with a waste management system, is essential to understand waste streams. There must also be a common understanding of the underlying purpose of waste management, the definition of zero waste and how companies can thrive by addressing it. A common understanding will also reduce implementation gaps that otherwise can reduce the quality of reporting.

Engaging employees, management and universities, companies can promote new solutions in detecting and reducing waste streams. There must also be a better communication of best practice. By not developing and redeveloping new solutions, the development of improving profitability, waste performance and saving natural resources will decelerate.

By looking at the waste hierarchy, and the environmental and financial problems related to landfill, we can conclude that companies must incorporate a zero landfill target in their agenda.

To ensure that Electrolux take a leading position in waste management, sharing best practice have been incorporated both internally via the new waste reporting system and externally via the new waste management system.
6. Recommendations

I recommend further research in understanding and simulating waste streams. Building virtual factories have become an important tool to improve companies’ efficiency. To include waste streams and the option to predict and monetise waste can be used to improve waste performance further. How to use waste as a resource for new products is also a substantial concern.

Further research is recommended on the relationship between financial and environmental impacts. For Electrolux, and other companies as well, it is interesting to understand how they are related, both from a short term and a long term perspective and what pay-off periods are to be expected.

It is also desirable to understand how to stimulate growth in new waste reducing technologies, and by resolving regulatory challenges. How can Electrolux and its competitors work together to create profitability for all involved?

Two areas which I found very interesting for further research are early waste separation and establishing a recycling network between companies with high industrial production.

An example of early waste separation is to separate different kinds of metals before it is being mixed together and sent for recycling. The benefits are that less time will be spent at the recycling company to separate e.g. steel and copper, which will reduce the amount of necessary resources to separate and refine the residual product. This will reduce costs for the recycling company, which companies can benefit from by negotiating better prices. Early waste separation also has the possibility to ensure that non-magnetic products not will get caught between two magnetic products. This is an example that was discussed during the factory visit at Electrolux in Ljungby, where they found that the prices for the various metals where considerably large enough to justify an investment in early waste separation if the volumes are high enough.

By establishing a recycling network between companies with high industrial production, it will be possible for them to collectively choose a recycling company that offers best conditions in terms of prices and availability. If a company is located in an area where there is a strong presence of other industrial companies, they are possibly using different recycling companies. However, by creating an industrial network and symbioses between these companies they can choose the recycling company that gives them the best conditions. If the recycling company is allowed to monitor volumes and weights for specific hazardous and non-hazardous waste from each facility, they can increase their control over supply and demand, and increase efficiency in transportation. This way of working can be seen as a node network where a limited amount of data is shared to increase efficiency and promote improved recycling quality.

As presented in Chapter 4 Discussion, I recommend further research in the decision making process of who will be responsible for reporting data. To avoid glitches and uncertainties in the reporting quality, companies need to address this issue and establish a method for how waste data is best transferred into their ERP system. Can this be managed by a manual process, or should it be automated to ensure higher quality?
7. References


## Appendix I - List of waste

*Table 14: Chapter of the list from the European List of Waste. Source: (European Parliament and of the Council, 2014).*

<table>
<thead>
<tr>
<th>Chapters of the list</th>
</tr>
</thead>
<tbody>
<tr>
<td>01 Wastes resulting from exploration, mining, quarrying, physical and chemical treatment of minerals</td>
</tr>
<tr>
<td>02 Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing</td>
</tr>
<tr>
<td>03 Wastes from wood processing and the production of panels and furniture, pulp, paper and cardboard</td>
</tr>
<tr>
<td>04 Wastes from the leather, fur and textile industries</td>
</tr>
<tr>
<td>05 Wastes from petroleum refining, natural gas purification and pyrolytic treatment of coal</td>
</tr>
<tr>
<td>06 Wastes from inorganic chemical processes</td>
</tr>
<tr>
<td>07 Wastes from organic chemical processes</td>
</tr>
<tr>
<td>08 Wastes from the manufacture, formulation, supply and use (MFSU) of coatings (paints, varnishes and vitreous enamels), adhesives, sealants and printing inks</td>
</tr>
<tr>
<td>09 Wastes from the photographic industry</td>
</tr>
<tr>
<td>10 Wastes from thermal processes</td>
</tr>
<tr>
<td>11 Wastes from chemical surface treatment and coating of metals and other materials; non-ferrous hydro-metallurgy</td>
</tr>
<tr>
<td>12 Wastes from shaping and physical and mechanical surface treatment of metals and plastics</td>
</tr>
<tr>
<td>13 Oil wastes and wastes of liquid fuels (except edible oils, 05 and 12)</td>
</tr>
<tr>
<td>14 Waste organic solvents, refrigerants and propellants (except 07 and 08)</td>
</tr>
<tr>
<td>15 Waste packaging; absorbents, wiping cloths, filter materials and protective clothing not otherwise specified</td>
</tr>
<tr>
<td>16 Wastes not otherwise specified in the list</td>
</tr>
<tr>
<td>17 Construction and demolition wastes (including excavated soil from contaminated sites)</td>
</tr>
<tr>
<td>18 Wastes from human or animal health care and/or related research (except kitchen and restaurant wastes not arising from immediate health care)</td>
</tr>
<tr>
<td>19 Wastes from waste management facilities, off-site waste water treatment plants and the preparation of water intended for human consumption and water for industrial use</td>
</tr>
<tr>
<td>20 Municipal wastes (household waste and similar commercial, industrial and institutional wastes) including separately collected fractions</td>
</tr>
</tbody>
</table>
Appendix II – Electrolux new waste management system

Figure 12: The new waste management system.
Appendix III – Electrolux new waste reporting system

Figure 13: The new waste reporting system.
### Appendix IV – Ranking System

*Table 15: A suggestion for how to rank factories within Electrolux.*

**Waste Management System (WMS)**

<table>
<thead>
<tr>
<th>Site</th>
<th>WMS</th>
<th>Reporting system</th>
<th>Zero landfill</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Asia Pacific</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrolux Major Appliances - Asia Pacific / Factory 1</td>
<td>B</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Electrolux Major Appliances - Asia Pacific / Factory 2</td>
<td>B</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Electrolux Major Appliances - Asia Pacific / Factory 3</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Electrolux Major Appliances - Asia Pacific / Factory 4</td>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>Electrolux Major Appliances - Asia Pacific / Factory 5</td>
<td>C</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td><strong>EMEA</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrolux Major Appliances - EMEA / Factory 1</td>
<td>A</td>
<td>C</td>
<td>B</td>
</tr>
<tr>
<td>Electrolux Major Appliances - EMEA / Factory 2</td>
<td>B</td>
<td>A</td>
<td>A</td>
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<tr>
<td>Electrolux Major Appliances - EMEA / Factory 3</td>
<td>C</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Electrolux Major Appliances - EMEA / Factory 4</td>
<td>A</td>
<td>C</td>
<td>A</td>
</tr>
<tr>
<td>Electrolux Major Appliances - EMEA / Factory 5</td>
<td>A</td>
<td>A</td>
<td>C</td>
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<td>Electrolux Major Appliances - EMEA / Factory 6</td>
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<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Electrolux Major Appliances - EMEA / Factory 7</td>
<td>A</td>
<td>C</td>
<td>A</td>
</tr>
<tr>
<td>Electrolux Major Appliances - EMEA / Factory 8</td>
<td>A</td>
<td>C</td>
<td>B</td>
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<tr>
<td>Electrolux Major Appliances - EMEA / Factory 9</td>
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<td>A</td>
<td>B</td>
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<td>Electrolux Major Appliances - EMEA / Factory 10</td>
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<td>C</td>
<td>C</td>
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<td>Electrolux Major Appliances - EMEA / Factory 11</td>
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<td>Electrolux Major Appliances - EMEA / Factory 12</td>
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<td>B</td>
<td>B</td>
</tr>
<tr>
<td>Electrolux Major Appliances - EMEA / Factory 13</td>
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<td>C</td>
<td>C</td>
</tr>
<tr>
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<td>C</td>
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</tr>
<tr>
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<td>C</td>
<td>A</td>
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<td>Electrolux Major Appliances - EMEA / Factory 16</td>
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<td>Electrolux Major Appliances - EMEA / Factory 18</td>
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<td>A</td>
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<tr>
<td><strong>Latin America</strong></td>
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<td></td>
</tr>
<tr>
<td>Electrolux Major Appliances - Latin America / Factory 1</td>
<td>A</td>
<td>C</td>
<td>B</td>
</tr>
<tr>
<td>Electrolux Major Appliances - Latin America / Factory 2</td>
<td>B</td>
<td>A</td>
<td>A</td>
</tr>
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<td>C</td>
<td>C</td>
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<td>A</td>
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<td>A</td>
<td>C</td>
</tr>
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<td>Electrolux Major Appliances - Latin America / Factory 6</td>
<td>B</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Electrolux Major Appliances - Latin America / Factory 7</td>
<td>A</td>
<td>C</td>
<td>A</td>
</tr>
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</table>

### Reporting

<table>
<thead>
<tr>
<th>ISO 9001</th>
<th>Electrolux</th>
<th>Whirlpool</th>
<th>BSH</th>
<th>GM</th>
<th>BMW</th>
</tr>
</thead>
<tbody>
<tr>
<td>All production facilities.</td>
<td>All production facilities.</td>
<td>All plants are ISO 9001 certified.</td>
<td>-</td>
<td>ISO/TS 16949. A quality standard for the automotive industry.</td>
<td>ISO/TS 16949. A quality standard for the automotive industry.</td>
</tr>
<tr>
<td>96% of all production facilities</td>
<td>-</td>
<td>India only, Faridabad- and Pondicherry plant is ISO 14001 certified.</td>
<td>-</td>
<td>Partly, GM have implemented their own EMS, which partly includes element of ISO 14001</td>
<td>All production facilities, German dealerships, and 6 other dealerships in Europe.</td>
</tr>
<tr>
<td>19 production facilities are OSHAS certified.</td>
<td>-</td>
<td>India only, Faridabad plant is OSHAS 18001 certified</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>ISO 45000 / OSHAS 18001</td>
<td>-</td>
<td>-</td>
<td>All German sites, three EU sites, and one site in Turkey. ISO 50001 should be introduced at all sites within the EU by 2016.</td>
<td>GM has implemented ISO 50001 at a handful of factories</td>
<td>In progress</td>
</tr>
<tr>
<td>ISO 50001</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Appendix VI – Interview questions

The questions presented below were the one used during the interview with the European Commission. The questions asked during the other interviews presented in Chapter 1.4.4 where similar and will not be listed in the Appendix.

What does the European Commission consider to be most sustainable? A tax on waste, or subsidies for companies who overperform? Any suggestions on KPIs to measure progress or setbacks?

What does the EU consider to be the best way for companies to improve the quality of their waste?

What is the incentives for companies to use more sustainable metals (or other materials) in electrical components?

Does the European commission work closely with different manufacturers? Why & How?

Is it a big issue in the way companies comply with different legal requirements? E.g. different interpretations?

Is there a difference in the way companies report or comply with different legal requirements, due to different interpretations of e.g. the WEEE directive? Does this perhaps disturb the long-term sustainability process?

How do the European Commission follow-up that all member states are following the directives?

Is there a difference in quality of waste from different regions, due to different legislations? If so, what are the main differences? (E.g. EU vs USA vs Brazil).

Does the European Commission work together with other governmental agencies to prevent regional disagreements when it comes to waste legislation (E.g. between EU, USA, and Brazil)?

Any general trends in the waste industry? (Interesting graphs, illustrations, tables are more than welcome).
Appendix VII – Number of zeroes for each sector

Table 17: List the number of zeroes for each sector, including average.

Number of zeroes for each sector, including average

<table>
<thead>
<tr>
<th>Sector</th>
<th>Nr of factories</th>
<th>Total 0:s</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrolux Major Appliances - Asia Pacific</td>
<td>5</td>
<td>53</td>
<td>10,6</td>
</tr>
<tr>
<td>Electrolux Major Appliances - EMEA</td>
<td>19</td>
<td>116</td>
<td>6,1</td>
</tr>
<tr>
<td>Electrolux Major Appliances - Latin America</td>
<td>7</td>
<td>34</td>
<td>4,9</td>
</tr>
<tr>
<td>Electrolux Major Appliances - North America</td>
<td>9</td>
<td>74</td>
<td>8,2</td>
</tr>
<tr>
<td>Electrolux Professional</td>
<td>7</td>
<td>53</td>
<td>7,6</td>
</tr>
<tr>
<td>Electrolux Small Appliances</td>
<td>4</td>
<td>19</td>
<td>4,8</td>
</tr>
</tbody>
</table>

Table 18: List the number of zeroes for each product line, including average.

Number of zeroes for each product line including average

<table>
<thead>
<tr>
<th>Product line</th>
<th>Nr of factories</th>
<th>Total 0:s</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Component factories</td>
<td>3</td>
<td>35</td>
<td>11,7</td>
</tr>
<tr>
<td>Dish care</td>
<td>3</td>
<td>13</td>
<td>4,3</td>
</tr>
<tr>
<td>Fabric Care</td>
<td>7</td>
<td>50</td>
<td>7,1</td>
</tr>
<tr>
<td>Food preparation</td>
<td>11</td>
<td>85</td>
<td>7,7</td>
</tr>
<tr>
<td>Food preservation</td>
<td>12</td>
<td>61</td>
<td>5,1</td>
</tr>
<tr>
<td>Home comfort</td>
<td>3</td>
<td>22</td>
<td>7,3</td>
</tr>
<tr>
<td>Multi product line factories</td>
<td>1</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>Professional</td>
<td>7</td>
<td>53</td>
<td>7,6</td>
</tr>
<tr>
<td>Small appliances</td>
<td>4</td>
<td>19</td>
<td>4,8</td>
</tr>
</tbody>
</table>