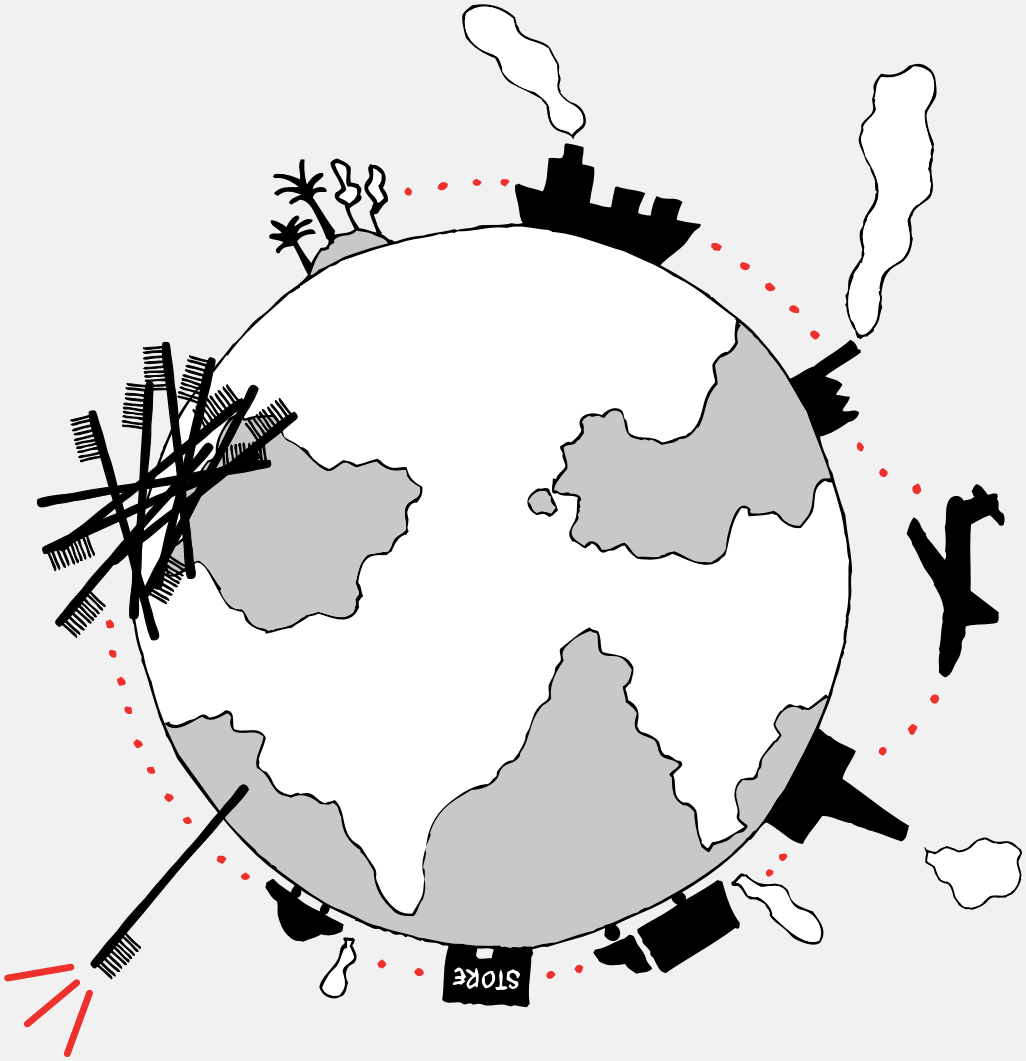
# ECOLOGY + DESIGN?

BACHELOR PROJECT IN INDUSTRIAL DESIGN




**Amanda Österlin La Mont**

Lund University 2012

# ECOLOGY + DESIGN?
BACHELOR PROJECT IN INDUSTRIAL DESIGN

**Amanda Österlin La Mont**
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Degree Project for Bachelor of Fine Arts in Design / Lund University / School of Industrial Design
Examiner: Prof. Claus-Christian Eckhardt / Supervisors: Lecturer Anna Persson, Prof. Jasjit Singh,
Lecturer Charlotte Sjödell / 2012 / Lund / Sweden

# THANK YOU

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# ABSTRACT


How can design be used to minimize negative environmental impact?

I strongly believe that we, human beings, are facing an unavoidable paradigm shift. The world we have created for ourselves is a ticking bomb and we need to rethink the fundamental system in order to have a future at all. In this project the goal was to understand what role design can play in the process of reaching a more sustainable society, and to see how the design of an object affects the global production system and our earth. I decided to focus on the ecological aspect of sustainability and investigate how it can be included in the design process.

In nature there is no such thing as waste. The ecosystem is optimized in a closed loop where leftovers from one process are a resource in another. All parts are closely related in a complex symbiotic system. Inspired by natural systems, this project has been an attempt to find a more holistic and sustainable approach to design by applying cyclical thinking to the design process.

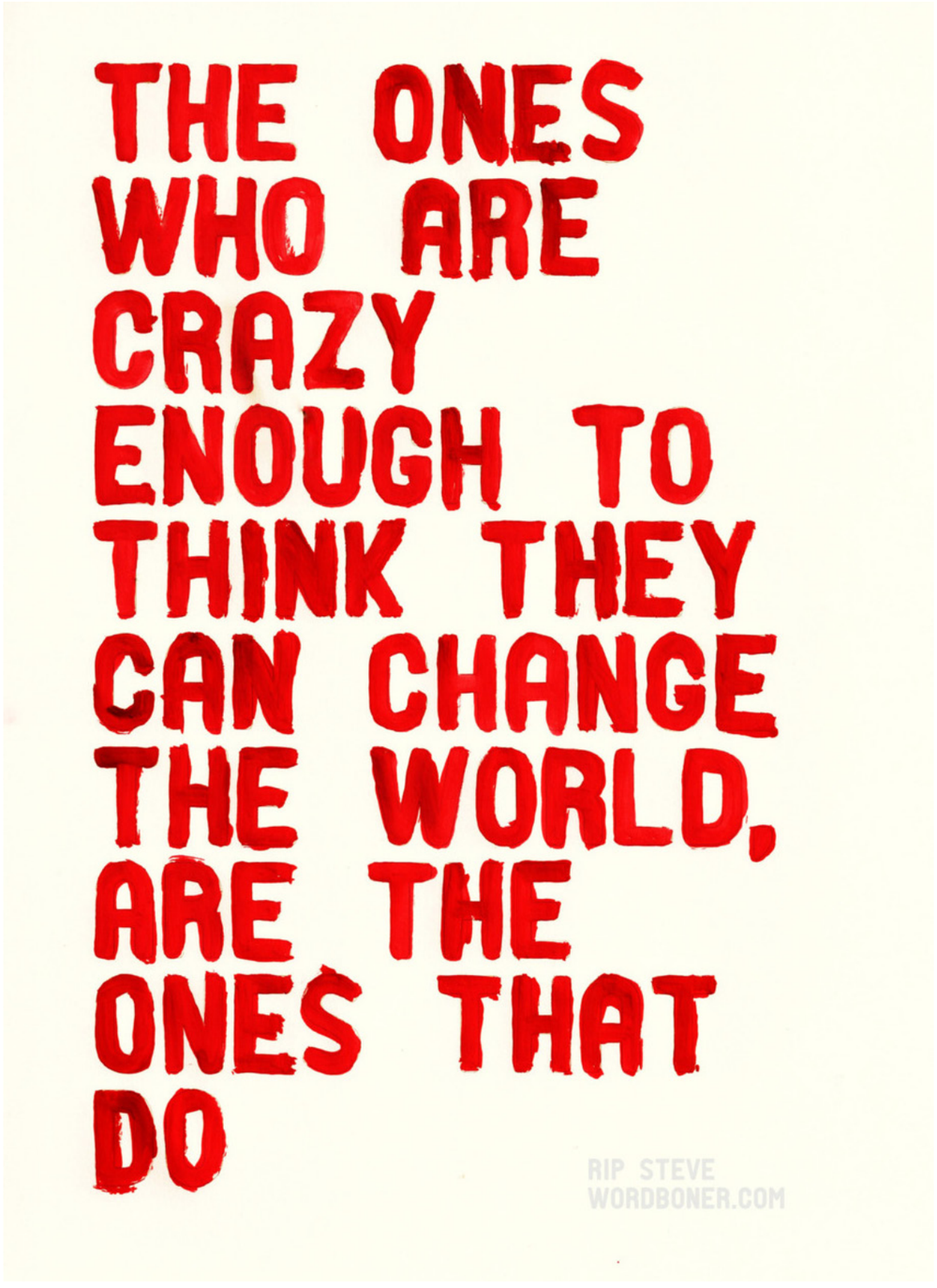
The first part of the project was very theoretical, including a lot of research and reading to collect all necessary knowledge. The research consisted of learning about Eco design methods, recycling processes and manufacturing techniques, as well as by practicing system thinking. A deeper understanding of consumer behaviours was also an important part in identifying what designers can do to change existing patterns. The theoretical phase was followed by a reflective part where important conclusions, that became cornerstones for the project, where made. These conclusions where then applied and tested during the practical phase.  During the whole project the aspect of zooming in and zooming out has been important to understand how the system at macro scale affects the microscopic parts in it, and vice versa.

I think designers have a great opportunity to influence the global system and change living patterns into a future balance between ecology, economy and social aspects. With a unique overview and possibility to affect different parts of the system, such as users and producers, we need to act responsibly.

To visualise my research and conclusions, I chose to work with the toothbrush. It is an everyday product with a short life cycle, and therefore important to recycle after usage. The necessity of the product it self is justified from a sustainable point of view, as people need to maintain basic mouth hygiene. The biggest problem with the toothbrush today is the complex combinations of different materials, which makes recycling impossible.

The final concept, “My precious toothbrush”, is based on European waste regulations and strives to minimize waste by providing a reusable toothbrush handle and a recyclable toothbrush head. Because of the complexity in choosing the right material for the handle, two different concepts were developed. Both handles are designed to achieve a longer life cycle with proper care. One handle is produced from recycled aluminium, and the other from birch branches and other leftover pieces. The toothbrush heads are made from 100 % polyamide and can be recycled up to ten times. After usage, the heads are sent back to the factory for reprocessing.
The material is then used in processes where the demand on material quality is lower, such as in the construction sector. In addition to the toothbrushes a distribution system based on the "take back" strategy was designed, to facilitate recycling of the used heads. The cyclic system works with two reusable metal cases; one to store the toothbrush, and one as a refill case for distributing used and unused heads.

This project has been a starting point for me and a motivation for my future career as an industrial designer. I consider myself to be in the beginning of a process of practicing a new way of thinking.

# PAGE INDEX

# TIME PLAN

16th January - 11th April

**Phase 1 - Zoom out**

Research
Documentation
Analysis

1 2 3 4 5 6 7 8 9 10 11 12 13

**Phase 2 - Zoom in**

Analysis
Synthesis
Realisation

# PROJECT BACKGROUND

*“There can be no understanding between the hand and the brain unless the heart acts as mediator. ” - Metropolis 1927*

When starting this project my head was filled with questions. Questions all treating the connection between the big world and me as a future designer. For quite a long time I’d had doubts about design and how it could be applied in, for me, a meaningful way. Therefore I was desperate to find something I could stand for.

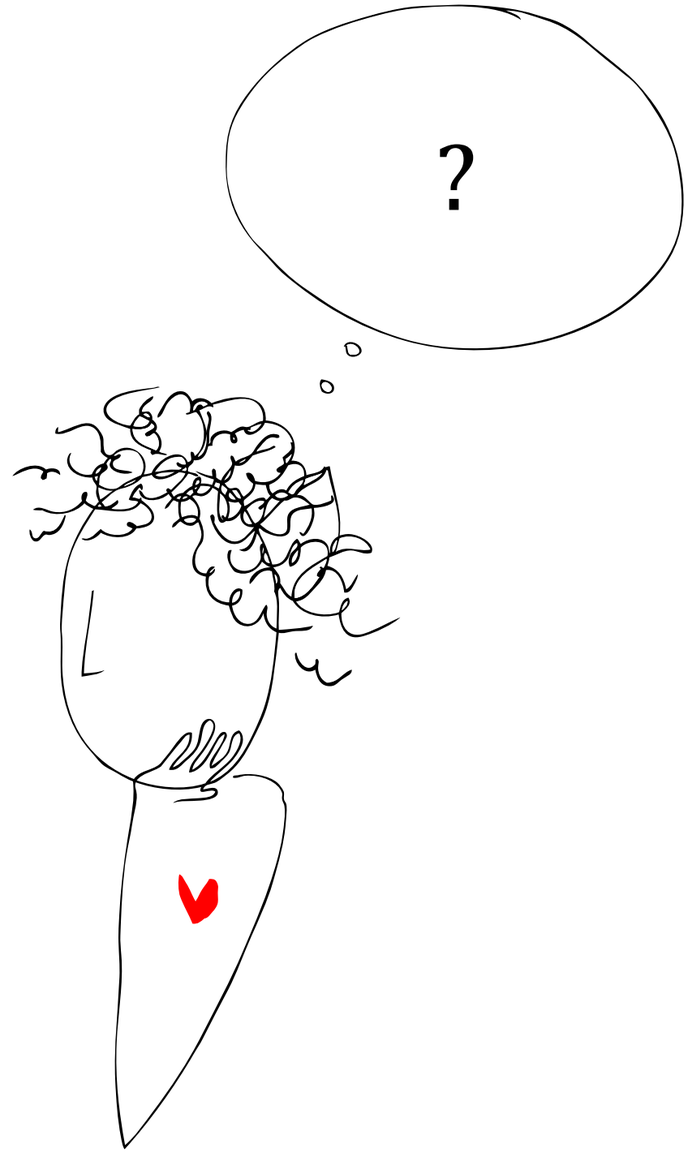
After almost three years of higher education within industrial design I felt there was still something crucial missing for me. Having practiced and learned a great amount of important tools and methods within design I was still lacking the application and meaning – my design foundation.  I felt I couldn’t finish these three first years of education without clarifying some important things for myself.

**What kind of designer do I want to be?**

My basic point of concern, not only in design but also in my life, is our modern life styles. Today we live in a completely man-made world and all we do is based on an enormous capitalistic system built up by ourselves during centuries. Everyday we take a bigger step away from nature and our origins. Still aware of the danger of our acts we are not capable of changing this system that has now turned into a self-driven machine. One could almost say we have become prisoners in our own society.

In my search for meaningfulness and something to believe in I kept coming back to the term ‘sustainability’. Being faced with the term repeated times, both within and outside my education and life, I got curious. Could this be a tool for questioning and rethinking our most basic patterns of living today? I started believing that it was in this direction I could find motivation. My initial question therefore became – **what is Sustainable design?**





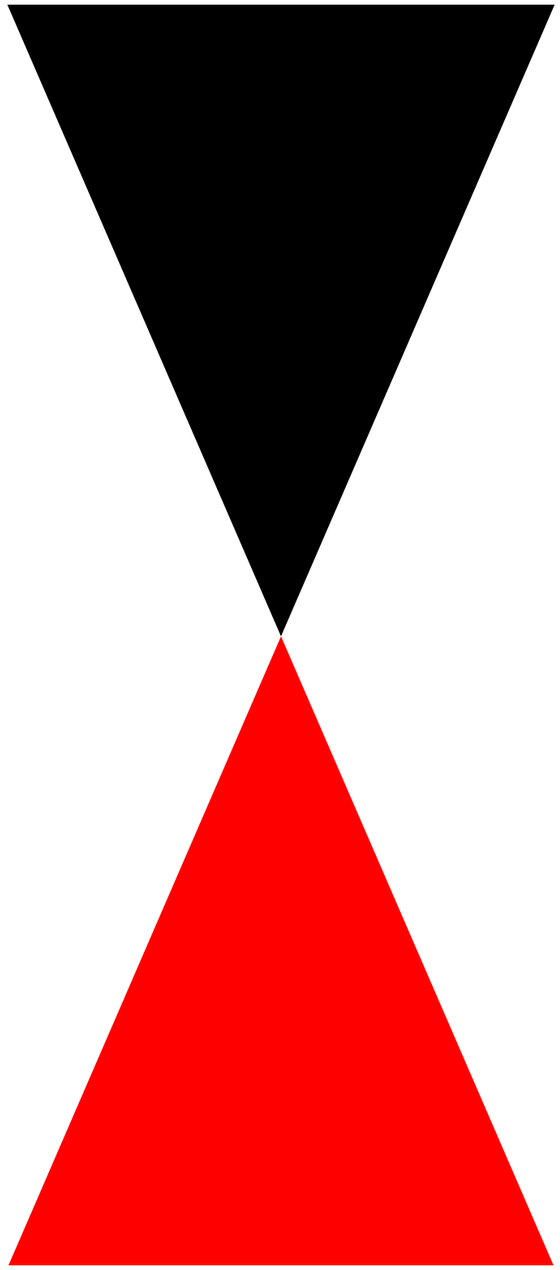
# GOAL & METHOD

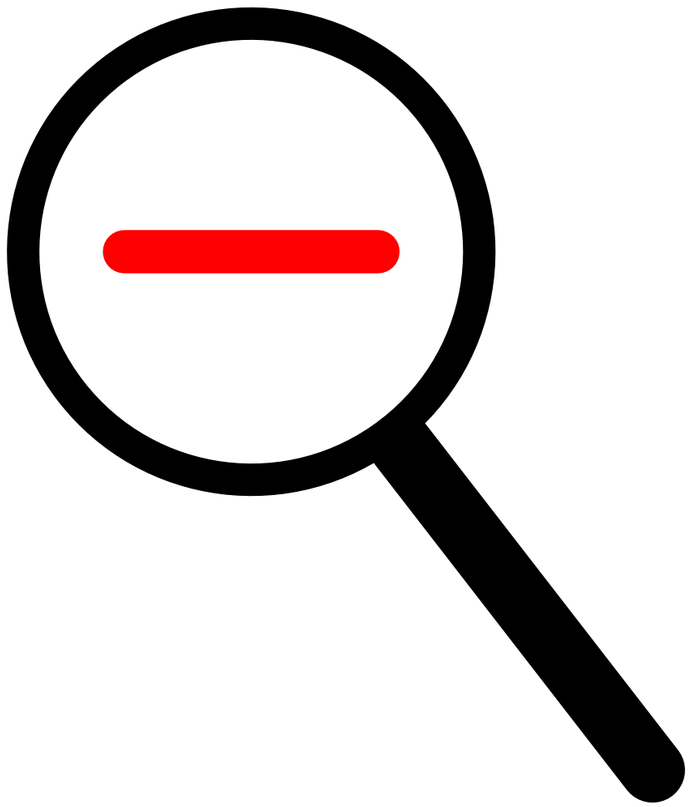
## Understand - act

The goal was to give myself time to better understand the possibilities that I as a designer have to change negative patterns into future positive ones. My intention was to understand the basic structure of the global production system. A system that I believe determines the way we design produce, use and dispose objects by economy, legislation and politics. I wanted to understand the basic terminology and methodology of Sustainable design, and investigate how it could be applied to create more meaningful design improving the life of the planet and all people on it. With this understanding in mind the goal was to highlight one existing problem and try to come up with an example of how it could be done differently.

## Theory + Reflection + Practice at macro and micro scale

The planned method to apply in this project was Theory + Reflection + Practice. The idea was to start an open-ended research process about Sustainable design, and trust that the collected knowledge, insights and conclusions would guide me into a direction for my project. To avoid getting lost in such broad and complex subjects as sustainability, design and production the idea was to approach them both from a macro and micro perspective. By zooming out and analysing the big system and then zoom in to understand how this affects one single part, the goal became to see how small changes could make big impact.





## ZOOM OUT

Phase 1

# CHAPTER 1

Introduction to areas of interest

# ECOLOGY

## Natural societies and production

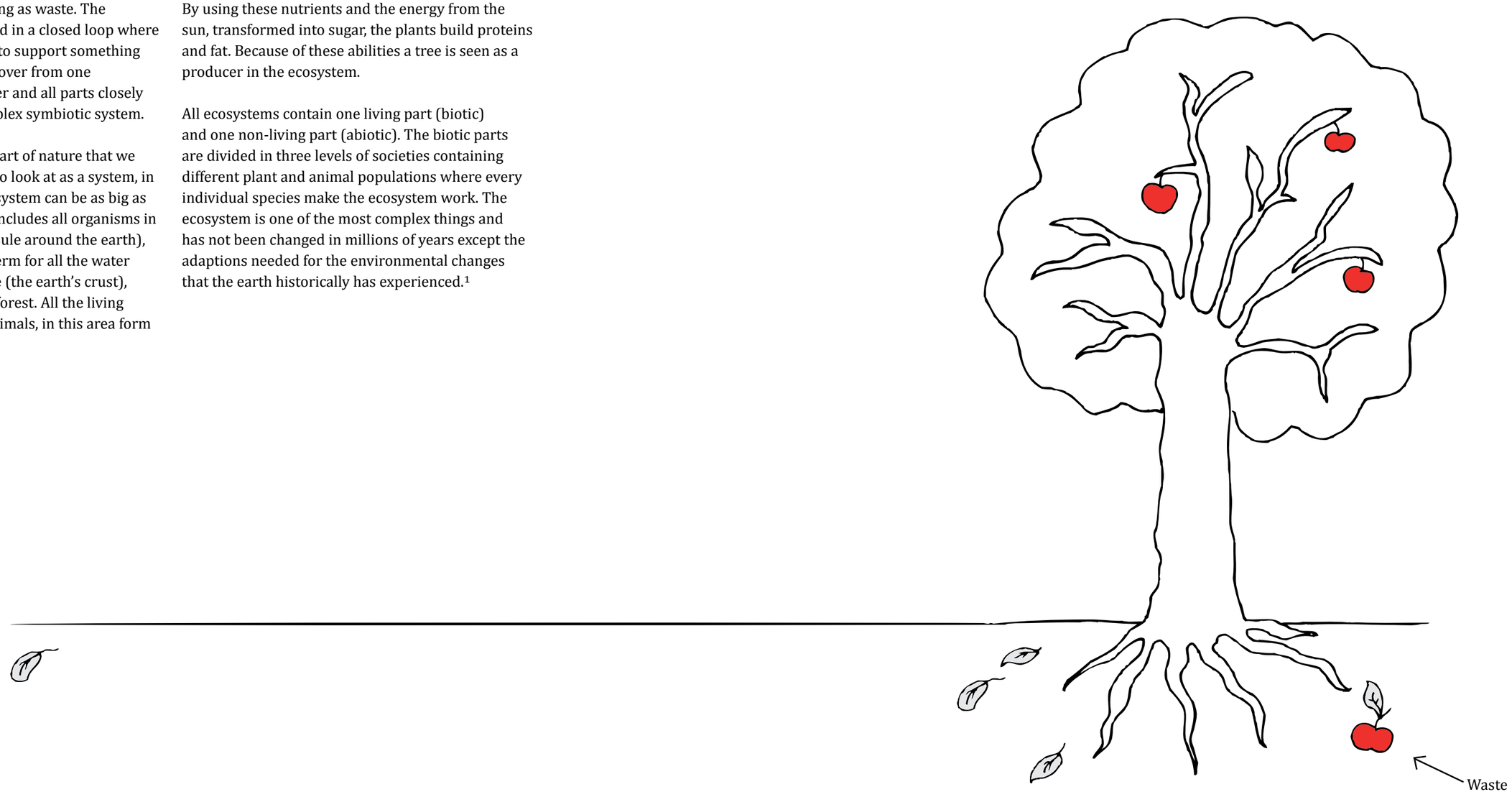
The ecological system is something that fascinates me. To start my research I wanted to investigate how and if nature could be an inspiration for new ways of thinking when producing, using and disposing products.

In nature there is no such thing as waste. The ecological system is optimized in a closed loop where every single particle is there to support something else in the system. Every left over from one production is used for another and all parts closely relate to each other in a complex symbiotic system.

An ecological system is one part of nature that we human beings have decided to look at as a system, in other words a whole. An ecosystem can be as big as the whole biosphere, which includes all organisms in the atmosphere (the gas capsule around the earth), hydrosphere (the umbrella term for all the water on the earth) and lithosphere (the earth's crust), or a small area like a lake or forest. All the living organisms, like plants and animals, in this area form together an ecosystem.

The green plants form an important part of the ecosystem. Through the photosynthesis they transform the energy from the sun to chemical energy that animals and fungus can use. The plants can also be using the abiotic (non living) part of the ecosystem by collecting the nutrients in the ground. By using these nutrients and the energy from the sun, transformed into sugar, the plants build proteins and fat. Because of these abilities a tree is seen as a producer in the ecosystem.

All ecosystems contain one living part (biotic) and one non-living part (abiotic). The biotic parts are divided in three levels of societies containing different plant and animal populations where every individual species make the ecosystem work. The ecosystem is one of the most complex things and has not been changed in millions of years except the adaptions needed for the environmental changes that the earth historically has experienced.[1]




1. http://sv.wikipedia.org/wiki/Ekologi, 2012/03/24

# ENVIRONMENTAL ISSUES

## Industrial production

*"There can be little doubt that the environment and the ecological balance of the planet are no longer sustainable. Unless we learn to preserve and conserve Earth's resource, and change our most basic patterns of consumption, manufacture and recycling, we have no future"*[1]

Environmental issues are negative aspects of human activity on the biophysical environment.[2] All these issues are a result of human action and our constant strive to make life more comfortable and convenient, by using the earth's resources without thinking about the consequences.

In 1995 the European Environmental Agency defined the primary environmental issues of today as: climate change, ozone depletion, air pollution and quality, acidification of soils and surface water, soil quality, biodiversity, waste management, urban issues, inland water resources, coastal zones and marine waters, risk management (of man-made and natural disasters).[3]

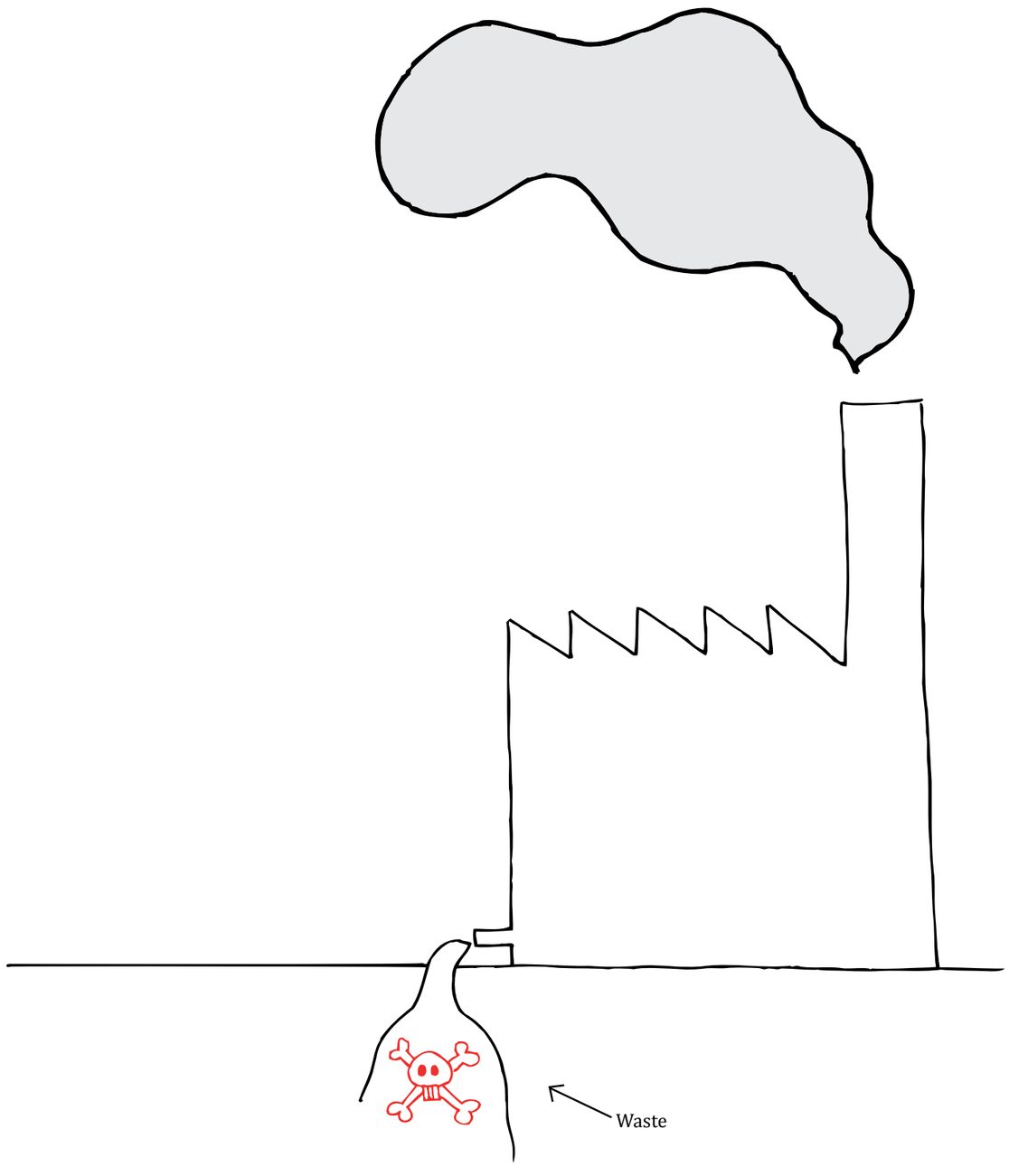
An example that closely relates to our irresponsible way of using the earth's resources today is the way we produce and use products. During the past three decades we have consumed one third of the planets natural resources. 80% of the planets forest is gone and only in the Amazons 2000 trees/minute are cut down.[4] With this is mind I think it is quite interesting that the word production can be used for two so different things as natural production and industrial production. While the natural production system is a holistic cycle where all parts produced by a source benefit the whole system, the industrial production and consumption system is a greedy world. This is a system where a big amount of resources serve a purpose for a small number of people a short period of time before being wasted. In addition to this the waste problem often affects the people not benefiting from the products in the first place.

The scale in which production is executed today demands many different synthetic chemicals that are not only harmful for the environment but also for us human beings and other species. A lot of people come into daily contact with or consume chemicals and other toxic substances by working with materials, handling or even using products.

In order to provide our ever-growing world population with goods on the demanded scale we need to make all processes extremely productive. In other words producing faster and more than nature is capable of. Therefore chemicals are used to squeeze as much out of our resources as fast as possible. Today chemicals are used to produce our food, our clothes and to transport ourselves. A fertilizer is only one example that is used to make the soil produce over its capacity.

Using chemicals however is not a long-term solution to the problem since it brings a number of problems into the picture. One example is poisoning since the chemicals don´t just disappear. Traces of chemicals can be found everywhere; in the water we drink, in the air we breathe, in the food we eat, in the clothes we wear. Scientists have, for example, discovered that the food with the highest level of contaminants comes from breast-feeding.[4]

**How could we use our knowledge about natural production and bring that in to industrial production?**




1. Papanek, V. (1995). The Green Imperative: Natural Design for the Real World, New York, Thames and Hudson.
2. http://en.wikipedia.org/wiki/Environmental_issue, 2012/03/24
3. Fuad-Luke, A. (2002) The eco-design handbook – a complete sourcebook for the home and office, Thames & Hudson
4. http://www.storyofstuff.org/, 2012/03/24

## The Real Meaning of Consumer Demand

*Our enormously productive economy demands that we make consumption our way of life, that we convert the buying and use of goods into rituals, that we seek our spiritual satisfactions, our ego satisfactions, in consumption. The measure of social status, of social acceptance, of prestige, is now to be found in our consumptive patterns. The very meaning and significance of our lives today expressed in consumptive terms. The greater the pressures upon the individual to conform to safe and accepted social standards, the more does he tend to express his aspirations and his individuality in terms of what he wears, drives, eats- his home, his car, his pattern of food serving, his hobbies. These commodities and services must be offered to the consumer with a special urgency. We require not only "forced draft"consumption, but "expensive" consumption as well. We need things consumed, burned up, worn out, replaced, and discarded at an ever increasing pace. We need to have people eat, as impulses which build up until they produce a sale. The consumer is not only faced with a multiplicity of choices, he is also being bombarded with a torrent of diverse pressures.*

Victor Lebow, Journal of Retailing, 1955
Marketing Consultant, President, Victor Lebow, Inc.



# THE IMPACT OF OUR LIVING

## Consumption and design

As if it wouldn't be enough with the way we produce products that are harmful for the environment and ourselves, the produced goods is only enjoyed by a small fragment of privileged societies, but still affecting everyone. 5% of the world's population is using 30 % of the world's resources and produce 30% of the worlds waste. If everyone on the planet would live as the developed world we would need 3-5 planets.[1]

The way we live our lives today in the developed world one could almost say that the rule "we are what we own" is the norm of living. We form our lives and personalities around buying and consuming. During the last century this has been implemented and become so strongly rooted in our society that it is hard to see an alternative way of living. It has become a wheel that spins faster and faster. Today the average person consumes twice as much as 50 years ago. The faster we consume the faster we dispose; in North America only 1% of all bought consumer goods is still in use after six months.[1]

Design has played an important role in forming these consumer patterns. During the history the design community has moved away from addressing peoples needs to exploit their desires making people buy things they didn't even know they wanted. Made up phenomenon's such as fashion and trends creates a perceived obsolescence and forces the user to constantly be updated and thereby consume faster and more.

If desire is not motivation enough for people to change their stuff often many products are also designed to stop working after a while. This is called planned obscolesence and means that products are designed to stop working and being hard to reapire, thus forcing the user to buy new stuff.

**Is this what I want to do as a designer?**

1. http://www.storyofstuff.org/, 2012/03/24

# GREEN DESIGN

## A brief introduction

There are many historical examples of what we today call green design since it was the norm for many cultures before the Industrial Revolution. Craftsmen produced everyday objects, like furniture and utility goods, locally from available local resources.

However, the Industrial Revolution 1750 - 1850[1] came to turn everything upside down in a very short period of time. Innovation in agriculture, manufacturing, mining, transportation, and technology had profound effects on the social, economic and cultural conditions. As the labour need within agriculture diminished and more jobs were created in industry people started moving to town to work in factories. These pattern where repeated all over the world during the twentieth century as countries industrialized and created new urban centres.

As a reaction movements were founded to protest against the new paradigm. One examples is the Arts and Crafts movement (1850-1915)[2] who's concerns about the environmental degradation and poor quality of mass produced goods made them examine other ways to produce in a large scale with lower impact. The modernist movements followed and insisted that the form of an object has to suit its functions, be durable and standardized for effective mass production.

One of the first advocates of a more Sustainable design philosophy, Richard Buckminster Fuller, developed both a building system based on cement with waste wood shavings, and a house and car within the concept "maximum human benefit from minimal use of materials and energy" 1929[2]. Sadly the concepts were too radical for the time and never became commercial products.

Between 1945 and mid 1950[2] Europe suffered a lack in material and energy, which encouraged new challenges and the general belief that "less is more". During the 1960's - 1970's the hippie movement questioned consumerism under the back-to-nature and do-it-yourself slogan.

The first energy crisis around 1971[2] with increased oil prices, resulted in products consuming less energy and later methods for examining a products life cycle, today Lifecycle analysis (LCA). The same year Victor Papanek confronted designers to take their social responsibilities in the book "Design for the Real world". In 1988 "The green consumer guide" by Julia Hailes and John Elkington educated the public in exercising their 'consumer power', forcing designers and manufactures to be 'environmentally friendly'.

The term 'sustainable development' was first defined in the so-called Brundtland report, "Our common future" prepared by the World Commission on Environment and Development in 1987. This together with the collaborative work between governments, industry and academia fed the green design debate.

Over the past twenty years tools for lifecycle analysis, terminology and methods have been developed forming a concept for Sustainable design.

1. http://en.wikipedia.org/wiki/Industrial_Revolution, 2012/03/03
2. Fuad-Luke, A. (2002) The eco-design handbook – a complete sourcebook for the home and office, Thames & Hudson



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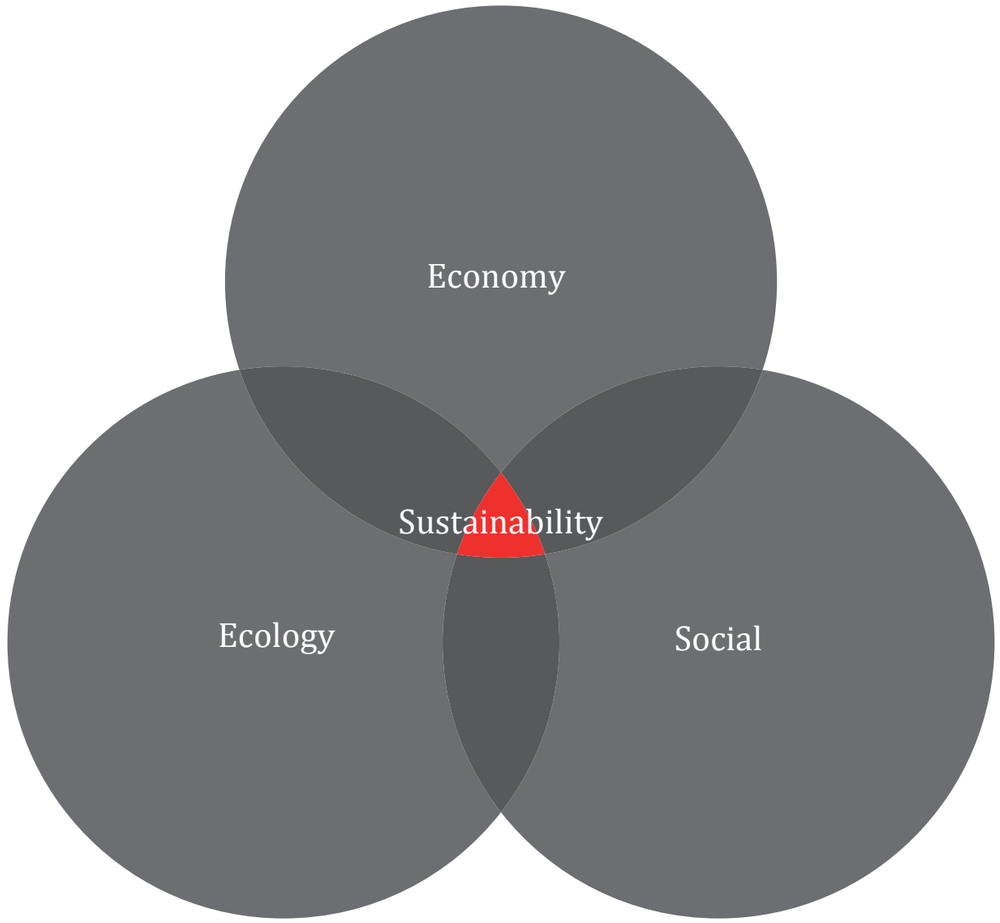





# SUSTAINABLE DESIGN

*"Sustainability is the key to preventing or reducing the effect of environmental issues. There is now clear scientific evidence that humanity is living unsustainably, and that an unprecedented collective effort is needed to return human use of natural resources to within sustainable limits. For humans to live sustainably, the Earth's resources must be used at a rate at which they can be replenished."*[1]

*"Sustainable design (also called environmental design, environmentally sustainable design, environmentally conscious design, etc.) is the philosophy of designing physical objects, the built environment, and services to comply with the principles of economic, social, and ecological sustainability."*[2]

Sustainable development aims for reaching human well being with a working economic development and at the same time make sure the ecological system is in balance. In order for this enormous change to be possible everyone has to take their responsibility and do what is possible for them.[3]

From a design point of view Sustainable design very much involves production and consumption of products. Where an object is produced, by whom, from what material, how and how long it is used for etc. In 1995 the World Business Council for Sustainable Development, a coalition of 120 international companies committed to the principles of economic growth and sustainable development, published the report Sustainable Production and Consumption: A Business Perspective. In the report sustainable production and consumption was defined as "involving business, government, communities and households contributing to environmental quality through the efficient production and use of natural resources, the minimization of wastes and the optimization of products and services".[4] The United Nations Commission on Sustainable Development (UNCSD) considers the role of business as crucial since it "requires the integration of environmental criteria into purchasing policies, the design of more efficient products and services, including a longer lifespan for durable goods, better after-sale service, increased reuse and recycling and the promotion of more sustainable consumption by improved product information and by the positive use of advertising and marketing".[4]

There are a number of tools and manifests for Sustainable design. This is a summary for eco-pluralistic design; designs that tread lightly on the planet:

1. Satisfy real needs
2. Minimize the ecological footprint
3. Harness solar income
4. Enable separation of components
5. Exclude the use of toxic or hazardous substances
6. Engender maximum benefits to the intended audience
7. Use locally available materials and resources
8. Exclude innovation lethargy
9. Dematerialize products into services
10. Design to maximize a product/material/service product's benefits to the communities
11. Encourage modularity in design
12. Foster debate and challenge the status quo
13. Publish eco-pluralistic design in the public domain
14. Create more sustainable products/materials/service products for a more sustainable future[4]

**Is this really possible for a designer to do?**

1. http://en.wikipedia.org/wiki/Environmental_issue, 2012/03/24
2. http://en.wikipedia.org/wiki/Sustainable_design, 2012/03/24
3. http://www.svid.se/Hallbarhetsguiden/, 2012/03/25
4. Fuad-Luke, A. (2002) The eco-design handbook – a complete sourcebook for the home and office, Thames & Hudson

# DIRECTION

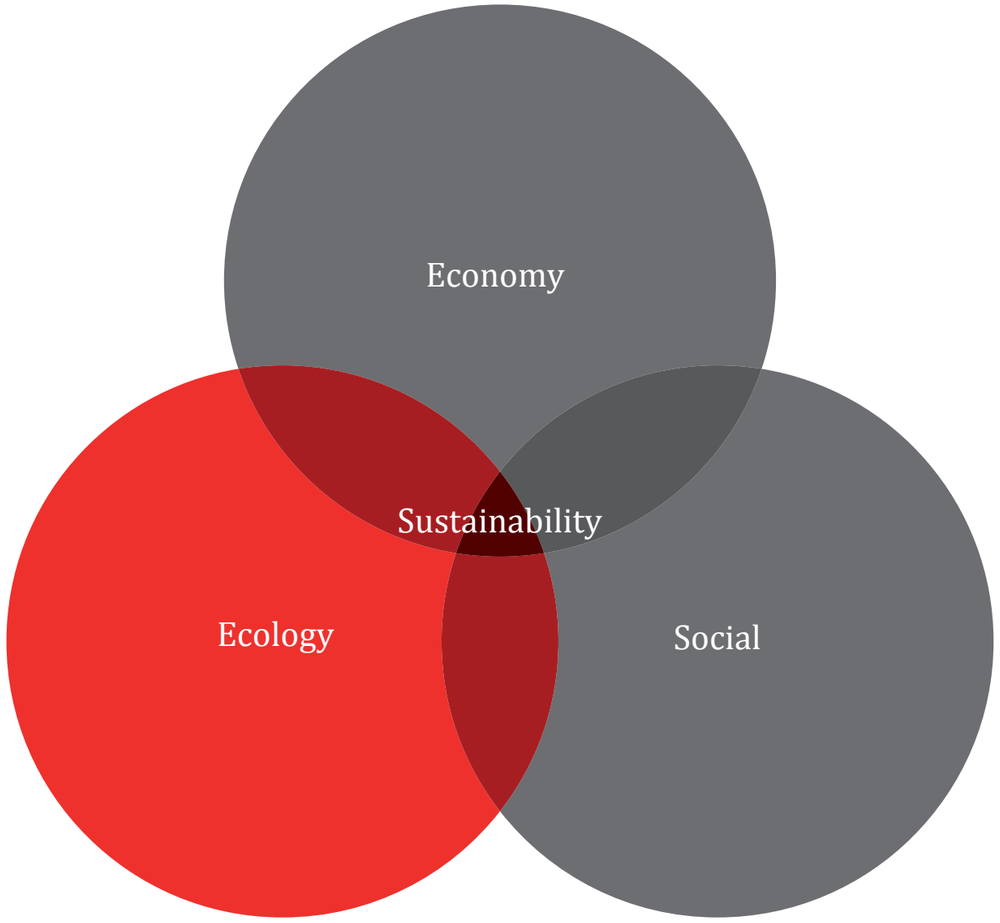
## Initial brief - ecology and design

In an attempt to find a way to answer all the question coming to my mind during the initial research I decided to take a closer look at ecology and design, focusing on alternative ways to produce, use and dispose products. I realized that the project had to quickly move into one direction to give time for analysis and comparison of different aspects. I decided to look at Eco design not because I think this aspect is more important than the other two within Sustainable design.  But simply that it is more connected to my initial research about natural production compared to industrial production.

As mentioned in the beginning the method of zooming in and zooming out is crucial for my understanding of the subject. I will need to zoom out and try to grasp the system from a macro perspective, and at the same time zoom in to micro perspective to understand how this system is affected by one individual part. Just as comparing the atmospheric ecosystem with its importance to, and its affect on, a single tree and vice versa. I decided to divide my project into Phase 1 - Zoom out and Phase 2 - Zoom in.

**Phase 1 – Zoom out**
What can I as a designer do to minimize the environmental impact of products?
The basic aim with the project is to explore and analyse methods and aspects within Eco design to inspire and motivate myself for my future as a professional designer. Research and analysis should lead to a final conclusion and a concept for ecological design. An understanding of materials, production and recycling processes from the environmental point of view is a very important part of the project.

**Phase 2 – Zoom in**
When the concept method is defined it should be tested on a real example by applying these aspects on a simple everyday object. In the design of the object the main focus will lye on its cyclic material flow and the environmental aspects.



# CHAPTER 2

Eco design

# ECO DESIGN - HOLISTIC THINKING

## What does it mean?

*"Eco design is an approach to the design of a product with special consideration for the environmental impacts of the product during its whole lifecycle"*[1]

When focusing on the ecological aspects of Sustainable design a whole new world opens up with a huge amount of methods to use and aspects to consider. In order to systematize the issue of Eco design many different attempts have been made resulting in different tools to use when meeting the challenge of reducing environmental impacts at the design stage. These methods, such as simple checklists, impact matrices, eco-wheels, Lifecycle Inventory (LCI) and Lifecycle Analysis (LCA) software, are more or less holistic and exact and can be applied in different stages of the product developing process.[2]

Holistic thinking is a key factor for successful Eco design. Equal amount of focus of improvement has to be put into all the stages in a products life cycle. This demands great amounts of knowledge in the process of developing a sustainable product and would be too much to expect from one single designer. Therefore a design challenge should be considered a team task with representative from different fields.

*"As the whole product life cycle should be regarded in an integrated perspective, representatives from advance development, design, production, marketing, purchasing and project management should work together on the Eco design of a further developed or new product as they have together the best chance to predict the holistic effects of changes of the product and their environmental impact. "* [1]

One way to systematize and evaluate a product in an ecological perspective is looking at the products life cycle usually divided in procurement, manufacture, use and disposal. For all of these steps during a products life cycle an evaluation of the consumption of resources (energy, materials, water or land area), emissions to air, water and the soil (or earth) and miscellaneous (e.g. noise and vibration) needs to be made resulting in a general overview of the environmental impact of a product.[1]

However all aspect within Eco design cannot be measured in an objective way. One important part of design and products is the user consuming the products and in many cases it is in this stage where the most environmental impact is created. Therefore communication and information is of great importance to inform the users and implement an awareness that hopefully can lead to a change of behaviour. A designer will therefore work very much as a communicator for Eco design and the environmental impact of a product.

In this chapter you will find a dictionary of Eco design strategies and terminology. Far from all methods are listed but the most common ones and the ones that has been most important for this project are included.

1. http://en.wikipedia.org/wiki/Ecodesign, 2012/03/25
2. Fuad-Luke, A. (2002) The eco-design handbook – a complete sourcebook for the home and office, Thames & Hudson
3. http://en.wikipedia.org/wiki/Biomimicry, 2012/03/25
4. http://en.wikipedia.org/wiki/The_Natural_Step, 2012/03/25
5. http://en.wikipedia.org/wiki/Factor_10, 2012/03/25



## Eco design - Glossary

**Dematerialization** — the process of converting products into service.[2]

**Lifecycle Analysis** — The calculation on paper or with the use of software of the key areas of environmental impact of a product or building and subsequent effort to minimize such impacts by design.[2]

**Product-service system (PPS)** — creating a service (based upon infrastructure network and ICT provision) whose products have less environmental impact than individually owned and consumed products.[2]

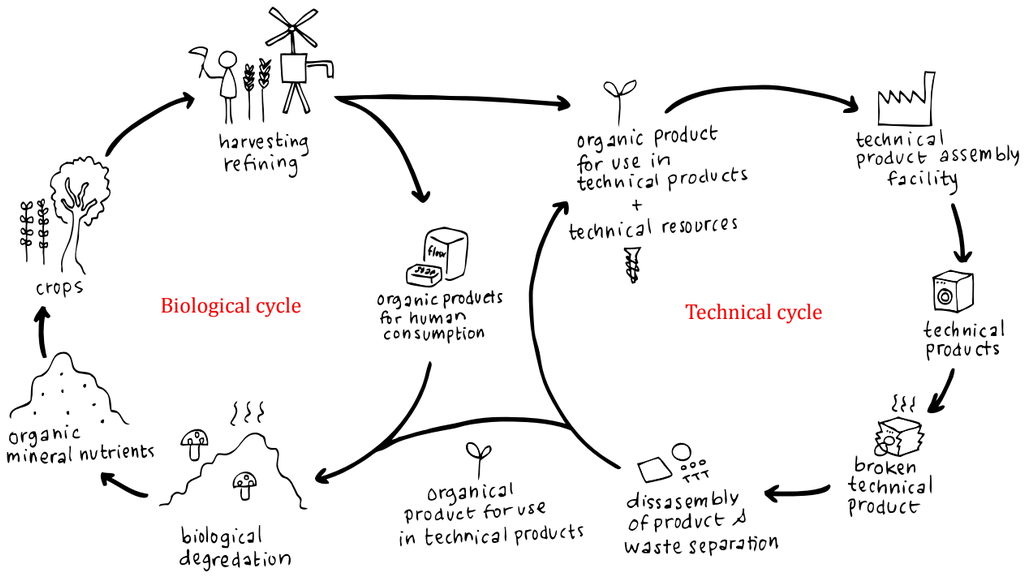
**Product take-back/Producer responsibility** — a system under which manufacturers agree to take back a product when it has reached the end of its useful life so that components and/or materials can be reused or recycled. [2]

**Bio mimicry** — the examination of nature, its models, systems, processes, and elements to emulate or take inspiration from in order to solve human problems.[3]

**The natural step** — is a non-profit organization founded in Sweden in 1989 by scientist Karl-Henrik Robèrt. Following publication of the Brundtland Report in 1987, Robèrt developed The Natural Step framework, setting out the system conditions for the sustainability of human activities on Earth; Robèrt's four system conditions are derived from the laws of thermodynamics.[4]

**Factor 10** — Factor Ten refers to the possibility of creating products and services that have massively lower resource intensity than the conventional alternative. It evolved from the concept of Factor Four, as developed at the Wuppertal Institute for Climate, Environment and Energy. (5)

**Cradle to cradle** — See next page.






# **CRADLE TO CRADLE** - A cyclic approach to design

Cradle to cradle is a bio mimic design philosophy initiated by the American architect William McDonough and the German biologist Michael Braungarth. The philosophy, summarized in the book Cradle to cradle - rethinking the way we make things, is a cyclic design and production method aiming for reaching an eco friendly future. The cradle to cradle method is based on the thought that the most common sustainable actions today, hence recycling materials, reducing waste, producing with less emissions etc. is a step in the wrong direction. According to McDonough and Braungarth this only postpones the waste without solving the fundamental problem and they even call it “down cycling”. And the problem as they see it is, opposite to cradle to cradle, a cradle to grave thinking and means linear thinking where everything eventually anyway ends up in a landfill.

The long-term solution would, according to the cradle to cradle method, be cyclic thinking where “waste equals food” just like in natural ecosystems. All waste coming out from a process should become “food”, hence a resource, for a new product or process instead of ending up on a landfill or being incinerated. For this to be able to work all materials should be sorted in two cycles - the technical cycle and the biological cycle.

The technical cycle contains all man made synthetic materials. These materials should be non-toxic, 100% clean, in one component that can be reused over and over again. In this cycle the material will form part of a product until it is disposed, then the product is disassembled and the parts sorted for recycling, to become a new product.

The biological cycle is based on natural production with growth and degradation. In this cycle the material is produced by nature and then goes back to nature, providing nutrition for the soil and new biological products.

For this system to be able to work Braungarth and McDonough speaks about the importance of designing for disassembly, designing products that can easily be taken apart. One product often contains several material kinds and therefore the design has to allow easy disassembly so that all materials can be separated and brought back to their cycles. “Designing products as products of service means designing them to be disassembled”[1]

The ‘C2C Certification’ is a proprietary certification system distributed by McDonough Braungart Design Chemistry (MBDC) consultants to companies working according to this method. The certification has different grades according to the level the product or system meets the Cradle to cradle demands.

Several experts within the field of Eco design, engineering and recycling have criticized the principle and questioned the technical implementation of the Cradle to cradle concept. For example Friedrich Schmidt-Bleek, head of the German Wuppertal Institute, believes it to be completely out of the question that the concept can be realized on a bigger scale.[2]

1. Braungart, M. & McDonough, W. (2009) Cradle to cradle – Remaking the way we make things, Vintage Books
2. http://en.wikipedia.org/wiki/Cradle-to-cradle_design, 2012/03/25

## **MATERIALS** - Is there a good material?

*"Careful selection of materials and manufacturing processes can often create products comparable in price and performance to non-sustainable products. Even mild design efforts can greatly increase the sustainable content of manufactured items."* [1]

The choice of material is crucial for the environmental impact of a product. It affects and determines the impact on all the other aspects in the products life cycle. To give some examples it determines the energy required during extraction and processing of the material, what production methods can be used, if it's safe, durable and functional to use and how it can be handle after its usage.

Generally there is no 'good' or 'bad' material; it all depends on the circumstances and the product kind. There are some materials and chemicals that are illegal to use, because they are toxic and directly harmful for the user or extremely harmful for the environment. There are also materials that should be used only when really needed, when no other substitute can serve the same purpose. But it all depends on the product and should be evaluated in every single case.

One important part to consider when choosing a material is the total handling process needed in order to transform it from a raw material into a product. How can it be manufactured? How much energy and water resources are needed? How does it serve the purpose of the product? How can it be handled after its usage? These questions have to be evaluated considering the kind of product and needs it should serve, if it's a product that should last "a life time" a durable material can be defendable even if it requires a lot of energy during production because it will level off in the long run.

1. http://en.wikipedia.org/wiki/Sustainable_design, 2012/03/24
2. Fuad-Luke, A. (2002) The eco-design handbook – a complete sourcebook for the home and office, Thames & Hudson



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|---|---|
| **Abundant materials from the lithosphere/geosphere** | inorganic material, such as stone, clay, minerals and metals from the earths crust. |
| **Biodegradable** | decomposed by the action of microbes such as bacteria and fungi. |
| **Biopolymers** | plastics made from plants. Biopolymers can be composed and returned to nature. |
| **Certified sources** | materials that are independently certified as originating from sustainably managed resources, from recycled materials or conforming to a national or international eco-label. |
| **Compostable** | can be decomposed by microbes such as bacteria and fungi to release nutrients and organic matter. |
| **Durable/extremely durable** | tough, strong materials that do not break or wear and survive the life of the product or well beyond. |
| **Lightweight** | materials with a high strength-to-weight ratio. |
| **Locally sources materials** | materials originating from close proximity to the point of manufacturing or production. |
| **Low-embodied-energy materials** | materials that require relatively little energy to extract and manufacture. |
| **Non-toxic/non hazardous** | not likely to cause loss of life or ill health to people or degradation of living ecosystems. |
| **Precious materials** | precious materials can serve to ensure the socio-cultural longevity of a product or building. |
| **Reclaimed** | materials saved for reuse on demolition of the built environment. |
| **Recyclable materials** | components of a product that can be used in a new product. |
| **Recyclate/Recycled feedstock** | materials that have been made into a new material comprising wholly or partially recycled materials. |
| **Recycled** | materials that have been processed, (such as cleaned, graded, shredded, blended) then remanufactured. |
| **Reduction in materials used** | reducing the materials required to deliver the required design functions. |
| **Renewable** | a material that can be extracted from resources which absorb energy from the sun to synthesize or create matter. |
| **Single / mono-materials** | consist of pure materials rather than mixtures. This facilitates recycling. |
| **Waste materials** | materials that originate from managed resources which are forecast to last for a very long time and/or are renewable resources.[2] |

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| **Avoidance of toxic substances** | avoiding substances liable to damage human health and living ecosystem. |
| **Bio-manufacturing** | using nature to help fabricate products in situ, i.e. ‘manufacturing natural gourds by training them in special shapes for later use as packaging; growing plants to produce biopolymers (natural plastic). |
| **Clean production** | systems are put in place to reduce the impact of manufacturing goods by minimizing the production of waste and emissions to land, air, and water. |
| **Closed loop recycling/ production** | the process of introducing waste streams back into the manufacturing process in a continuous cycle without loss from that cycle. |
| **Cold construction/ manufacturing** | methods that require no heat or pressure and hence reduce energy consumption and facilitate disassembly. |
| **Design for assembly (DfA)** | is a method of rationalizing and standardizing parts to facilitate the fixing together of components during production pr manufacture. |
| **Design for disassembly (Dfd)** | is a method of designing products to facilitate cost-effective, non-destructive breakdown of the component parts of a product at the end of its life so that they can be recycled or reused. |
| **Efficient use of raw and manufactured materials** | reducing materials used and minimizing waste production. |
| **Innovation of traditional (low impact) technologies** | using inherently low environmental impact, traditional or craft, technologies in an innovative way. |
| **Lightweight construction** | reducing materials used but maintaining strength. |
| **Low-energy manufacturing** | reducing the energy required to make components or products. |
| **Reduce resource consumption** | reducing materials used, especially raw materials extracted from the environment. |
| **Reduction in embodied energy of materials and construction** | considering the production process as an energy flow and trying to reduce the total energy used. |
| **Reduction in use of consumables** | reducing consumables used during the manufacturing process. |
| **Reduction of production waste** | achieved by more efficient designs and/or manufacturing processes. |
| **Self-assembly** | the final assembly is done by the consumer, thereby saving energy in the fabrication process. |
| **Simple, low-cost construction** | manufacturing with simple, inexpensive tooling and low-energy processes. |
| **Zero waste production** | the elimination of waste from the production process. |
| **Local economy/employment focused** | creating products or buildings that generate local employment and/or nurture the local economy using local materials and resources.[1] |



## **MANUFACTURING** - Is there a clean production?

The only 100 % clean production is natural production where nature is left alone producing in it’s own pace without additives and fertilizers.

The choice of production or manufacturing method is closely related to the chosen material. Depending on the chosen material the manufacturing process, from raw material to finished product, may be very simple or contain several stages requiring energy, water and chemicals.

The shape and design of an object also determines the efficiency of manufacturing. By designing products with components that easily can be put together and taken apart, the manufacturing impact can be lowered.

Location and scale in which the manufacturing is excecuted in strongly determines to the suitable way of manufacturing a material and its effect on the environment. Small-scale production with local materials and distribution can be beneficial because of its small effect on the environment.
But to believe that local production could replace todays global production system would be absurd, I believe, since it would force us to go back to a more primitive and simple living with much less variations and resources. Instead striving towards a local production whenever possible and trying to optimize the effect of all production could be a possible direction.

1. Fuad-Luke, A. (2002) The eco-design handbook – a complete sourcebook for the home and office, Thames & Hudson

# DISTRIBUTION / TRANSPORTATION

The journeys a product travels before reaching the user are long and many, and often crosses international borders many times before ending up very close to where the material was extracted in the first place.

There are numbers of methods for reducing the transport volume saving space and energy when transporting a product or material. Besides reducing $CO_2$ emissions and other negative environmental impacts during transportation, this is also an important economic factor, which makes it one of the most commonly seen methods for Eco design already implemented.

The long distances products and materials travel today are also strongly linked to economy and the fact that it is cheaper to produce something in a country on the other side of the world than where it will be retailed, even if the material is extracted where the product later is sold. This aspect is connected with national and international legislations regarding labor force, the use of certain substances and disposal.

How and how long the goods is transported is of course a key factor for reducing the negative environmental impact. Just like the manufacturing aspect, the distribution aspect can be substantially lowered or improved if local production with local materials is applied to a product.

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| **Flat-pack products** | products that van be stored flat to maximize use of transportation and storage space. |
| **Lightweight products** | products that have been designed to be lightweight, yet retain full functionality, and as result require less energy to transport. |
| **Reduced energy use during transport/reduction in transport energy** | this can be achieved by careful design of products to maximize packaging per unit area and minimize weight per product. |
| **Reusable packaging** | packaging that can provide protection on more than one trip. |
| **Self-assembly** | designs that are assembled by the consumer, therefore saving valuable space in transport and storage.[1] |

1. Fuad-Luke, A. (2002) The eco-design handbook – a complete sourcebook for the home and office, Thames & Hudson

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| **Classic design** | creating a design that will have a socio-cultural durability. |
| **Community ownership** | encourages group rather than individual ownership and some improves the efficiency of product usage. |
| **Customizable** | describes a product that the customer can alter to his or her own specification or configurations. |
| **Improved ergonomics** | products that are easier and more comfortable to use. |
| **Improved health and safety** | products that don't endanger health or safety or that promote better health. |
| **Improved social well being** | products that encourage social interaction or deeper, more meaningful experience or where users contribute to making the experience. |
| **Improved user-friendliness** | products that are easier to use and more fun to use. |
| **Improved user functionality** | products that serve their purpose better than previous design. |
| **Interactivity / User involvement** | engaging the user's abilities and skills in the product or building to improve the experience. |
| **Modular design / modularity** | products that can be configured in many ways to suit the user by changing the arrangement of individual modules. Modular design also offers the user the possibility of adding modules as the need requires. |
| **Multifunctional** | a product capable of more than one function. |
| **Portable** | a product that is easily transported for use in different locations. |
| **Universal/inclusive design** | design that encourages use by a wide range of people with varying abilities; design that enables rather than disables. |
| **Upgradable/upgradability** | a product that is easy to upgrade by replacing old components/elements with new. This is especially important technological products. |
| **Universal design** | The application of widely accepted practices, components, fixtures, materials and technologies suitable for a wide range of end-users. |
| **Design for ease of maintenance/maintainability** | products with good instructions and easy access to maintain or service parts that wear. |
| **Durable** | products that are though, owing to strong materials and high-quality manufacturing, and so resistant to use and wear. |
| **Ease of repair/reparability Anti-obsolescence** | products easy to assemble/disassemble to repair worn or broken parts. Anti-obsolescence – A design that is easily repaired, maintained and upgraded so it is not made obsolete with changes in technology or taste.[1] |



## USAGE AND FUNCTIONALITY

The usage aspect is crucial for saving our resources. How environmentally harmful a product will be is often determined during it's usage phase. How long the product is used for, how well it is taken care of and how it is recycled or disposed after usage is the users full responsibility.

There are many different design methods for minimizing the negative impact during usage. Even if this aspect can be helped by design it can never fully be controlled. If for example the product is consuming resources during its lifetime it can be minimized by giving the user the knowledge and option to do so. Designing to maximizing the functionality and to encourage the user to take care of the product is another way for a designer to optimize the usage. This aspect is closely related to how the designer communicates with the user.

Designing products for use by more than one user can also be a way to improve the usage phase. By encouraging community ownerships instead of individual ownership a product is dematerialized and a service rather than a physical object fulfils the need.

1. Fuad-Luke, A. (2002) The eco-design handbook – a complete sourcebook for the home and office, Thames & Hudson

## **AND THEN? -** Disposal or reincarnation

Waste is the negative backside of the whole product life cycle. This step needs to be designed out of the system from the start by optimizing the whole life cycle chain. By improving the products design, making the production cleaner, applying recycling processes, take-back systems and composting, waste can be minimized. This will never be enough though and the most important thing is simply to use less stuff.

There is waste coming from all steps in the product life cycle. When the material is extracted certain parts might not fulfil required standards and therefore sorted out. During the production of a component a lot of waste is created. Depending on the kind of material this waste can sometimes be recycled, but many times not. The majority of all the layers of packaging surrounding a product are used one time before being thrown away. And last but not least the product itself after usage.

The different design methods focus on reducing different parts of the waste problem by for example minimizing the material, making it easier to reuse parts and labelling the material to communicate how it should be handled.

Producer responsibility could be one key factor for solving the problem. By implementing a product take-back system where producers agree to take the responsibility for a product after it's usage waste could be minimized. This would probably also affect the design of the object making the production, assembly and disassembly more efficient.

1. Fuad-Luke, A. (2002) The eco-design handbook – a complete sourcebook for the home and office, Thames & Hudson



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| **Conservation of landfill space** | products that decompose to release landfill space or products that can be recycled, reused or remanufactured to avoid being sent to landfill. |
| **Encouraging local composting/ local biodegradation of waste** | products that can be locally decomposed by the owner, so saving on the transport energy of waste collection and landfill. |
| **Producer responsibility/ product take-back** | a system under which manufacturers agree to take back a product when it has reached the end of its useful life so that it can be disassembled and components or materials can be reused or recycled. |
| **Recycling** | products that are designed to be easily recyclable by being made of single materials or by being easily disassembled into materials or components that can be recycled. |
| **Remanufacture** | products that are easily disassembled for refurbishment or to manufacture new products. |
| **Reuse** | products that are easily reused for the same or a new purpose or are easily disassembled for the components and/or materials to be reused. |
| **Design for recyclability (DfR)** | is a design philosophy that tries to maximize positive environmental attributes of a product, such as ease to disassembly, recyclability, maintenance, reuse or refurbishment, without compromising the product's functionality and performance |
| **Design for recycling** | considers the best methods to improve recycling of raw materials or components by facilitating assembly, disassembly, ensuring that materials are not mixed and appropriately labeling materials and components. |
| **Materials labelling** | assists with improved identification of materials for recycling |
| **Reuse of end-of-life components** | taking back worn-out or old components/products and refurbishing them to an 'as-new' standard for resale. |
| **Reuse redundant components** | components formally manufactured for another use are re-employed in a new product |
| **Reuse materials** | reusing materials without changing their original state. By comparison, recycling involves some reorganization or partial destruction of the material followed by reconstruction. |
| **Reuse objects/products** | A product or object that can be reused at the end of its initial lifespan for an identical, similar or new use. |
| **Use of ready-mades/ready made components** | components made for one product reapplied to a new or different type of product. |
| **Recyclable packaging/ containers** | packaging and containers made of materials that can be recycled. |
| **Reduction in use of consumables** | products that reduce the use of consumables such as paper, inks, batteries, oils and detergents. |
| **Reusable packaging/ containers** | packaging and containers that can be reused for repeat trips.[1] |

**Design for reduce** — emissions/pollution/toxins.

**Free of CFCs and HCFCs** — products generally associated with refrigerants, that do not use either chlorofluorocarbons (CFCs), which are greenhouse gases, or hydro chlorofluorocarbons (HCFCs), which are greenhouse gases and ozone-depleting gases.

**Reduction in /avoidance of emissions (to water)** — products whose production and use avoids or minimizes emissions of hazardous and toxic substances to air, including greenhouse gases, hydrocarbons, particulate matter and cancer-causing substances (carcinogens).

**Reduction in /avoidance of emissions/pollution (to air)** — products whose production and use avoids or minimizes emissions of hazardous and toxic substances to air.

**Reduction in /avoidance of hazardous/toxic substances** — products that are safe for human use because they contain little or no hazardous or toxic substances. Safe for human use does not necessarily mean safe for plant and other wildlife.

**Zero emissions** — refers to vehicles powered with electric motors or with hydrogen fuel-cell power systems that do not produce exhaust emissions of greenhouse gases.

**Energy conservation** — products designed to prevent loss of energy.

**Energy efficient** — products/buildings designed to use energy efficiently.

**Energy neutral** — products/buildings that generate as much energy as they consume.

**Human-powered products** — products that use energy supplied by humans.

**Hybrid power** — products that combine two or more power sources, for example hybrid electric/petrol or fuel cell/electric cars.

**Integrated or intelligent transport systems** — transport systems that permit a wide range of mobility products to be used to offer a choice of mobility paths for the user.

**Low voltage** — products capable of operating on 12-volt or 24-volt electricity supply rather than higher voltage.

**Natural lighting** — Natural lighting –products that encourage the use of natural lighting (rather than consuming electricity).

**Rechargeable (batteries)** — products that encourage repeat battery use by recharging from mains or renewable power supply, and so reduce waste production.

**Renewable power** — electricity generated from products that convert the energy of the sun, wind, water or geothermal heat from the earths crust.

**Solar power (passive)** — products that produce light or heat by absorbing the energy from the sun.

**Solar power (generation)** — products that generate electricity by absorbing the energy of the sun. These typically include products equipped with photovoltaic panels.

**Water conservation** — products that reduce water usage, and/or facilitate water collection.

**Water generation (freshwater)** — products that generate fresh water from contaminated surface or ground water, seawater or water-saturated air.[1]



## ENERGY AND RESCOURCE USE

Every kind of activity demands energy and resource use. Also this aspect is central in all steps of the process of production, usage and disposal and needs to be carefully considered in order to minimize a products negative environmental impact.

Where the energy comes from an how it is produced is very important. The negative impact of the energy can be lowered in many different ways such as by using human power, renewable power, natural light, low voltage products etc.

For products consuming resources during their lifetime a big part of the responsibility lays on the user to save these. It is therefor important to offer options to use less resource, by for example providing a program for a half full washing machine. Also to communicating to the user how to minimize the consumption of resources and energy and pointing out the importance of it.

1. Fuad-Luke, A. (2002) The eco-design handbook – a complete sourcebook for the home and office, Thames & Hudson

# MARKETING AND COMMUNICATION

*"A designer has always been also a teacher, in a position to inform and influence the client"* [1]

Communication is a crucial part of Eco design, both for giving instructions to the specific customer and increasing the level of public awareness. Communication is also important for marketing reasons, giving the companies that makes the effort to apply Eco design attention.

By clearly communicating how a product should be used in a responsible way, and why a product or behaviour is better than the alternatives the consumer awareness can be increased. This could be done through labelling the material with origin and environmental impact. Usage instructions explaining how the product or service is used in the best way is another option to increase the consciousness amongst users. This consciousness probably also leads to a change of behaviour in the long run.

Trends are strongly related to communication and by making environmentally friendly products attractive a demand for green products would increase. This demand then puts pressure on producers to deliver according to the consumer's desires, and also demands competitors to take action to follow this trend. Thus, designers can, in my opinion, affect the production from different directions, and thereby increasing the chances of controlling production in an environmentally more gentle direction.

**Eco-labels** labels attached to products which confirm that the manufacturers conform to independently certified standards in terms of reduced environmental impacts.[2]

1. Papanek, V. (1995). The Green Imperative: Natural Design for the Real World, New York, Thames and Hudson.
2. Fuad-Luke, A. (2002) The eco-design handbook – a complete sourcebook for the home and office, Thames & Hudson

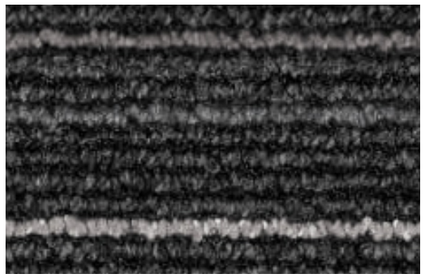
**EXAMPLES** - Different aspects of Eco design

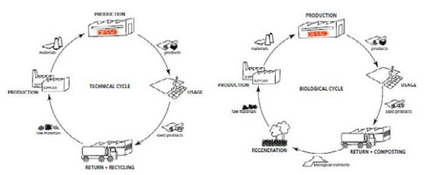
**Herman Miller Office Chair**
Office chair inspired by Cradle to cradle. Durable design, Easy to assemble and disassemble, Low emitting product, Recyclable and compostable materials. Minimal amount of materials.


**Apokalyps labotek - The Soap**
Soap made from recycled deep frying oil from local falafel restaurants in Malmö, Sweden.



**R2B2**
Three different kitchen appliances, powered by rotating a flywheel with muscular power.






**Desso Carpets**
A take-back system for carpets with Cradle to cradle certification.

**Nike considered**
A shoe made from recyclable materials, with zero toxins or chemicals and with closed loop production technology.

# MEETING AN EXPERT

## Johan Persson
## Research engineer

To get a better understanding of the feasibility of cyclic production I meet with engineer and recycling expert Johan Persson. The two main topics we discussed were recycling and the feasibility of cyclic production.

**How feasible is the cradle to cradle method?**

We started the discussion by speaking about the feasibility of the recycling processes that the cradle to cradle method is based upon. Johan told me that cyclic production is possible but very expensive today. Closing a production cycle by taking back all used material into new production can be done. However the circle will never be 100 % closed since there will always be leaks in the system. Some new material will always have to be added to keep the same amount of material in the new product. In the recycling system applied today, few materials can be recycled indefinitely. Therefore other recycling methods would have to be applied.

Today recycling is done by separating different kinds of material and then handling them in separate cycles. A chemical recycling system could be a more efficient alternative but this technology is still very expensive. There are different methods of chemical recycling where the bonds between the carbon chains are broken down. When using this process the separation of material could be less exact than in the method used today. However one could question if it is really a good idea to add more chemicals into the production process.

During the meeting Johan emphasized a lot on the importance of viewing the whole production chain and look at all details. Sometimes it is the secondary material that is the most environmentally harmful and not the main material. In some cases one solution works and in others it does not. Therefore it is important to calculate and evaluate all details during the process when developing and designing a product.

One important problem within recycling today is the difficulty of identifying different kind of materials. One example is bio-plastic material that looks exactly like conventional plastic products. Instead of being composted these products easily end up together with recyclable plastic and pollutes the new material. A solution could be an international labelling system marking all different kind of materials and how they should be handled.

# CHAPTER 3

How is waste handled in Sweden?

# FIELD TRIP

## Visit to Sysav AB in Malmö

To learn more about waste handling in Sweden I contacted Sysav, which is a company collection and processing waste in Malmö, Sweden. There I met Staffan Salö, an architect working with research about green housing and waste handling.

The company Sysav is owned by 14 districts in the southern region of Sweden. Sysav is handling all types of waste at their different plants for recycling, waste incineration, toxic waste plant, animal cremation, plant for secrecy waste, food waste etc. The year 2010 the company received 916 000 tons of garbage out of which 97% was recycled into energy or new material. 549 400 tons of this waste was incinerated and turned into heat and electricity for Malmö and Burlöv in the south of Sweden. The organization also has a plant for food waste where the biological waste is pressed into a liquid, which later is used for biogas or bio fertilizer. The year 2007 Sysav received the environmental certification ISO 14001.[1]

**Reflection**

It is easy to see these enormous systems as a solution when walking around in such a big, well-planned garbage-handling factory as Sysav. Everything looks surprisingly clean and all the numbers and facts presented sound very impressive, reasonable and harmless. I would guess that Sysav is one of the most clean garbage handling plants in the world so they are obviously doing a lot of things good, but what about the things that are not so good? What about the 3% of the 916 00 tons of garbage from the year 2010 that could not be handled in any of their well worked out “recycling” systems? In fact those “only 3%” are 27 480 tons of garbage. 27 480 tons of garbage, from 14 districts in the south of Sweden in one year, that can not be recycled, reused or burned. Instead it is buried in the ground, releasing toxins both into the air, soil and ground water. Then imagine again that this is a “good” system and a very small fraction of all waste created in the world in one year. Then it suddenly becomes quite scary.

1. http://www.sysav.se/, 2012/03/07



Inside Sysav AB, the process from garbage collection, to incineration, and finally all the left overs and ash.



# RECYCLING SYSTEMS

## Producer responsibility in Sweden

Extended producer responsibility (EPR) is a strategy with the aim to promote the integration of environmental costs, associated with goods throughout their life cycles, into the market price of the products. The idea is to use financial incentives to encourage manufacturers to design environmentally friendly products by holding producers responsible for the costs of managing their products at end of life.[1]

In Sweden there is a principal method adopted by The Parliament in 1993 where companies producing and using packages and magazines also need to take the environmental responsibility after a product is used. FTIAB is a company in the recycling industry that serves to ensure that packaging and newspapers in Sweden is collected and recycled. In total there are approximately 5800 collection points around the country where people can leave used packaging and newspapers. The collection system is financed by producers, i.e. companies that import goods, perform a packaging and selling an asset.[2]

1. http://en.wikipedia.org/wiki/Extended_producer_responsibility, 2012/03/07
2. http://www.ftiab.se/omfti.4.405877db1168b3d892a80003.html, 2012/03/07

# CHAPTER 4

Incentives

# ACCOUNTABILITY

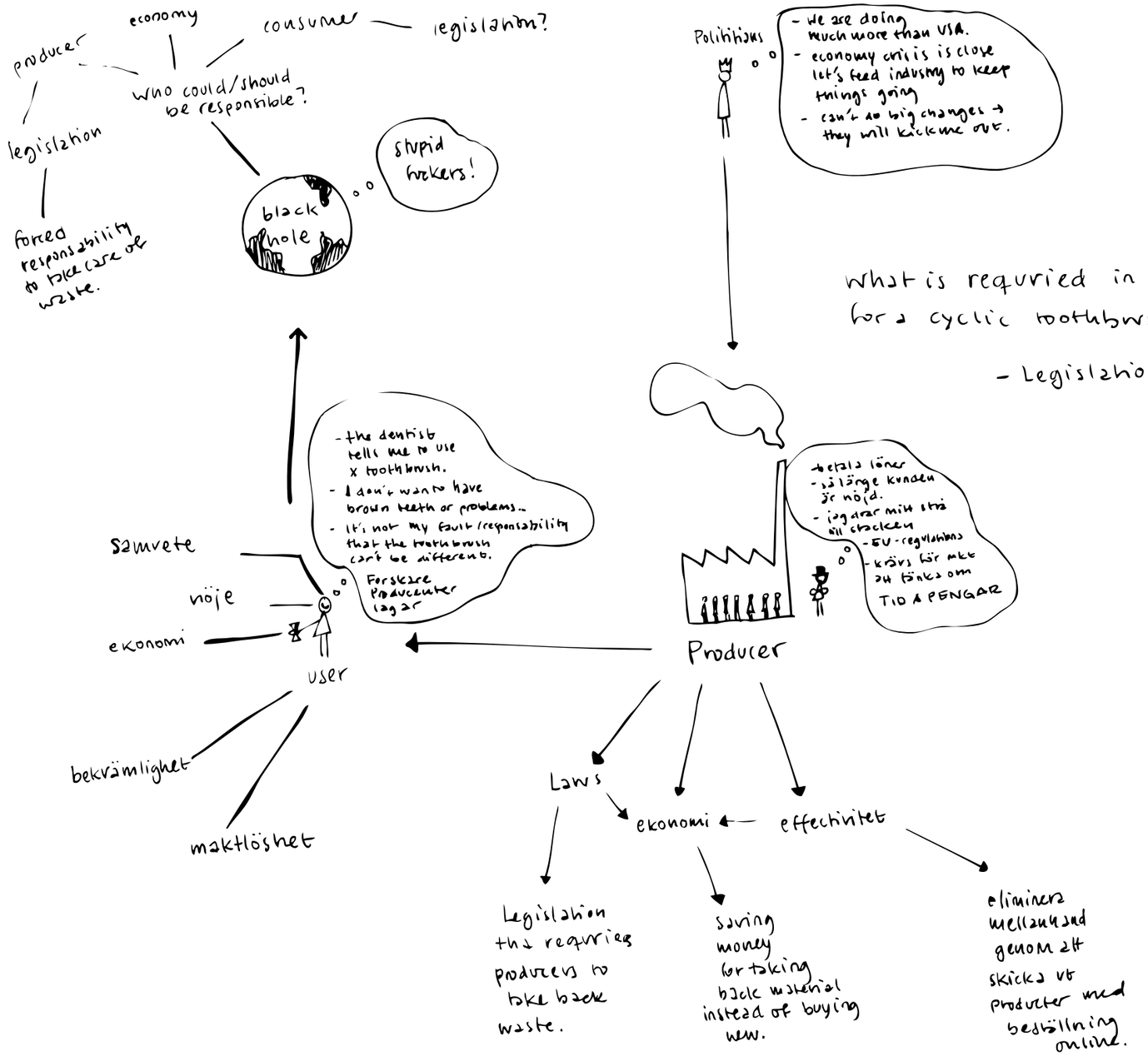
## Who has the power to change?

In addition to material, technology and construction factors also political, economic and social factors have a strong effect on a product's environmental impact. Our market system is today run by supply and demand, and usually the economic factor tends to dominate in relation to ecological and social aspects. Many factors cannot be solved at product level but requires changes in laws regarding producer responsibility, waste disposal, emission, etc.

In today's globalized society there is a great distance built into most production processes, motives and objects, since the system is structured so that all individual knowledge together form a working system. I think this system is a reason for why we keep destroying our earth, despite knowing the consequence of our lifestyle. The problem is to link your individual actions to the environmental impact and to understand that every action is important. Like a general paralysis the conclusion today is that a single individual has no power against the big system and is therefore also disconnected from responsibility.

**Who's responsibility is it to act?**
**How to motivate change?**

I strongly believe that all parts of the system have the power to act. And with power comes a responsibility to conduct this power. Suppliers and politicians can take decisions to quickly make big changes but in the long run I think it is the single individual and the consumer that needs to make certain demands. In the end it comes down to supplying what the customer demands both for producers and politicians. And if this demand is to buy more sustainable products the action will automatically happen.

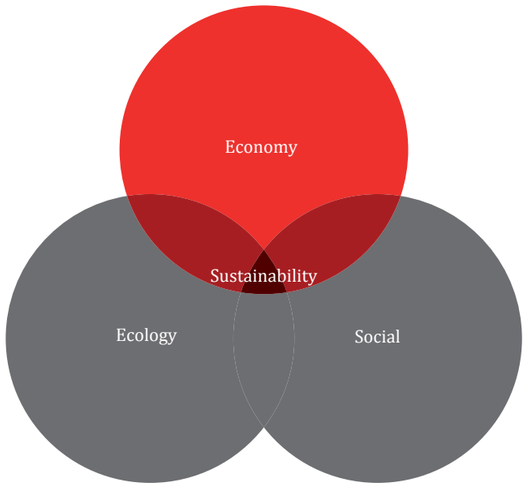


# POWER FACTORS

## Economy

The economic factor is the most important driving force for the global market system today. In relation to the other two factors within sustainability, ecology and social factors, economy is necessary for a working society. Without money constantly flowing the whole system fails.

In the process of changing our society into a more sustainable system I think economy can be both a hindering and helping factor. If a sustainable solution includes economic growth no one will question implementation and the economy will work in favour for a change. If it is for example possible to calculate that a certain amount of energy or material is saved, the change will not have to be discussed since profit will be gained. On the contrary situations where economy is lost or kept unchanged the change is more likely to not happen, even if it would be of great importance for the other two aspects within sustainability.






## Legislation

National and international legislation is responsible for a large part of environmental problems and inhuman working conditions. One problem in today's general legislation system is the allowance of waste and irresponsible material handling. Countries with strict legislation send their "problems" within production and waste to places where legislation is less strict and handling is cheaper. The result of this is additional, sometimes even greater problems such as life threatening working conditions, long transport distances and irresponsible waste handling with little or no control at all.

Legislation is a great part of the problem today and I´m convinced it must play a crucial role also in changes. For big changes to start I think a harder legislation system will be needed were producers will be charged for the waste they are depositing. Forcing them to find new solutions and systems to handle their waste material. This will have to be global agreements so that there are no wholes in the system where producers and countries can avoid the legislation.

The European waste regulation is focused on strategies for how to manage waste. The principle says that waste prevention is a key factor for a change towards a more environmentally harmless society. In the cases where waste cannot be prevented, as many of the materials as possible should be recovered, preferably by recycling or reusing. The last steps strive towards improved final disposal and monitoring. Where waste that cannot be recycled or reused should be safely incinerated, with landfill only used as a last resort.[1]

1. REDUCE
2. REUSE
3. RECYCLE
4. ENERGY EXTENSION
5. DEPOSIT

1. http://ec.europa.eu/environment/waste/index.htm, 2012/05/19

# HUMAN BEHAVIOUR

## Aspects of motivation

After having concluded that every human being has the power and responsibility to influence the system it was important to look at factors that can motivate a behaviour change. In the western society the majority of the people can have their fundamental needs, like physical needs, safety, social stimulation etc., fulfilled. According to the behaviour stair by Maslow these (see figure below) are basic human needs to fulfil first. When the base it satisfied the need of creating a personality and developing his/her own person becomes important. I believe it is also here consumption for pleasure comes in.

↑ Peak-Experience
Self-Actualization
Psychological Needs
Safety Needs (comfort)
Basic Needs (survival)

As human beings we constantly strive to make our lives better. In the modern society this is shown through the constant will to earn more money, own more stuff, be more beautiful etc. For a product to attract potential buyers it is crucial to understand the background of a consumers choice. This is also important when differentiating a product from other products on the market i.e. making people buy the more eco-friendly versions.

My conclusion is that there are four basic aspects that determine our choice when choosing a product: comfort, money, pleasure and conscience. We buy products to make our lives more comfortable and pleasurable but we need to afford it and if possible also save money. If any of these factors is better in one product compared to another it is very likely that this one will also be more attractive to the buyer. The fourth aspect, conscience, is the hardest one to control but maybe the most interesting when aiming for a behaviour change within consumption. In the article Emotional Engagement in Professional Ethics W. Scott Dunbar gives examples of factors that determines our choices and decisions in different situations.

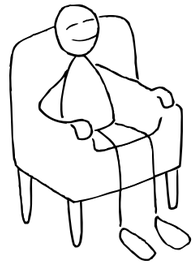
Dunbar means that the personal and impersonal connection to actions is crucial to a moral decision.[1] If an individual would face a situation where he/she is actively forced to pour out a kilo of chemicals in the ocean few people would probably do it. At the same time chemicals are used in numerous manufacturing processes in our society and then released straight into the wild.

In the same way as personal connection determines how we act emotionally, I think that distance affects an act by the degree of emotional involvement. Through social, cultural, geographical or action distance to the subject or object the emotional involvement is reduced and thereby allows morally hard decisions to be made. Henry Ford's quote "The man who puts in the bolt doesn't put on the nut, and the man who puts on the nut doesn't tighten it."[2] is a very telling example of how distance can be created in industry. Since all people involved contributes with such a small effort, no one is responsible for the thousands of cars produced that burden the environment both during and after production.

Awareness is a crucial part for changing consumer behaviour. In a survey in which different households received information about the size of their ecological footprint, as well as information on how it can be reduced, Sutcliffe shows that awareness leads to more environmentally friendly actions.[3] By clearly communicating how a product should be used, and why a product or behaviour is better than the alternatives consumer awareness can be increased, which probably also alters the behaviour.

1. Dunbar, Scott, W., 2005. Emotional Engagement in Professional Ethics
2. Walker, S., Dorsa, E., 2001. Making design work – Sustainability, Product Design and Social Equity.
3. Sutcliffe, M., Hooper, P., Howell, R., 2008. Can Eco-Footprinting Analysis Be Used Successfully to Encourage More Sustainable Behaviour at the Houshold Level?

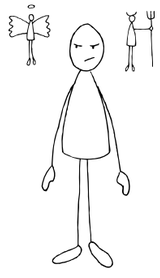




Comfort

Money


Pleasure

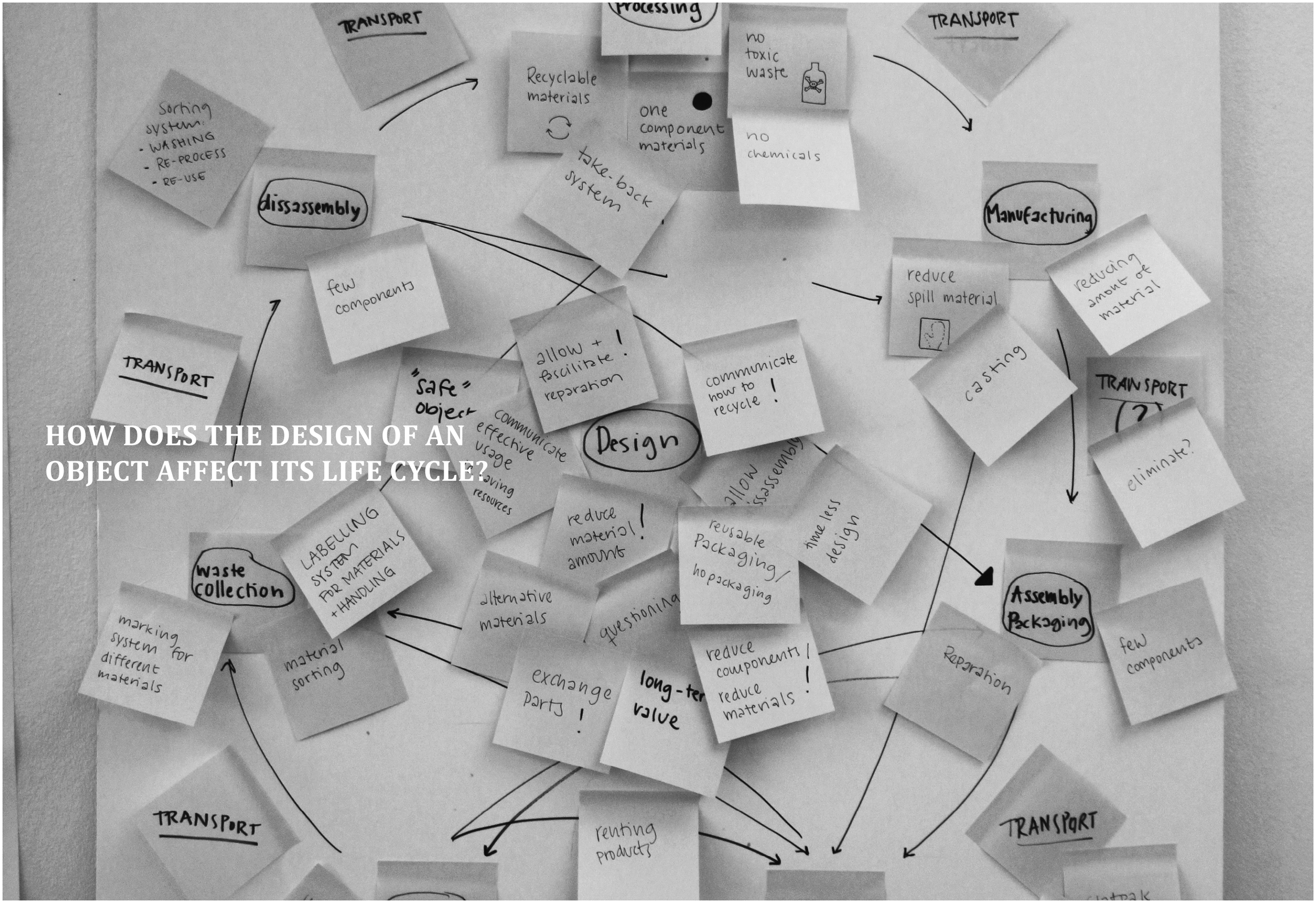


Conscience

# CHAPTER 5

Thoughts and conclusions

# HOW DOES THE DESIGN OF AN OBJECT AFFECT ITS LIFE CYCLE?



# A DESIGNER'S ROLE

*"Designers actually have more potential to slow environmental degradation than economists, politicians, businesses and environmentalists. The power of designers is catalytic. Once a new, more environmentally benign design penetrates the market its beneficial effects multiply. Businesses spend less on raw materials and production and so realize better profits, users enjoy more efficient, better-value products, government and the net gain is an improved environment and quality of life."*[1]

After having collected a lot of knowledge about Eco design, manufacturing and recycling techniques as well as psychological aspects of consumers I felt I had to translate this information into practical guidelines to use when designing a product. Starting to look at the whole life cycle of a product, from the extraction of raw material to disposal of used products, I could map out where and how the design of an object generally affects the different steps during this process. I realised that there are many steps where design can be used to make the process more efficient by i.e. prolonging the usage cycle or eliminating an unnecessary manufacturing step.

I strongly believe that we as designers have a great responsibility for the things we give shape to, and need to make sure they have as little negative environmental impact as possible. As demonstrated in the previous chapters the product life cycle contains many strongly related parts that together determine the environmental impact of a product. The system works like a chain and has to be looked at as a whole for avoiding holes or flaws in the system. In order to do this as designers we need to extend our perspective and understand the whole context that our design is included in. Instead of only focusing on a small part of it, such as the user, the design of a product should be seen as the design of a system including a product. The design process should use the method of creative problem solving with the aim to solve as many problems as possible in the life cycle of the product. Such as harmful material usage, short usage process, complex-manufacturing techniques, inefficient transportation, waste handling etc. These issues are just as important as how to best serve the functional purpose of a product.

"We must enlarge our own areas of knowledge, and at the same time redirect our ways of working."[2]

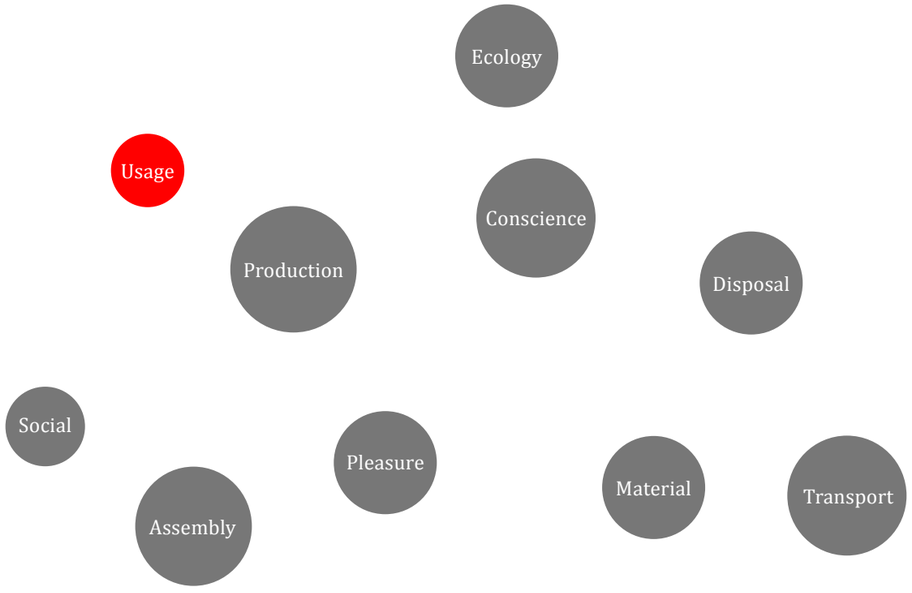
I think it is very important for designer to be able to relate to their work from the environmental point of view to evaluate the importance of a material or a certain shape in relation to its impact. To be able to do this requires a lot of preparation with relevant knowledge and practical experience that is not included in today's education. I think the most efficient and holistic design is created in team collaborations. The work must include various disciplines from which all the technical, social and economic knowledge can be implemented. In such cooperation a specialist, not a designer, would perform calculations of impact. Despite this, I think it is important that designers have a basic understanding of a product's impact. Both in order to communicate with specialists and assimilate facts related to the design of a product. And also because I think that awareness of the impact a product has on our environment will push the designer to actively make decisions to minimize that impact.

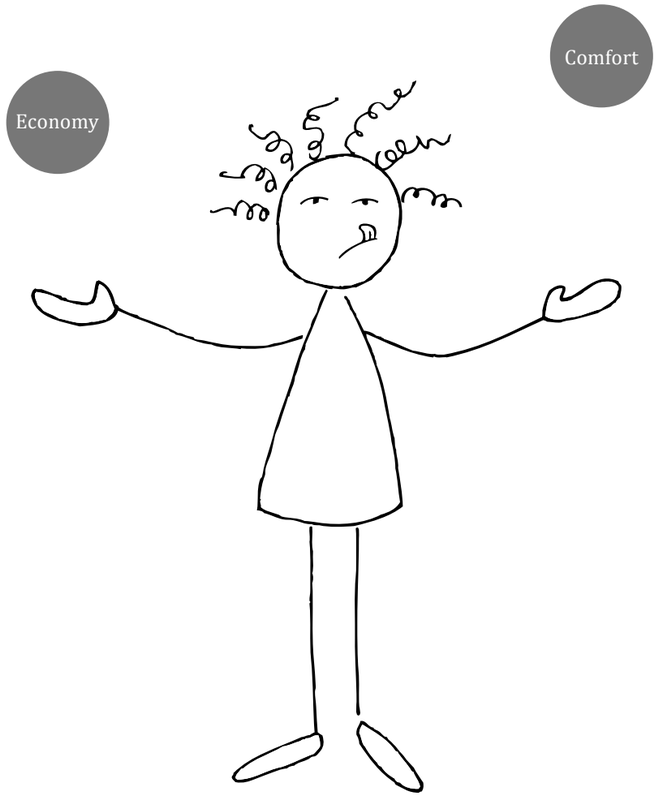
A designer has the unique possibility to affect all the steps in the life cycle of a product, since the whole system is affected by the choices taken during the design process. This gives the designer a unique role compared to the manufacturers, retailers, users etc., and an opportunity to affect both the manufacturing industry and the consumer behaviour towards a less harmful direction.

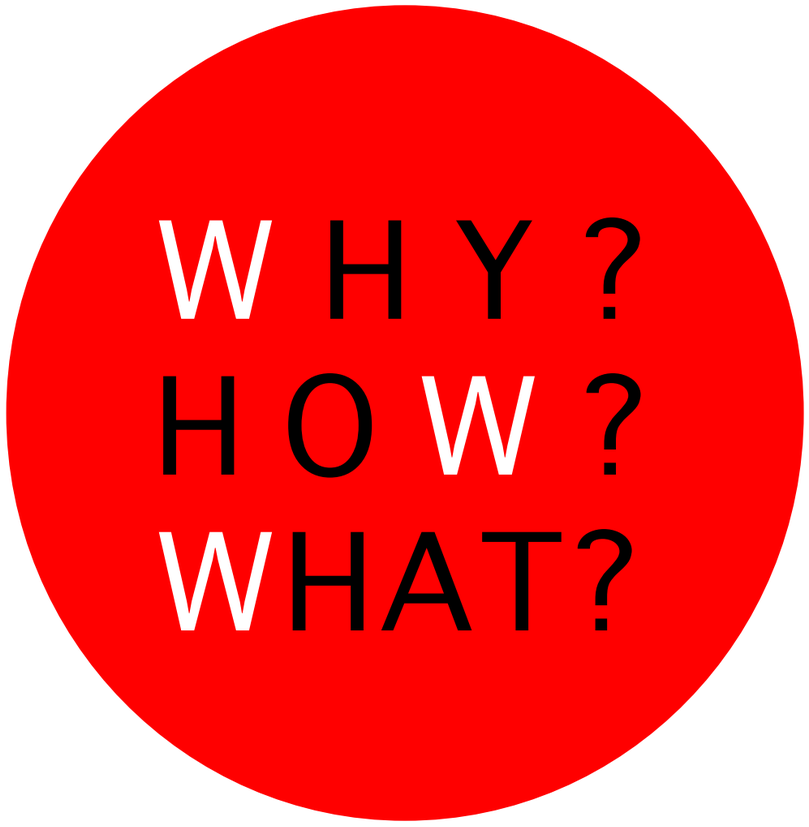
Design is also a tool to influence, shape and strengthen trends. Creating environmentally friendly products and making them attractive can create a greater demand for green products. This demand from the customer puts pressure on producers and retailers to deliver what the consumer desires and thus design can affect the production from different directions, thereby increasing the chances of controlling production in an environmentally more gentle direction.

1. Fuad-Luke, A. (2002) The eco-design handbook – a complete sourcebook for the home and office, Thames & Hudson
2. Papanek, V. (1995). The Green Imperative: Natural Design for the Real World, New York, Thames and Hudson.










# QUESTION TO IMPROVE

## Reduce, Reuse, Recycle

I believe that designers have an enormous opportunity to challenge and change conventional behaviour patterns of production, consumption and usage as a first step towards a more Sustainable design. By questioning I think we can find new ways of solving old problems and find new more efficient solutions. I strongly believe that we need to question the whole system we have created for our selves to be able to reach a sustainable future but in order to do this the problem needs to be broken down into smaller pieces and handled step by step.

As a start I think designers as well as consumers and producers must question the meaning and reason to create or consume another object. By calling on designers to ask questions like; ”Will the design significantly aid the sustainability of the environment? Can it make life easier for some group that has been marginalized by society? Can it ease pain?” etc. Papanek encourages designers to take action against products and projects that they find unethical or unnecessary.[1]

When working with a project the European waste regulations “Reduce, Reuse, Recycle” is a good reminder of what to strive for. In the search for the methods, materials, production techniques etc. with the lowest environmental impact it is important to always remember that this solely will never solve the problem. First and always most important is to minimize the production, usage and therefore the waste of physical objects.

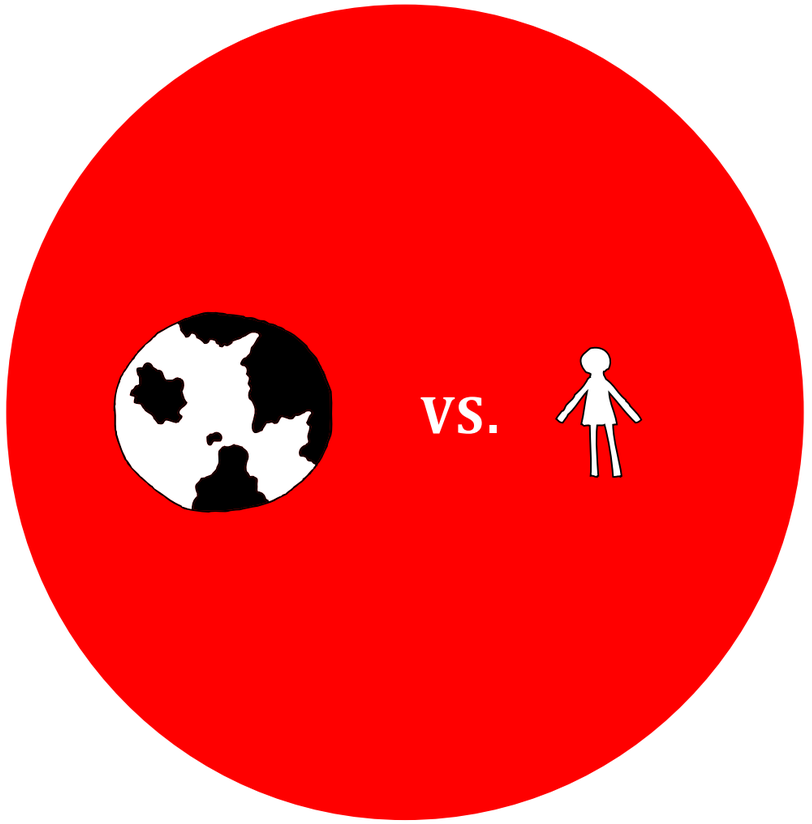
1. Papanek, V. (1995). The Green Imperative: Natural Design for the Real World, New York, Thames and Hudson.

# COMPROMISING

## What is best and for who?

Traditionally design has been used as a tool to stimulate consumption and commercial interests. By using design producers can differentiate their product on the market and potentially make the product more attractive to the buyer, thus selling more products and increasing the economic gain. Designing with economic growth in mind automatically puts the focus on the user, hence the buyer of the product. The best solutions for the one purchasing the product will this way always be the main goal when making choices during the design process.

When adding minimized negative impact as a goal in the process of designing a product the focus must be shifted. In order to design a both functional and ecologically less harmful product all the focus cannot be put on neither the user nor the environment. All materials, production processes, transportations etc. needs to be evaluated from both a functional usage perspective, as well as from an environmental perspective. Designing an eco product will always be a compromise between what is best for the environment in terms of material choice, production method and usage, and what the usage requests. Taking only one of the two aspects into account will either result in an environmentally harmful product or a product to far from what the user accepts.




# ONE SIZE DOESN'T FIT ALL

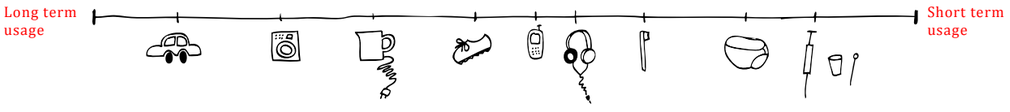
## Avoid general solutions

As demonstrated in the chapter "Eco Design" there is not one method for designing products with less environmental impact, but many. No solution can be applied to all problems, products, situations, scenarios or users. One method or solution is not generally better than another but might fit better for a specific case, just as there is not a "good" or "bad" material. All methods and aspects must be evaluated in every single case to find a suitable strategy for a project. In one case the reparability might be more important and in another it might be the material and production cycle that is essential in order to design a functional and more sustainable product. If it for example is a product that is most harmful during its usage an important goal could be to encourage the user to save resources during usage.

Today many products are produced in large scale and transported all over the world to be used in very different situations and contexts. This method demands many generalisations during the design process and the risk is that the product is "over equipped" or made extra strong because some user might need that function. One example is the mobile phone that today is stuffed with many functions and extra features that in many cases are never being used. This kind of thinking is a great waste with the earths resources and could be avoided if a less general method is applied.

One alternative solution could be applying local production as much as possible, where products are designed, produced and used within the same geographical, cultural and social context, using local resources, production methods and knowledge. This would decrease the diversity of the target group and probably allow more focused design solutions aiming for specific situations and needs.

Another alternative solution could be to integrate the user into the design process in an open source design where products can be customized and adapted to every user's need. This could be done by carefully researching the target group during the design process before designing the product. Or by designing a product that can be altered or changed during its life. One example could be the Smartphone where the user downloads applications to adapt the phone to his or her needs.



# SYSTEM THINKING

## Designing systems

As mentioned in the beginning of this chapter I think it is important to consider the design of an object as the design of a system including a physical object. Thus taking into consideration all processes and cycles that the product affects or forms part of, and view them as equally important. For example not only evaluating a certain shape from a usage perspective but also from the making and handling perspective.

One important system closely connected to a product is the process of making, using and disposing it, referred to as the product life cycle. When designing a product-system with minimized negative environmental impact it is very important to properly analyse this process in order to design the system as efficiently as possible. One way is to apply cyclical thinking with the aim to save the earths resources and minimize waste by bringing back as much of the used material as possible into new production of the same or another product.

Another important system to take into account is the implementation and distribution of the product. This process very much decides the products impact since it includes packaging, transporting and marketing.

The scale of the system surrounding a product varies and system thinking could also be applied to the usage of the product in order to design that process as efficiently as possible. The product category and character decides which systems to analyse and what to take into consideration, but all different systems needs to be taken into account all the time.

## Service systems

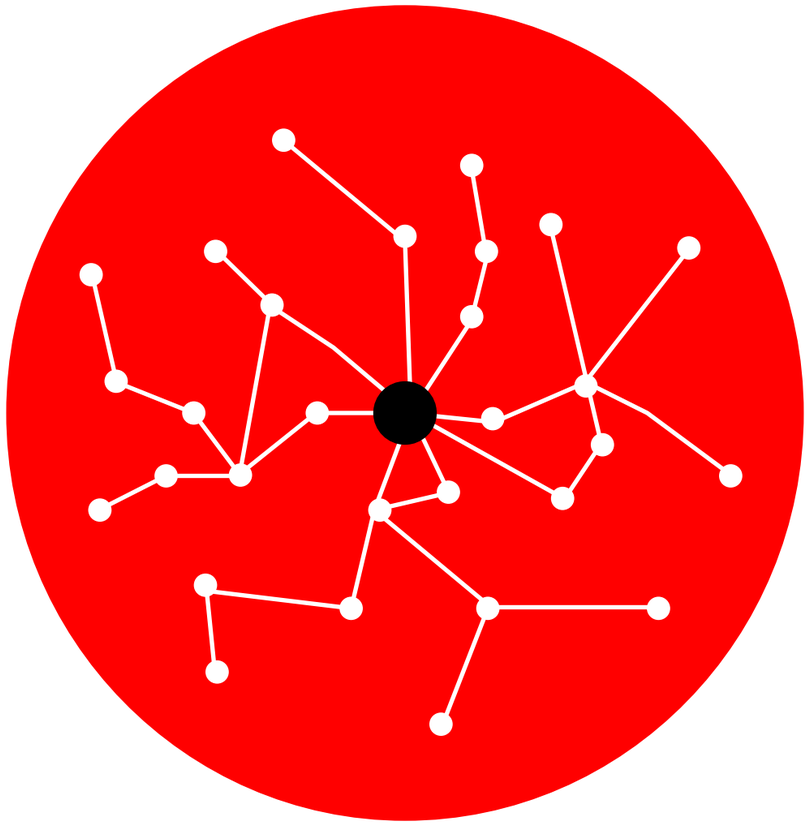
In our society today there is a vast amount of products that is only being used few occasions every year. These products have a great possibility to be shared in a community with neighbours or friends, or rented from a company when needed. In the transition into a more sustainable society an important step to take is to transform the norm owning and consuming into sharing and renting.

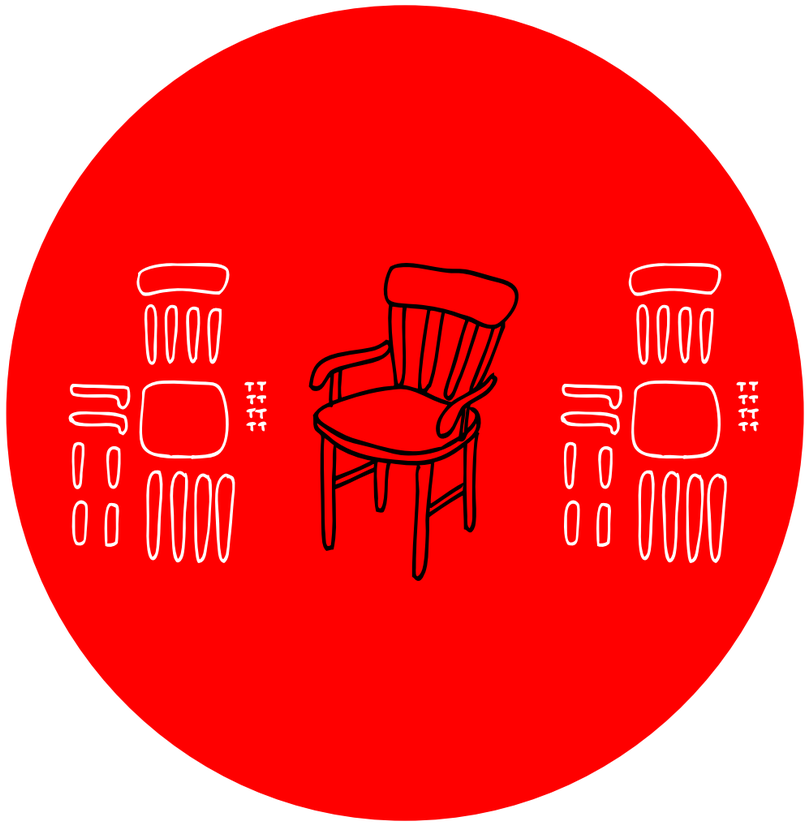
The fact that our society develops into a service society where you rather hire services than consume products, is necessary for us to achieve an ecologically sustainable system. A move in this direction means that in practice we meet people's needs by selling knowledge and solutions rather than physical products.

Say for example that you rent the service to watch TV in your home from a company. For a fee, the company is responsible for delivering your television monitor, installing it correctly and making sure it works properly as long as you want the service. There could be different subscription possibilities with reparation, customisation or upgrading services so that the product suits your current needs all the time.

A good example of product sharing is a local community sharing a car 'pool' in which all individuals have the opportunity to use a car when needed rather than own a car that stands unused for a large part of it's life.

Designing a service would create new demands on products and ways of thinking for designers. How to design a product to be shared by several users instead of owned by one person? How do you make people take responsibility for things they do not own? If the producer owns the products they produce and only rent them to the customer for a certain amount of time, an incentive for producing products that last longer would automatically be created. This would probably include larger focus on maintenances, longevity of parts and upgradability when designing products.





# DESIGNING AN OBJECT WITH LONG LIFE

## Take-apart design

The aspect of Take-apart design or Design for disassembly (Dfd) is a crucial part in cyclical design thinking. This means constructing products so that they can easily be taken apart and turned into several components. Many products are build up by components made from different materials which need to be separated to prolong the life of the product and bring back used material into re-production. A quick and easy disassembly of a product brings many positive aspects such as replacement of parts to upgrade the product, optimizing space during transportation or separating the materials for recycling. These separations could, depending on the product kind be performed by a specialist or by the user. To further involve the user in the assembly of their products could lead to giving the product greater value for the user, because he or she was engaged in the “creation” of the product. By using standardised screws and parts and thus allowing simple repairs to bee performed by an amateur, the user can take more control over their possessions. Such feature would encourage the user to take care of the product instead of buying new when something breaks.

The process of separating the material components has to be efficient and easy to be worthwhile for the user and to not slow down the recycling process. One way to aim for efficiency in the disassembly phase and also in the production process of a product is to reduce the amount of components. But in order for the single components in a product to be recyclable it is important to strive for components made from pure materials.

## Transparency

Communication and education is a crucial part in the transition into a more sustainable society. As mentioned in the chapter about human behaviour, information about how to minimize ecological footprints make people improve their life style. Thus knowledge makes people act. Informing the user about where the product comes from, how and where it is produced, how it should be used most efficiently, how and if it can be repaired, customized or altered and finally how to recycle or dispose it would probably have a similar positive effect. Such information would include rather than exclude the user in the design of an object and encourage him or her to take care of the product. A larger understanding of and awareness about how products are made would probably also be achieved and maybe make the person think twice before throwing away fully working stuff. When knowing more about the process and system surrounding an object the customer is forced to make more conscious choices.

In a product designed with the take-apart principle instructions about how to assemble and disassemble the product are crucial. As well as clearly showing what kind of material the different components are made from and how to recycle or dispose them. The shape itself also has to encourage the user to actually take them apart by clearly communicating that “ I am separable”. In a product that consumes resources during usage it is important also to communicate how the user can minimize consumption of resources when using the product.

# CHAPTER 6

Challenge

# APPLYING MY THOUGHTS

## Optimizing a specific system

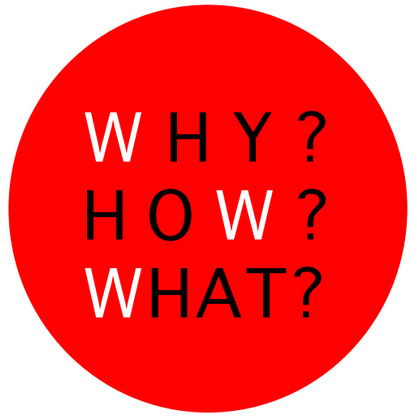
After reaching these important conclusions “A designers role, Question to improve, Compromising, One size doesn’t fit all, System thinking and Designing products with long life” I realised that I would need to find an existing product or product area to apply my thoughts to. I wanted to put my thoughts into practise and challenge myself to find a more efficient way of producing, using and disposing a specific everyday product, and the system around it. It may be easy to write about these methods and strategies but putting them into practice is extremely complicated. I understood that to fully investigate, understand and communicate these aspects I would simply have to intend doing that; putting my conclusions into practice by optimizing a specific product system.

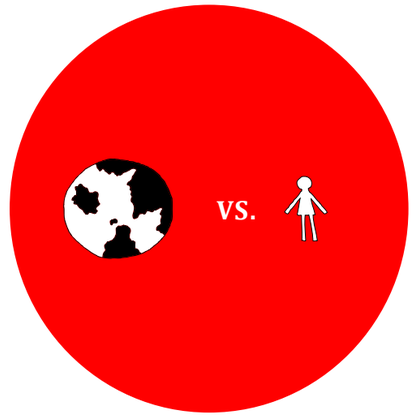
**What could be a suitable product category?**

The chosen product category would work as a tool to analyse the need, production process, usage, system, distribution, implementation, communication and disposal, of a product, from an environmental point of view. The product necessity would have to be justified from a sustainable point of view and be feasible within the time frames of the project. Another important aspect is the complexity of the product. The product should neither be too complex, with many components, materials and usage aspects, nor too simple, to be a suitable challenge for the project.

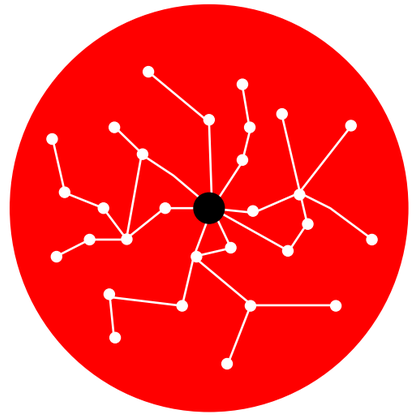
**Phase 1 – Zoom out**
What can I as a designer do to minimize the environmental impact of products?
The basic aim with the project is to explore and analyse methods and aspects within Eco design to inspire and motivate myself for my future as a professional designer. Research and analysis should lead to a final conclusion and a concept for ecological design. An understanding of materials, production and recycling processes from the environmental point of view is a very important part of the project.

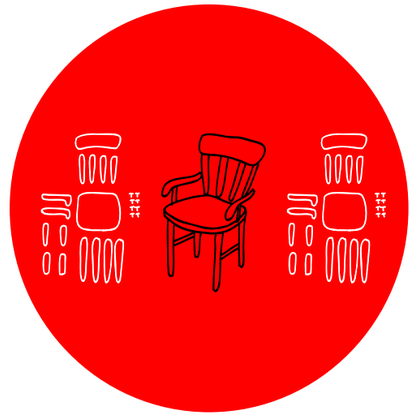
**Phase 2 – Zoom in**
When the concept method is defined it should be tested on a real example by applying these aspects on a simple everyday object. In the design of the object the main focus will lye on its cyclic material flow and the environmental aspects.

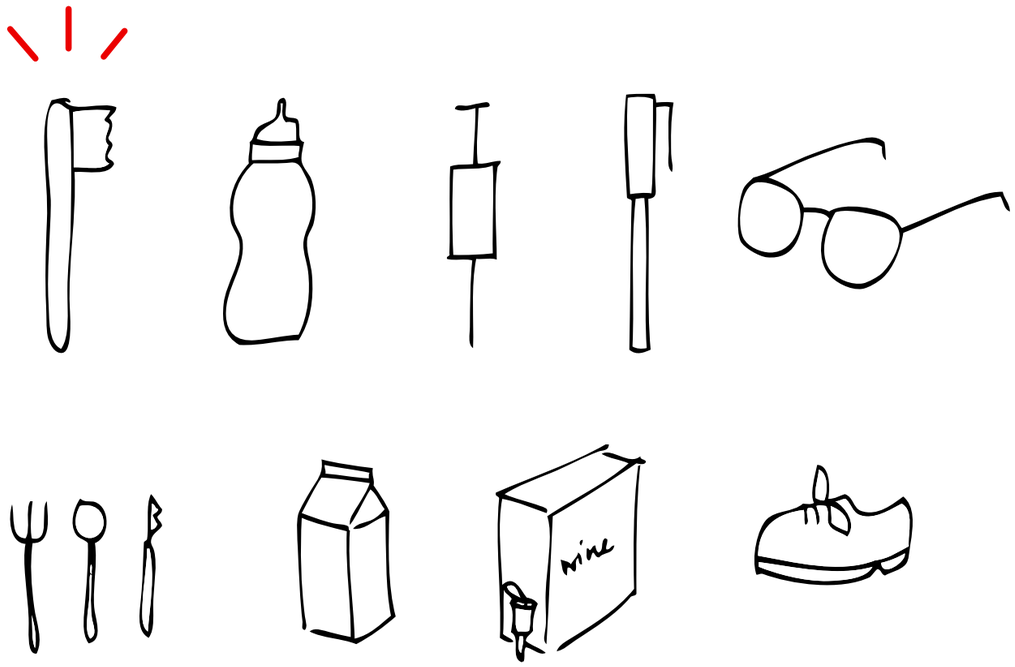


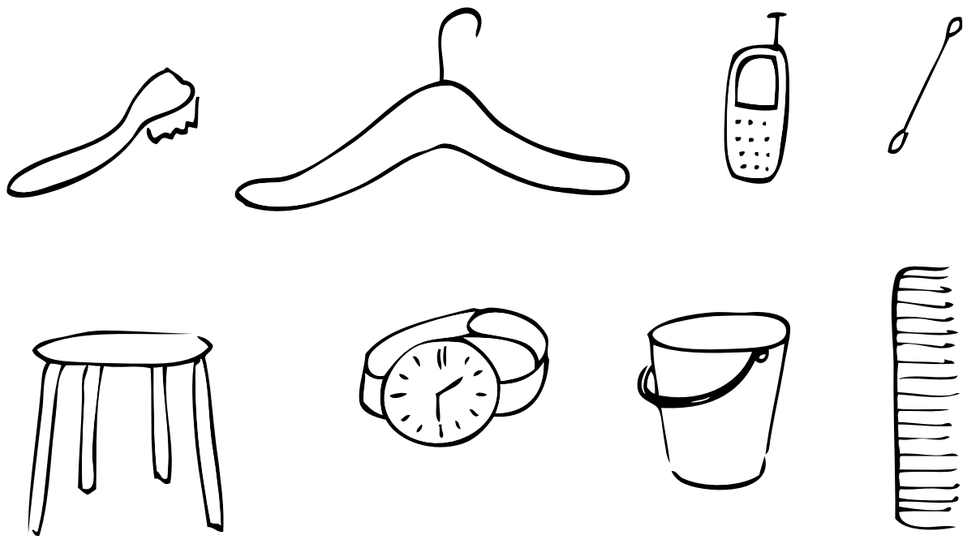





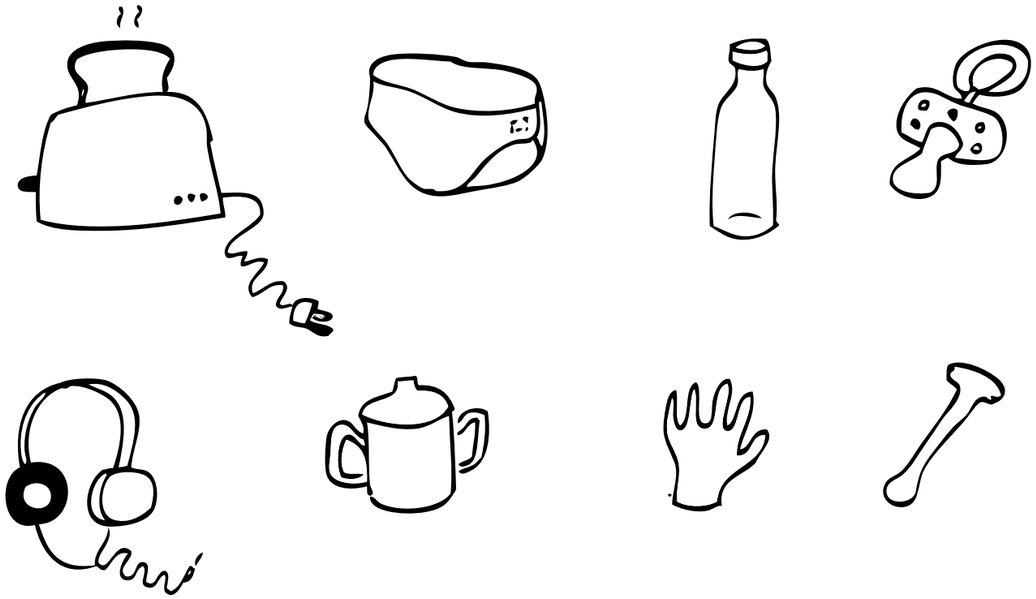


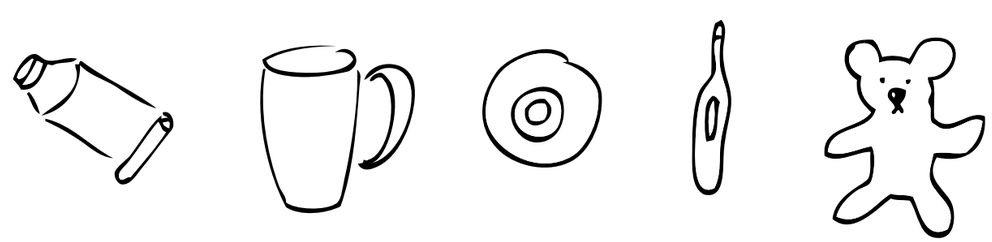




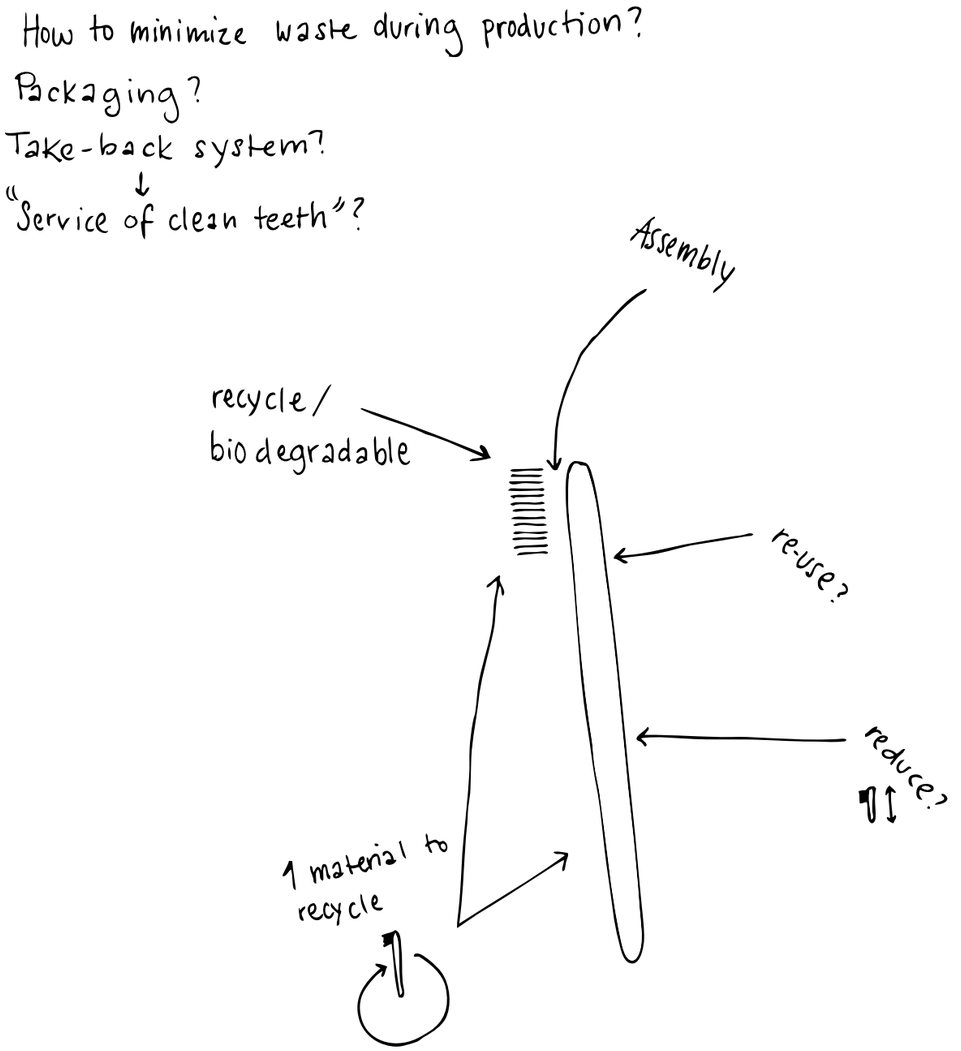



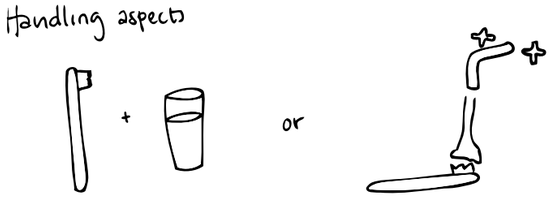






When searching for a suitable product category I decided to work with an everyday product with a short life cycle to mainly focus on the aspect of cyclical production and material handling. The product necessity determined the final choice.




Why?

Moves fast in cycles

re-use, recycle } EU regulations

Components with different function

Assembly aspect



# PRODUCT CHOICE

## Focusing on the life cycle of a toothbrush

The toothbrush is interesting from many points of view for this project. It is a common everyday product with a short life cycle, which means there is a great need for take-back systems and cyclical production. The product necessity is justified from a sustainable point of view, as people need to maintain basic mouth hygiene. The toothbrush is recommended all over the world for preventing mouth and teeth problems to maintain a basic public everyday health. A central aspect to consider when working with a toothbrush is the hygiene aspect in terms of user acceptance and behaviour. Where is the convenience barrier for the user?

The product complexity is also suitable for this project since the toothbrush contains different material components with different functions. Components that could be analysed with different Eco design methods such as; re-using, recycling, monomaterial, design for disassembly (Dfd), biodegradable materials, reducing material etc. Together with the conclusions from the research and reflective phase these aspects will be investigated to find out how the life cycle of a toothbrush can be made more efficient and more environmentally friendly.

# ZOOM IN

Phase 2

# CHAPTER 7

Zooming in on a toothbrush

# ZOOMING IN ON A TOOTHBRUSH

## A holistic approach

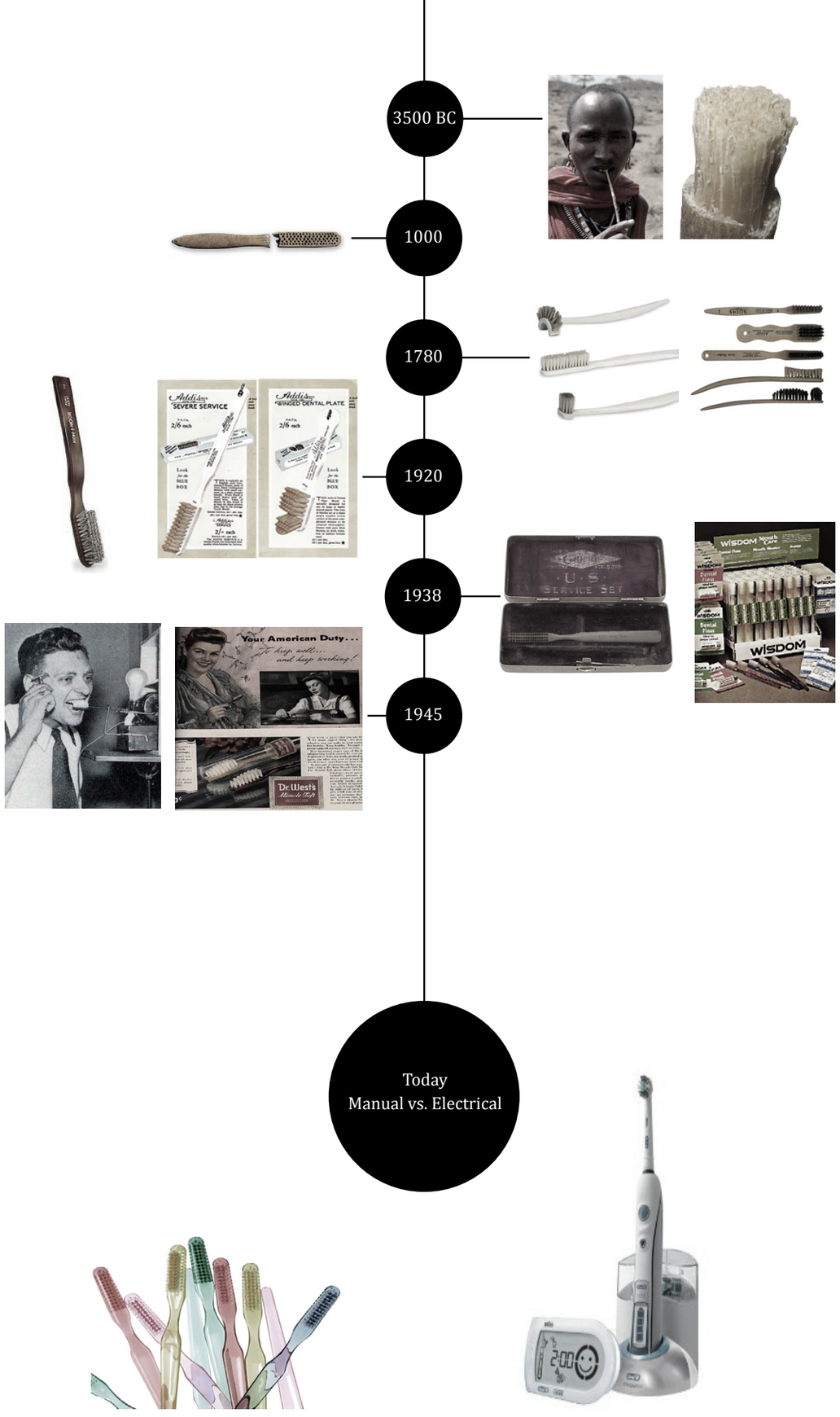
For the second part of the project I chose to focus on the toothbrush. It is important to understand what parts and aspects of the toothbrush that this project lays focus on.

In a previous project about dental hygiene I was investigating the difference between an electrical and manual toothbrush. All the demands and focus points in both the result and the process were about the user and how to clean teeth in a proper yet more sustainable way.

With this in mind I chose to focus this project on totally different parts and aspects of the same object, the everyday teeth cleaning tool.  The focus was how to optimize a product life cycle from a sustainable point of view including material, production, distribution, usage and disposal. The task was to analyse material processes and behaviour aspects and investigate how it could be changed.

Since the initial question in this project was about how to minimize the impact of products mainly from a material, production and system point of view, I decided to analyse how to optimise the life cycle of a physical toothbrush instead of questioning the toothbrush as an object.

**What are the limits and possibilities?**
**What do people accept in terms of communication, economical aspects and convenience?**




# PREVIOUS KNOWLEDGE

## Project about dental hygiene

Before analysing how the concept of a toothbrush could be done differently it is important to understand the product and the need it is fulfilling. Therefore I went back to go though my previous project and collect the most important conclusions and knowledge for this project.

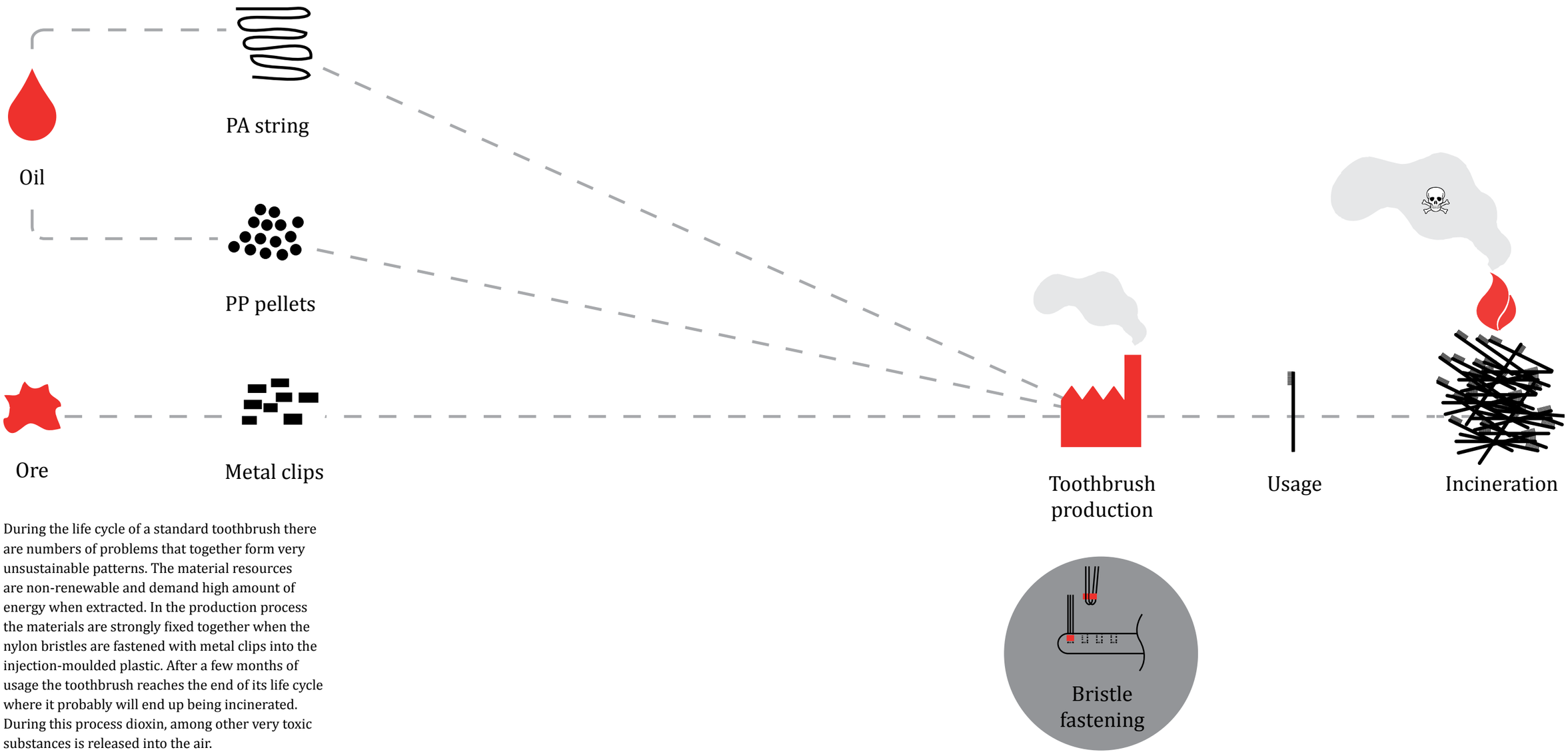
The most important points to bring into this project from the previous research are toothbrush history, market analysis and a comparison between the manual and the electrical toothbrush. In the previous project the goal was to design a manual tooth-cleaning tool that could compete with the efficiency of the electrical toothbrush. To do this a research and analysis about user behaviour and usage had to be done. Because of this in depth investigation in my previous project I felt I was ready to step away from that part and look at the environmental aspects of the toothbrush.

**Toothbrush history**
Oral cleaning dates back to 3500 BC in various cultures. The first example is a natural wooden stick where one end served as a toothpick and the other as a brush-like tool. 1000 years ago in China tools looking much like ours today were produced in ivory and horse hair. Throughout the history many shapes have been tried with pinch bristles and bone handle. The first nylon toothbrush was introduced 1938, which increased the hygiene substantially. In Europe the habit of using toothbrush started earlier than in the US, where the soldiers brought it back as an experience after the Second World War.

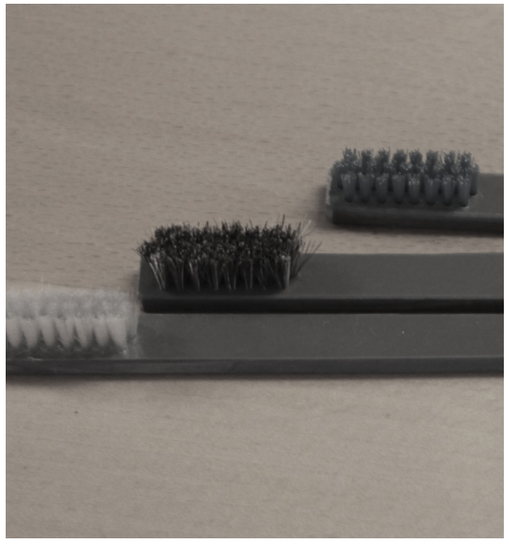
**Manual vs. electrical teeth cleaning**
Today most manual tools for teeth cleaning are products for single or short time use. Many of them are very simple and only offer the most necessary functions for basic cleaning. Products designed for longer usage are often more complex and include electricity consuming functions. The majority of the electrical products offer information and guidance for complete and correct cleaning. During my previous project I was in contact with a professional dentist and learned that the biggest difference between the manual and the electrical toothbrush is the level of concentration. When using an electrical tool in the mouth people automatically concentrate more.

# LARGE SCALE TOOTHBRUSH PRODUCTION

From cradle to grave




During the life cycle of a standard toothbrush there are numbers of problems that together form very unsustainable patterns. The material resources are non-renewable and demand high amount of energy when extracted. In the production process the materials are strongly fixed together when the nylon bristles are fastened with metal clips into the injection-moulded plastic. After a few months of usage the toothbrush reaches the end of its life cycle where it probably will end up being incinerated. During this process dioxin, among other very toxic substances is released into the air.





# SMALL SCALE BRUSH PRODUCTION

## Visit to ML Borstteknik AB

To learn more about how brushes of different kinds are produced, I visited ML Bortsteknik in Onslunda in the south of Sweden. ML Borstteknik has long history with brush manufacturing and they produce both specially ordered products in small amounts, and products for their own range. To be able to meet every customer's special needs they are very flexible in material and manufacturing techniques. They produce products both in a traditional way by hand with natural materials, and with modern computer based machines in synthetic materials.

**Brush materials**
During my visit I was shown different materials and production techniques. We also discussed the positive and negative aspects with different materials in relation to my project.

The most suitable natural materials for toothbrush bristles are animal hair of different kind. Horse or cow hair is a very durable and hardwearing material that is cut directly from the living animal. Cutting it does not harm the animal since it grows back out again and doesn't affect the animal's health. The material has different characteristics depending on the animal. The horsehair is less soft than the hair from the cow, and very soft bristles can be made from goat hair. An important aspect to consider about animal hair for use in a toothbrush is the hygiene aspect. The animal hair is greasy and tends to be hard to clean which makes it less suitable for a product to have in the mouth.

A vegetable material often used in brushes is fibre from the Aloe Vera plant. The Aloe Vera plant is an all-round plant where both the liquid and the hard parts form the plant is used for different purposes. The fibres are less suitable for a toothbrush since they are very stiff and would damage the mouth. Other vegetable fibres like coconut fibres and fibres from sorghum are also to rough for the mouth.

Synthetic brush materials like nylon or PP have many benefits when compared to natural materials. For a product such as the toothbrush where the hygiene aspect is crucial nylon is definitely superior. Nylon can easily be cleaned and disinfected and can be found in a variety of hardness, resilience and thickness.

## Handmade vs. machine made

Just as with the brush the handle can be made in both natural and synthetic materials. For a toothbrush in natural material the absolute best material is beech. Beech is the only wood kind that is certified to use for hygiene products in Sweden because of its antibacterial capacities. Beech is for example used in ice cream sticks and tooth sticks because it does not give taste or splinters and can withstand contact with water. However synthetic materials are often more suitable for hygienic products since plastic material is easier to clean.

Machine production can be applied to both synthetic and natural materials. Handmade brushes are mostly done in natural materials according to the tradition but the technique could be applied to any kind of material.

Regardless of choosing a handmade or machine-punched brush the pattern of the brush clusters can be designed in different ways such as in rows, circles, zigzag, angles, et cetera. All of which will affect the functionality of the brush.



# MARKET - ECO TOOTHBRUSHES

## Natural materials

**Miswakstick**

**Econess:** Naturally produced stick
**Material:** Unknown plant
**Packaging**: Plastic
**Communication:** Natural look
**Source:** Made USA[1]

**Naturborsten**

**Econess:** 100 % natural / renewable / biodegradable materials
**Material:** sustainably harvested beech wood handle with vegetable oil + bristles form pighair
**Packaging:** cellophane wrapping with unknown clip
**Communication:** Natural look
**Source:** Made in germany[2]

1. http://www.miswakstick.com/home.html
2. http://myplasticfreelife.com/2011/05/eco-friendly-toothbrush-review-and-giveaway/
3. http://vitacareworld.com
4. http://www.preserveproducts.com/
5. http://www.yumaki.com/product/7



## Recycled materials

**Vitacare**

**Econess:** 100% recycled and biodegradable materials
**Material:** "(like yogurt containers and ketchup bottles)"
**Packaging:** Printed cardborad and plastic
**Communication:** Not very communicative
**Source:** Unknown[3]

**Preserve**

**Econess:** 100% Recycled materials / take-back system
**Material:** Handle 100 % recycled yoghurt cups, bristels virgin nylon
**Communication :** Comunication on package (travel bag)
**Packaging:** Reusable travelpack in clear plastic
**System:** Agreemen with companys to recycle their yoghurt cups, turn them into toothbrush handles, send them by mail to the customer (If wanted in a subscription service), getting them back from the customer in a return envelope and sending the used brushes to an outdoor furniture company.
**Source:** Made in USA[4]

**Yumaki**

**Econess:** Recycled materials / take-back system - biodegradable?
**Material:** Handle unknown recycled materials, bristels virgin nylon
**Communication:** Comunication on package (travel bag)
Packaging: Reusable travelpack in clear plastic
**System:** Sent by mail to the customers all over the world. Yearly subscription service is provided and the customers are encouraged to send back their used brushes. For 3 back the customer recieves 1 new.
**Source:** Produced in Vietnam[5]

## Reusable handle & Replacable head


**Wisdom**

**Econess:** Durable / Long lasting handle / Replacable head
**Material:** Wood / Metal / Plastic
**Packaging:** Printed cardboard
**Communication**: Exclusive
**Source:** Project by Design student Kirk Summers[1]

**Source**



**Econess:** Bio-plastic / Replacable head
**Material:** Recycled dollar bills, wood or flax blended with 100 % recycled polypropylene
**Packaging:** Unknown
**Communication:** Exclusive - different
**Source:** Unknown[2]


**Econess:** Replacable head
**Material:** unknown
**Packaging:** Printed cardboard and plastic
**Communication:** Not very communicative
**Source:** Unknown[3]

1. http://monkeyzen.com/2011/06/cepillo-de-dientes-eco-friendly
2. http://familyfocusblog.com/tag/eco-friendly-toothbrush/
3. http://www.pristineplanet.com/natural-toothbrush-recycled-toothbrush-eco-friendly-toothbrush-organic-toothbrush-natural/toothbrushes/25117_a_0.html
4. http://myplasticfreelife.com/2011/05/eco-friendly-toothbrush-review-and-giveaway/
5. http://www.lavishandlime.com/Compostable-Ecobrush-Toothbrush-p-1200.html
6. http://www.usimprints.com/store/custom-toothbrushes-toothpaste-promotional/product/eco-green-eco-friendly-biodegradable-adult-toothbrush/



## Biodegradable / Compostable


**The environmental toothbrush**

**Econess:** Mostly plastic free and compostable toothbrush and packaging
**Material:** Bamboo handle + Nylon 4 bristles
**Packaging:** Cardboard with black ink + unknown material in bag
**Communication:** Natural look
**Source:** Designed in Australia - Made in China[4]

**Compostable ecobrush**

**Econess:** 100% Compostable / Biodegradable
**Material:** Starch based resin with renewable crops like corn, wheat, tapioca and potatoes
**Packaging:** Printed cardboard with plastic
**Communication:** Neutral look
**Source:** Unknown[5]

**Eco green**

**Econess:** Biodegradable
**Material:** Polypropylene handle with unkonown additive
**Packaging:** Individually cello-wrapped
**Communication:** Green - eco look
**Source:** Unknown[6]

# CONSUMER ATTITUDES

## Survey about aesthetic preferences

After learning about how toothbrushes are produced and what kind of eco toothbrushes that can be found on the market today I was interested in finding out how people in general think when buying a toothbrush. On the market today I found four different categories of toothbrushes based on their material source, usage time and function (natural materials, recycled materials, reusable handle & replaceable head and biodegradable / compostable). This is of course only one way of categorising the market and when instead doing a visual comparison two extremes where found; the toothbrushes that took like any other toothbrush, and the toothbrushes strongly communicating that they are eco friendly.

After this observation I was interested in finding out what aesthetic expression people generally prefer when buying eco friendly products and toothbrushes. In order to make a small comparison I created a survey containing six questions both regarding everyday eco-awareness and some more specific questions treating the toothbrush choice. The questions where carefully selected to get and overall impression about the eco-aware behaviour and how it is connected to the choice of toothbrush. The survey was mainly sent to other young persons in a similar life situation as myself. This has probably had and affect on the result and the credibility of the survey. But still so the result allowed me to get a broad understanding about how and why people choose a certain kind of toothbrush.

One important conclusion from the survey was that the contestants generally where quite environmentally conscious and many where performing the majority of the activities in question nr one. The two most performed activities where; turning off the water when brushing (78,8 %) and recycling everything that can be recycled in the garbage (59,1 %), while the other four aspects where performed by 30,3 % - 56,7 %. On question number two where the contestants where asked if they wanted an ecological product to express “eco-ness” 53,7 % said yes, and 46,3 % said no. Some of the reasons for answering yes on this question where about spreading awareness, being more beautiful and distinguishing it next to conventional products. The reasons for answering nowhere about not wanting to show off and that an ecological look can create suspicions. When buying a new toothbrush quality seems to be the most important aspect for the decision, after that comes aesthetics and price and least important is environmental friendliness. Question number four treated a choice between two equally environmental friendly toothbrushes with different aesthetic expression. Here 52,9 % of the contestants would choose the plastic one because it feels more hygienic and functional, while 40 % would choose the wooden one mainly because of aesthetics. 33,3 % of the contestants would be willing to pay more for an environmentally friendly product and 59,4 % to buy a more simple product. 62,9 % of the contestants would like to have a subscription service for receiving a new toothbrush and sending back the old one.

The answers from the survey helped me to gain a general understanding about what people want in terms of environmentally friendly toothbrushes, and worked as a base for decisions taken later during the project.



**1. Do you do any of the following?**

- Always turn off the lights when leaving an empty room?
- Recycle everything that can be recycled in your garbage?
- Turn off the water when brushing your teeth?
- Avoid the water running when doing the dishes?
- Buy ecological food?
- Prefer to buy clothes either second hand or ecologically produced?

**2. If buying an ecological product do you prefer the product to visually “express eco-ness” (ecological feeling)?**

- Yes
- No

**3. When you buy a new toothbrush what determines your choice?**

- Price - the cheapest one
- Quality - that it’s a really good toothbrush for my teeth
- What ever - I don’t really care, I just buy the first one I see
- That it’s environmentally less harmful i.e. exchangeable head, biodegradable, locally produced etc.
- Aesthetics - that it looks nice

**4. Which one of the two toothbrushes above would you choose if the price and quality was the same as your previous toothbrush, if they where both equally environmental friendly?**

**5. Would you be willing to do any of the following for buying an environmental friendly toothbrush?**

- Paying more
- Buying a ‘simpler’ toothbrush with less features
- Neither of them

**6. Would you like having a toothbrush subscription where you get your toothbrush sent to your home buy mail when it’s time to change? And where you send your old one back in a prepaid envelop?**

- Yes
- No

# CHAPTER 8

Visualisation

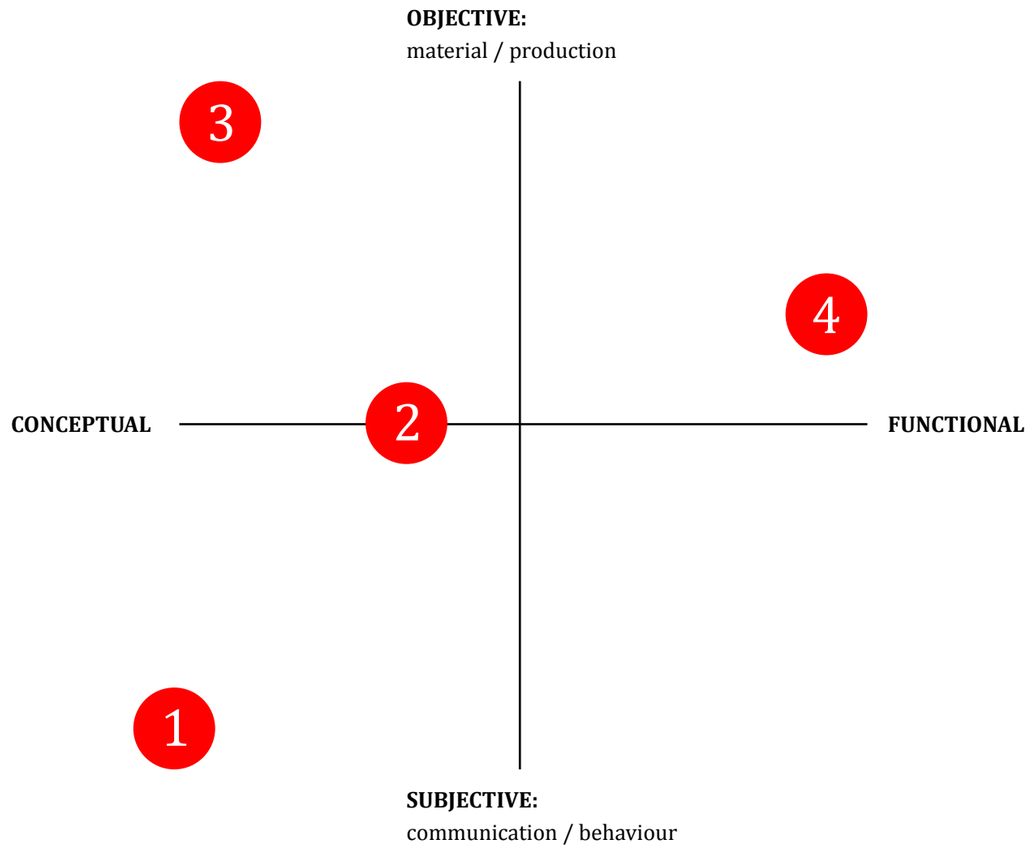
# VISUALISATION

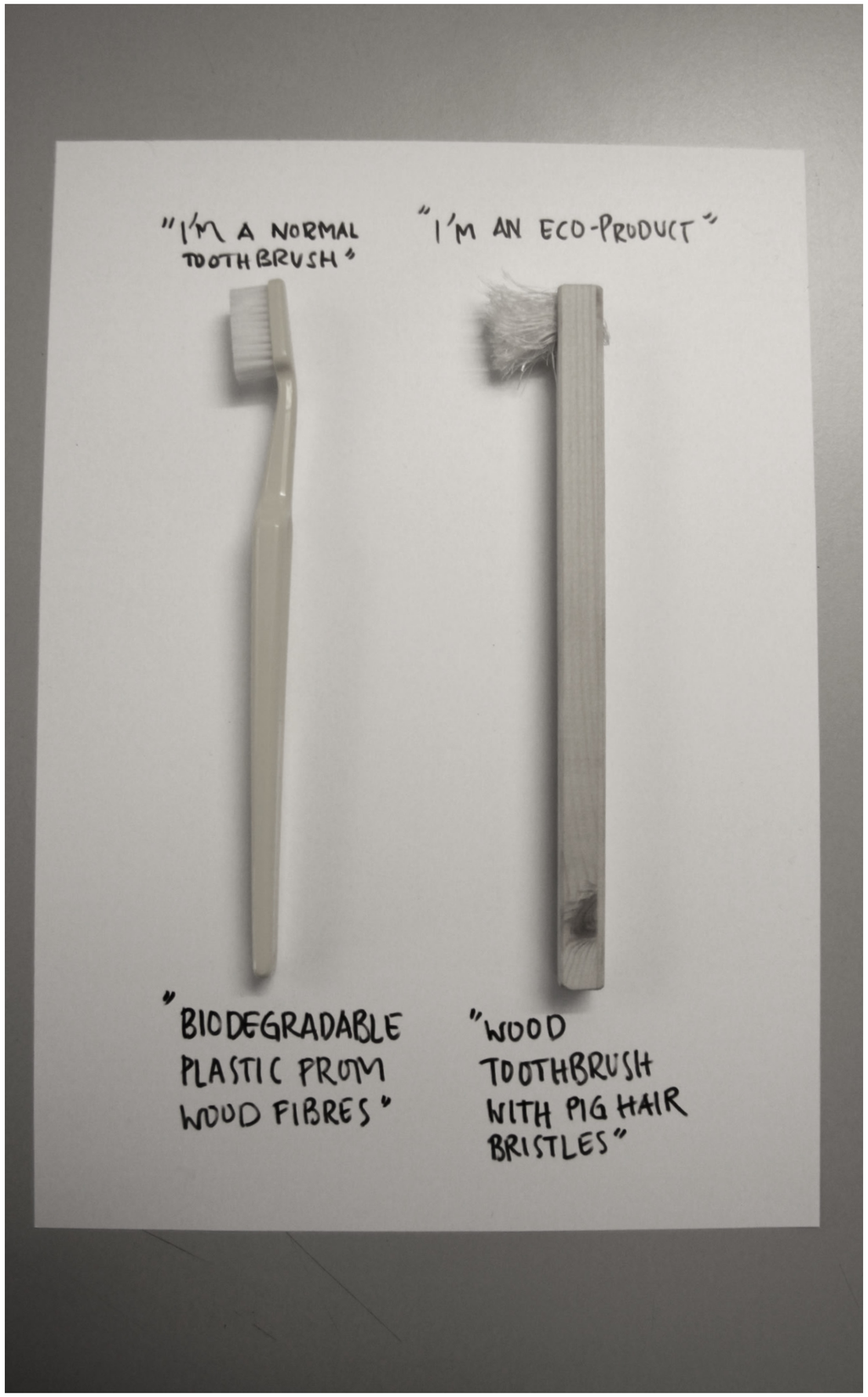
## What is a sustainable toothbrush?

After having collected a vast amount of research and conclusions at both big and small scale it was important to find a suitable method for visualising my project. Because of the many layers of conclusions, understandings and facts I had to find a very holistic method for it to give justice to the project. Not only had the project been about understanding how the design of an object can minimize negative environmental impact but also about finding out what my design philosophy is, and what I as a designer can do. To capture and communicate such a broad topic in a good way seemed impossible. Yet I realised I had to try.

In order to present my research and conclusions in a good way I felt it was important that the end focus would not appear as the one and only truth. Rather I wanted the visualisation to be an example of a way of thinking and to demonstrate the complexity in putting sustainability into practice. I wanted it to be obvious that the visualisation was a next step in my process of conclusions, but not the last one. That it was just a way to practice what I had learned and to open up for discussion with other people.

Four concepts where developed in chronological order, all with slightly different approach; conceptual vs. functional and objective vs. subjective. After coming up with one concept and realising that it wouldn't give justice to the project, the next one was found.  In that way conclusions from the previous one gave birth to the other. Until a suitable visualisation method was created.








# CONCEPT 1

## Eco communication

Inspired by the analysis of existing eco toothbrushes and the results from the everyday eco-awareness survey I wanted to visualise the ambiguousness and difficulty with the communication aspect.

Without telling anyone what is right and wrong I would design two toothbrushes that were as equal as possible in all the life cycle aspects, the only thing that would differentiate them would be the physical appearance.

Asking the question - “Which one would you like to use if the two were equally environmental friendly?” I would aim for discussion about the eco-aesthetics today and bring in the problem with green washing (products that appear as environmentally friendly but are not).

Thinking a bit further I realised this concept would be too superficial for my project. The communication part is only a small fraction of all the research done and I felt this realisation would not do the project justice. Therefore I decided to not go further with this concept.

# CONCEPT 2

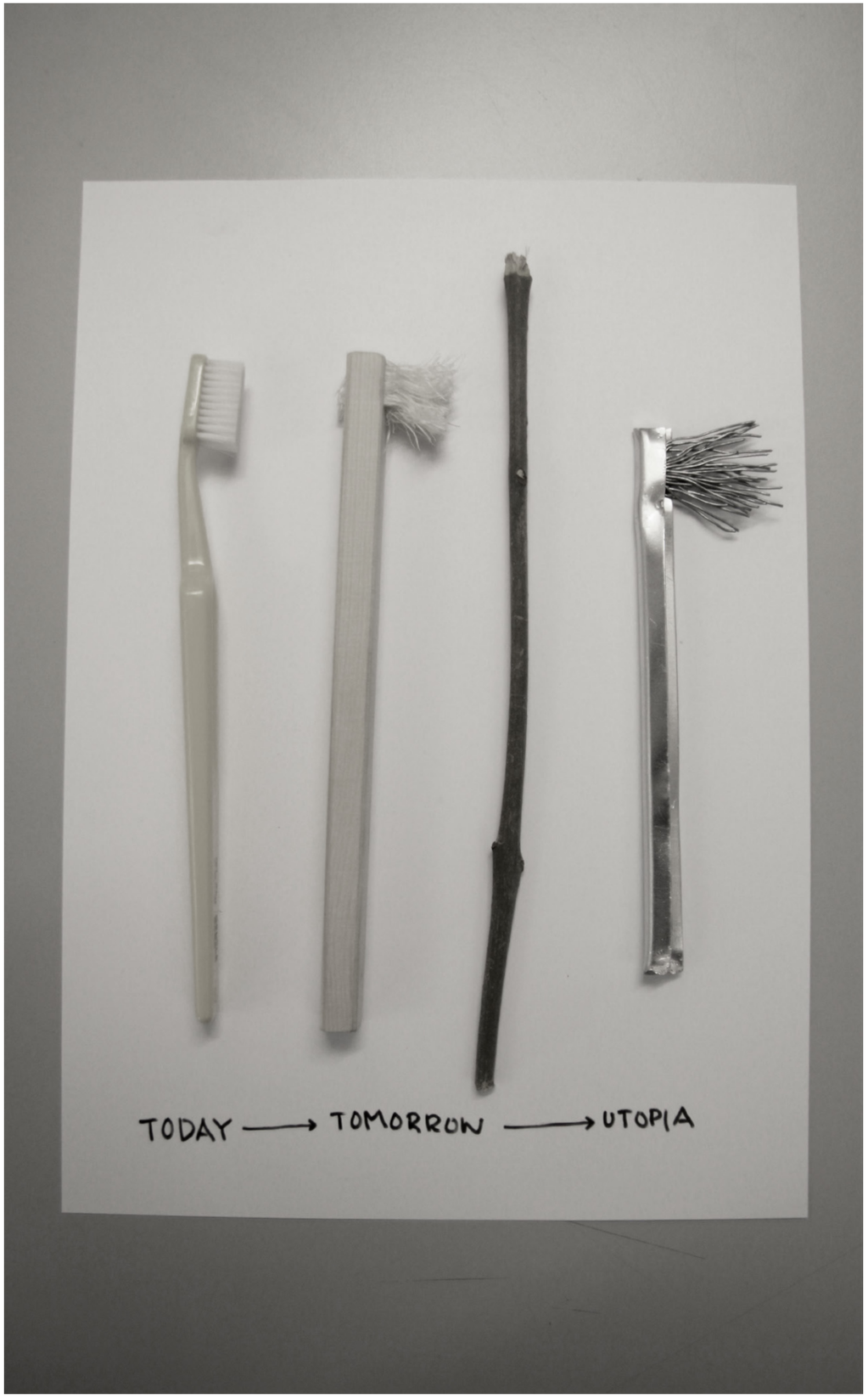
## The toothbrush evolution

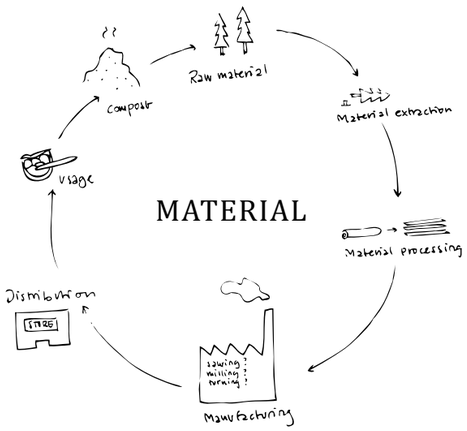
This concept shows the way towards the “toothbrush utopia”, the perfect toothbrush focusing only on environmental aspects. What does the “utopia toothbrush” look like? Would it be accepted? What is accepted today? And how could we get there step by step?

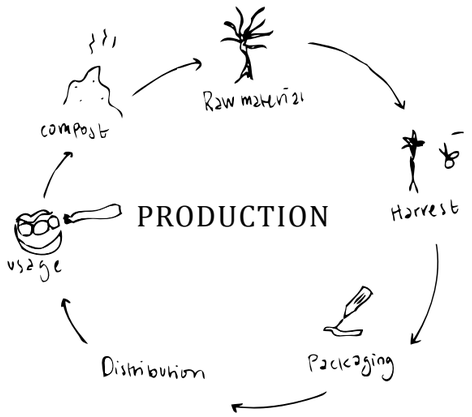
**Today**
Looking at the market of eco-toothbrushes today we find many examples of attempts to offer the customers a more eco-friendly choice without sacrificing the comfort ability. By using more or less efficient methods with recycled, biodegradable or natural materials, my opinion is that these products only do a small effort in actually being more sustainable. I dare to say that many of these products could almost be comparable with green washing since the most important thing they do is making people aware.

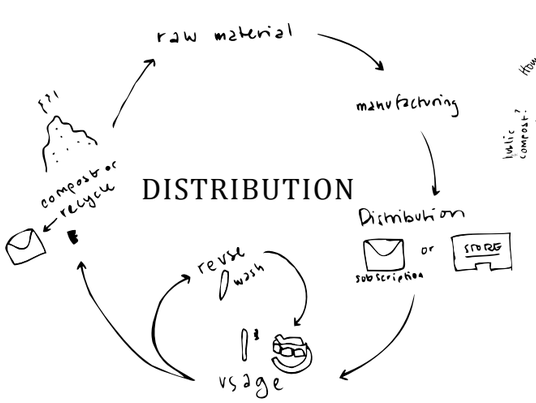
**Tomorrow**
When the level of awareness is raised I think people overall will be more willing to act as long as it doesn’t stretch to far beyond their hygiene and comfort barriers. Looking at the results from the survey everyday eco-awareness people are already today willing to both pay more and purchase a simpler toothbrush than the common ones today. With these two conclusions in mind we could probably expect tomorrows toothbrush users to act more sustainable when the right information is provided. How would a toothbrush look for this target group?

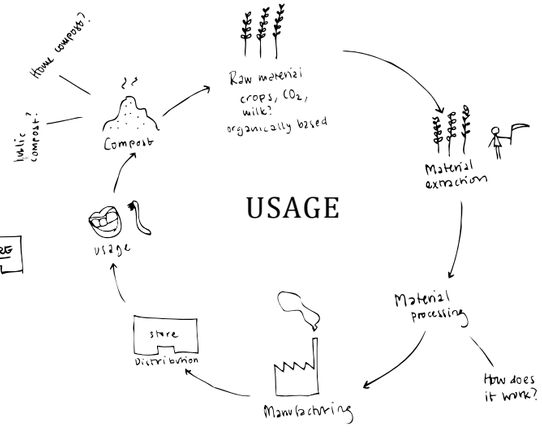
**Utopia**
How would the absolutely perfect toothbrush look from an environmental point of view? Would it even exist? The perfect toothbrush is relative and would probably depend on what aspects you look at. This thinking led me into the third concept.

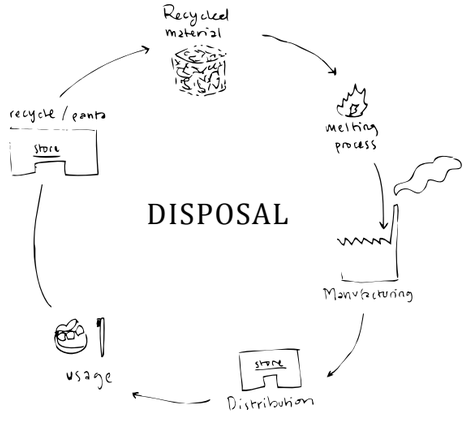




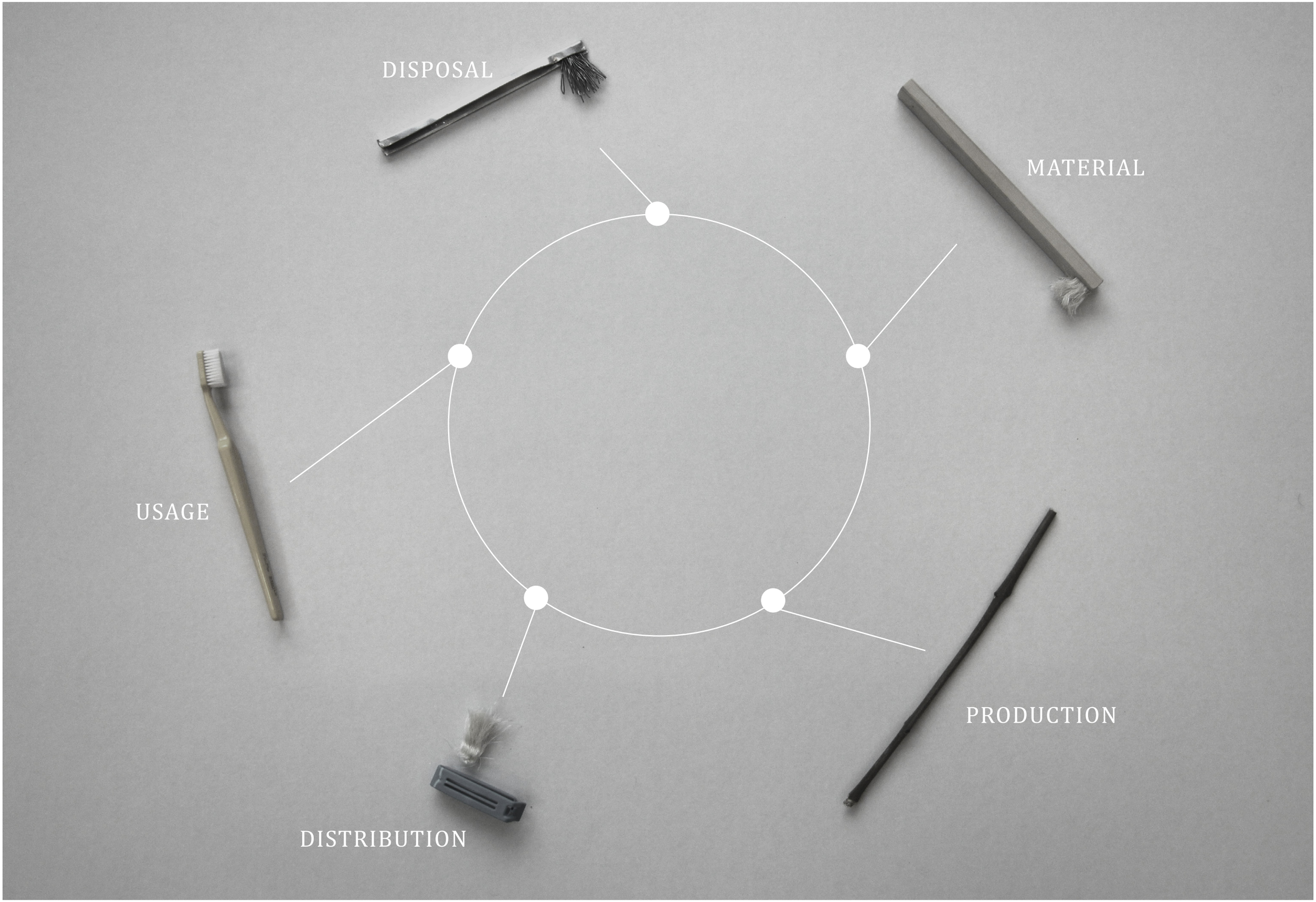



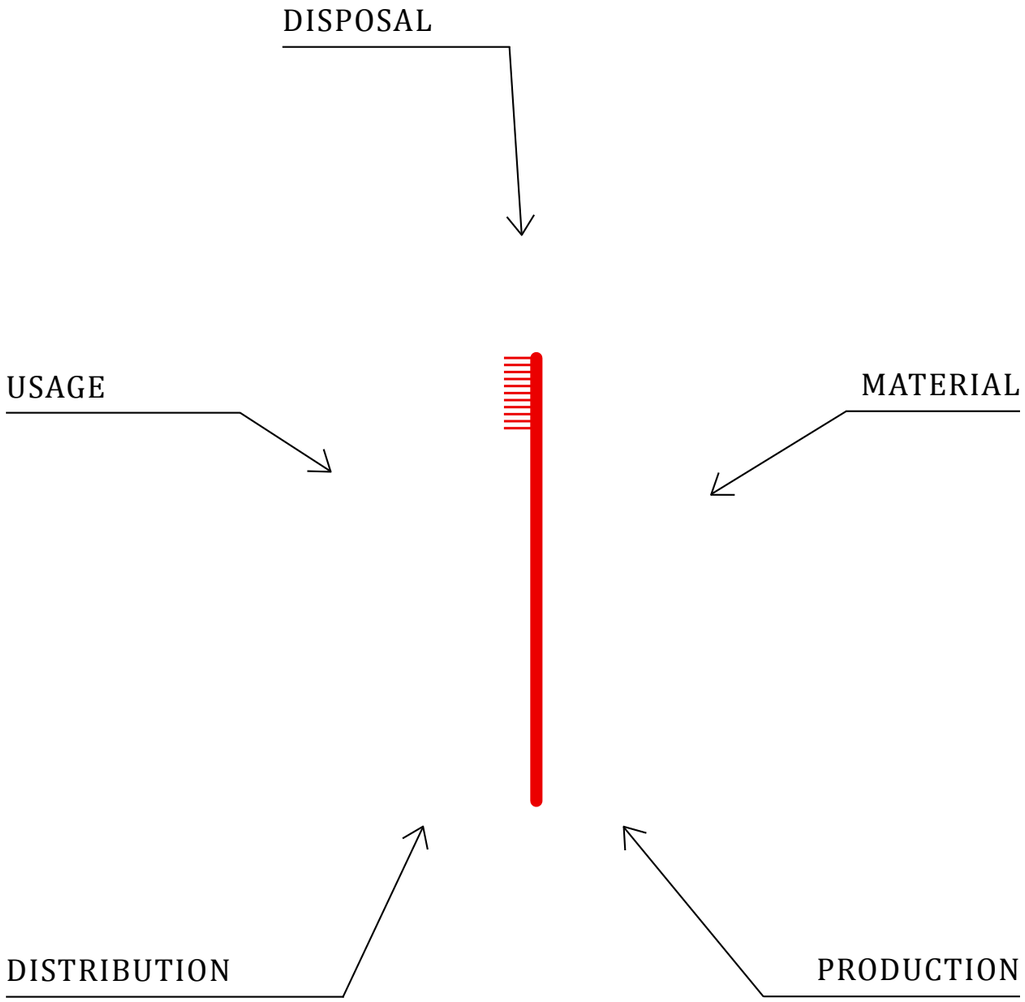

# CONCEPT 3

## Extremes - cyclic concept

This concept strives to highlight the compromise and difficulty in putting Eco design into practice. The five brushes should each one represent an environmentally friendly solution for one aspect in the life cycle of a product; material, production, distribution, usage and disposal. For example the best toothbrush from solely a material point of view would be made from natural materials like wood and pig hair. From a production point of view the best solution would be a naturally produced piece like the Miswak stick, a branch from the Salvadora persica tree often used to clean teeth in the Middle East. The best toothbrush for distribution would minimize distribution material by reusing everything except the brush, and the best option for the user would be similar to the ones we use today. From a disposal point of view the best solution would be an extremely durable “life time toothbrush” that almost eliminates the disposal step totally or a 100% recyclable material.

At first this concept seemed to be the best way to visualize my project since I felt it was a good way to communicate my thoughts and conclusions. It would demonstrate the subject’s complexity and the difficulty of compromising between the solutions, and it could be a good tool for discussion without showing the right way. Thinking a bit further I realised that this concept was an easy way out.
By only showing the difficulty with Eco design I wouldn’t reach my project goal; learning how to minimize the environmental impact of products. Regardless of how difficult I felt it would be I realised I would have to design a product trying to combine all the aspects into one product.


DISPOSAL
MATERIAL
USAGE
PRODUCTION
DISTRIBUTION






# CONCEPT 4

## Compromising

What happens if I try to optimize all aspects in the life cycle of a toothbrush into one solution? To develop a feasible eco toothbrush that could compete with existing products I would have to make compromises and rank functions. Can I as a designer take feasible decisions regarding the environmental impact of different kinds of material, production, handling et cetera, or is that out of my control? What does the user accept? The goal became to show an example of a toothbrush life cycle with minimized negative environmental impact.

## Final brief

Design a cyclic system for clean teeth and clean environment. The goal is to design a system for the need of cleaning teeth for grown-ups in Sweden. The toothbrush system should be designed for the Swedish market, taking resources, production methods and infrastructural systems into account, as well as cultural and behavioural aspects. The design of the toothbrush should optimise handling in a cyclic production system including all steps – material - production – packaging – distribution – usage – disposal. The toothbrush should clearly communicate how it should be used and the system it is included in.

# CHAPTER 9

Defining

# WHAT IS THE BEST SOLUTION?

What if you could use your toothbrush for a lifetime?
What if your toothbrush "disappeared" when it was time to get a new one?
What if your toothbrush could be recycled over and over again 100 %?
What if you could make your own toothbrush and customize it for you?
What if your toothbrush was an old ketchup bottle?
What if you could throw your toothbrush in the compost?

# CRITERIA

Toothbrush cycle

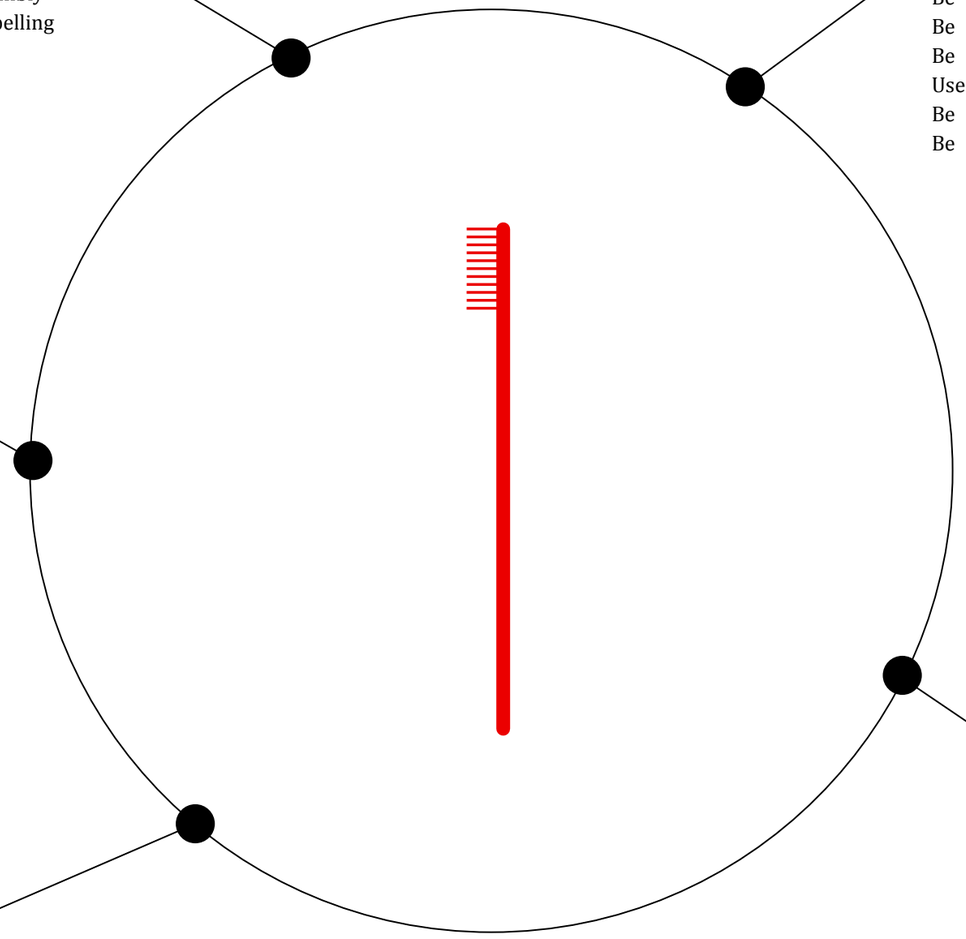
**Context:**
Toothbrush for adults
Swedish market and culture
Manual toothbrush

## DISPOSAL

| | |
|---|---|
| Provide | fast disassembly |
| Provide | material labelling |
| Communicate | handling |

## MATERIAL

| | |
|---|---|
| Be | renewable or recyclable |
| Be | pure |
| Be | durable |
| Use | materials available in Sweden |
| Be | water resistant |
| Be | non toxic |



## USAGE

| | |
|---|---|
| Clean | all teeth properly without harming |
| Be | easy to clean |
| Be | easy to understand |
| Provide | good and comfortable grip |
| Fit | standard adult mouth size |
| Raise | Awareness |

| | |
|---|---|
| Express | quality and durability |
| Feel | pure |
| Communicate | environmental benefits |

## PRODUCTION

| | |
|---|---|
| Minimize | spill material |
| Minimize | energy use / emissions / pollution |
| Avoid | chemicals or toxic materials |
| Keep | pure separate components |
| Use | production methods used in Sweden |
| Minimize | Components |

## DISTRIBUTION

| | |
|---|---|
| Minimize | transport distance + amount |
| Choose | low emission transport |
| Optimize | use of space |
| Provide | storing + transport of heads |
| Provide | storing of tools in use |
| Provide | information of system |
| Allow | 1+1 separate packages put together |
| Be | recyclable |
| Be | hygienic |

# FINAL CONCEPT

## Life time handle + replaceable head

The overall final concept for the design of the toothbrush system is based on my conclusions from the research phase. The goal was to solve as many environmental problems as possible during the life cycle of a standard toothbrush of today and yet design a toothbrush that would be accepted by the Swedish cultural and behavioural standards.

The designed system should include a toothbrush based on the three first points in the European waste regulations; Minimize, Reuse, Recycle. Waste would be minimized by reusing as much as possible of the toothbrush and by recycling the materials that, for hygienic reasons, cannot be reused. To achieve this the toothbrush should be designed according to the Design for disassembly (Dfd) principle, by separating the different functions by material and making the parts easy to disassemble.

The design of the toothbrush should strongly communicate its purpose. By showing that the head is separated from the handle, and how these should be handled after usage the user is encourage performing this act. Making the handle functional, pleasurable and beautiful the user will hopefully take care of and keep the product for a long time.

The toothbrush system should include an efficient implementation and distribution strategy with a take-back service to recycle the used heads. This strategy should also include communication to inform the user about the system and a packaging supporting the system.

1. MINIMIZE
2. REUSE
3. RECYCLE
4. ENERGY EXTENSION
5. DEPOSIT

**ALUMINIUM**
Recycled

| + | - |
|---|---|
| - 100% recyclable<br>- Saves approx. 95% energy when recycled<br>- Durable<br>- Easy to clean<br>- Can be used for the handle and fastening detail | - Energy consuming production process |

**LCA (Life cycle analysis)**
Die-cast + anodise
New melt: 220 MJ/Kg + 12 kg $CO_2$
Re-melted: 20 MJ/Kg (135-115 MJ/Kg) + 1 Kg $CO_2$

**BEECH WOOD**
FSC certified Swedish resource

| + | - |
|---|---|
| - Naturally antibacterial<br>- Renewable<br>- Abundant resource in Sweden<br>- Small dimensions allow spill material source and branches | - Less water-resistant<br>- Harvesting in big scale can be problematic<br>- Requires added material for the fastening detail |

**LCA (Life cycle analysis)**
Walnut/Ash/Birch
15 MJ/Kg + 1 KG $CO_2$
If reused saves: 12 MJ/Kg / If combusted saves: 5 MJ/Kg

Source: CES Edupack



# MATERIAL AND PRODUCTION

## Evaluation for handle

The material for the toothbrush handle should be durable, resistant to water, last for many years and allow safe handling after usage. Since the hygienic requirements are much lower than for the toothbrush head the material options where many. For a quick general comparison of different suitable material families a morphologic matrix was made listing the pro's and con's with every material and their production possibilities according to the environmental impact.

The included materials where the following:
Hard wood (Beech), Corian, Plastic (Polyamid, PP, PET), Biodegradable plastic, Aluminium, Stainless steel, Ceramic, Glass, Stone.

The majority of the materials could quickly be sorted out because of environmental aspects, production possibilities or fragility. Finally beech and aluminium where the two remaining materials that seemed to share the same amount of pro's and con's. The evaluation between these two materials proved to be very complicated and therefore recycling engineer Johan Persson was contacted again. By using CES Edupack, a program calculating the $CO_2$ emissions during a products life cycle, we could evaluate the different material sources, and their environmental impact, more closely. Still reviewing it with Johan I came to the conclusion that I would never find out which of these material resources that was best without having access to much more detailed information about exact extraction location and method, transportation method and distance, usage length, disposal etcetera. Information that I would not be able to collect within this project. Because of the difficulty in evaluating the negative environmental impact of the materials I decided to use both aluminium and beech, and design two different toothbrushes.

## Motivation of final choice

**Aluminium**
Aluminium is a durable, water resistant and hygienic material that can be 100% recycled indefinitely. When re-melted approximately 95% of the energy is saved compared to when using virgin aluminium. By using recycled aluminium from Sweden the transportation distance is lowered. The whole handle with fastening detail could be produced from the same material to facilitate recycling after usage. All spill material during production can be re-melted to minimize waste. A negative point is that a lot of energy is still needed for processing the material. But this aspect could be accepted since a handle produced in aluminium could be reused for a very long time.

**Beech**
FSC certified beech is an abundant and renewable resource in Sweden that requires very little energy for harvest and production. The FSC label ensures that the forest is responsibly grown and harvested.[1] Beech is the only wood kind with natural antibacterial capacities and is for that reason very suitable for hygiene products. Because of the handles small dimensions left over pieces from the wood industry, such as factory left overs and branches from harvesting, can be used. A beech handle would probably not last as long as a handle produced in aluminium but requires much less energy. To protect it from moisture the wood can be treated with natural hard wax oil, for example oil from bees wax. For fastening the head a detail produced in a stronger material is required, which will complicate both the production and handling after usage. If this detail is produced in metal, such as steel or aluminium, the wood can be burned using energy extension and the metal piece recycled after usage.

1. http://www.fsc.org/certification.html, 2012/03/28

# Evaluation for brush head

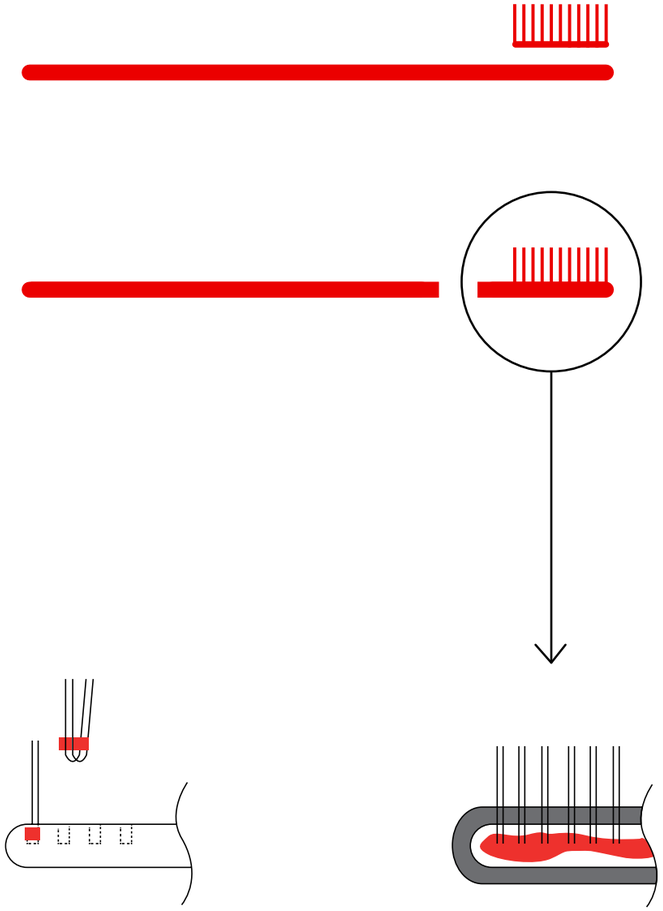
When choosing a suitable material for the toothbrush head and bristles the choices where much fewer than for the handle. Strict hygienic requirements, together with recyclability, durability and strength demands decided the final material and production method. The final construction concept, with the connection point in the neck instead of under the bristles, was decided to separate the handle material from the part in contact with the mouth. This to prolong the life of the beech handle and prevent the aluminium handle from damaging the mouth when brushing. To facilitate recycling the whole head part should be produced in the same material according to the monomaterial principle.

**Material**
During my visit to the brush factory ML Borstteknik I realised that nylon, or polyamide (PA), bristles are better than natural bristles for many reasons. First of all natural bristles are not as hygienic as polyamide bristles since they are harder to clean, and bacteria is therefore easily collected inside the brush. A polyamide brush also lasts longer than a natural brush since the natural bristles easily break off when brushing. Polyamide is a thermoplastic and can be recycled up to ten times by re-melting the material. The whole head could be produced from polyamide since the material can be produced with different characteristics; such as high elasticity for the bristles.

**Production method**
For producing the whole toothbrush head in polyamide a new technology called 'Anchorless toothbrush production'[1] would be used. This method allows the bristles to be fastened into the head base without adding another material or component. Instead of fastening the bristles into the head base after it has been injection moulded the bristles are inserted in the mould, thus making the production more efficient by saving one step. Before inserted in the injection mould the bristle filaments are welded together. When the plastic is injected into the mould, over spraying the welded bristle ends, they are automatically fastened.

1. http://www.brushexpert.com/news/article.asp?MagArticleID=1089, 2012/03/28





**Traditional production**

Bristles fastened with metal clip

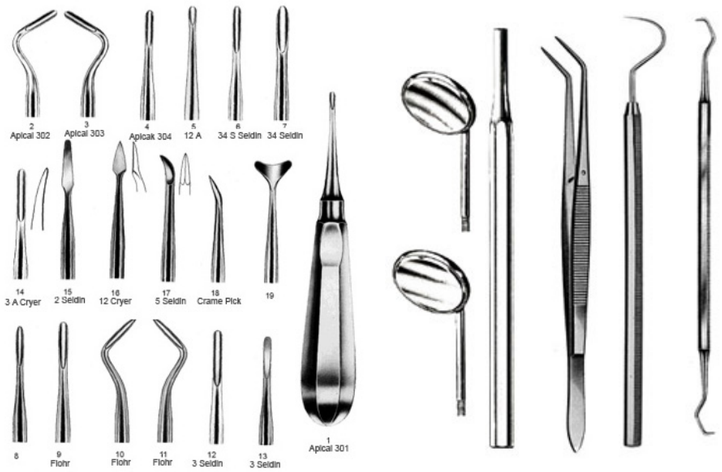
**Anchorless production**

Inserting bristles in mold



# SHAPE INSPIRATION

Aluminium toothbrush

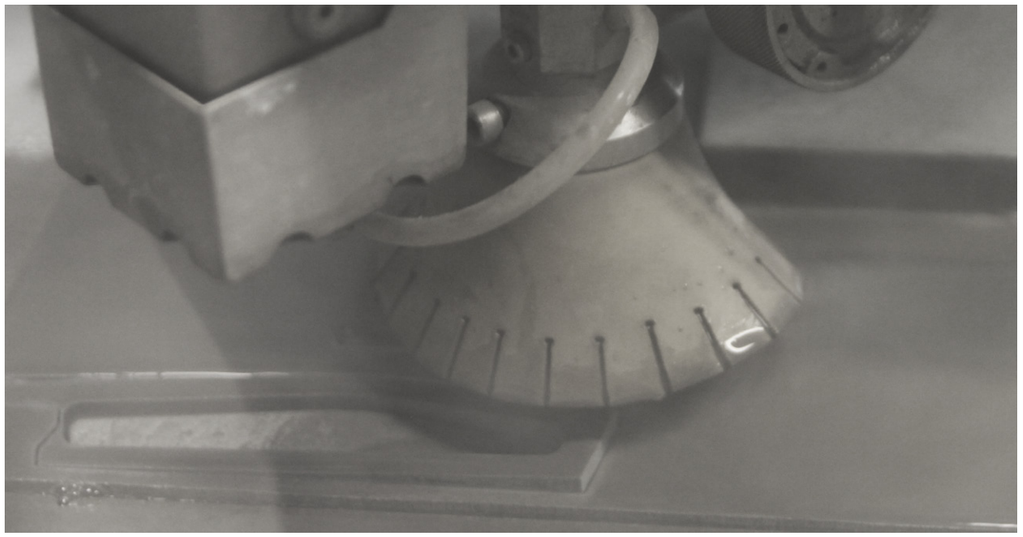


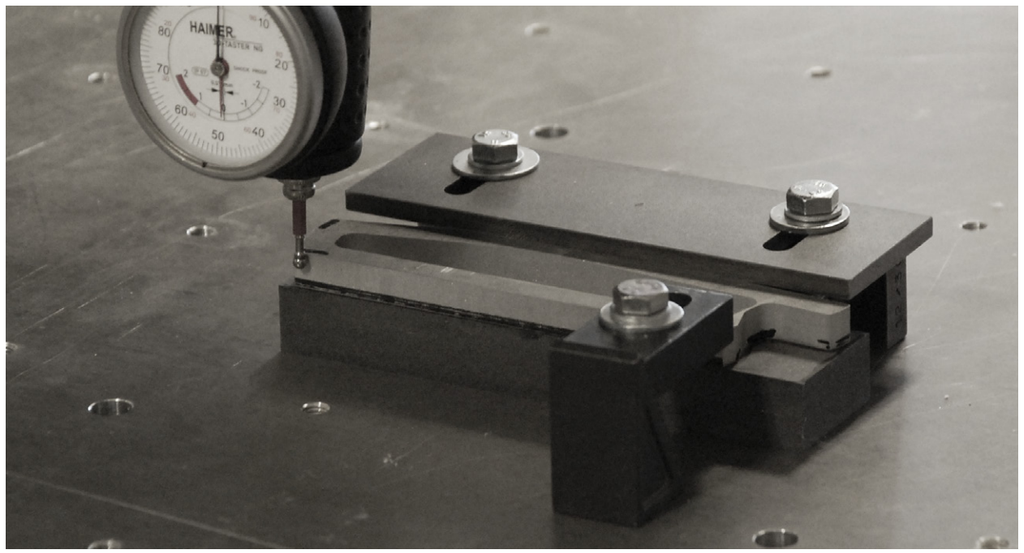





Beech toothbrush



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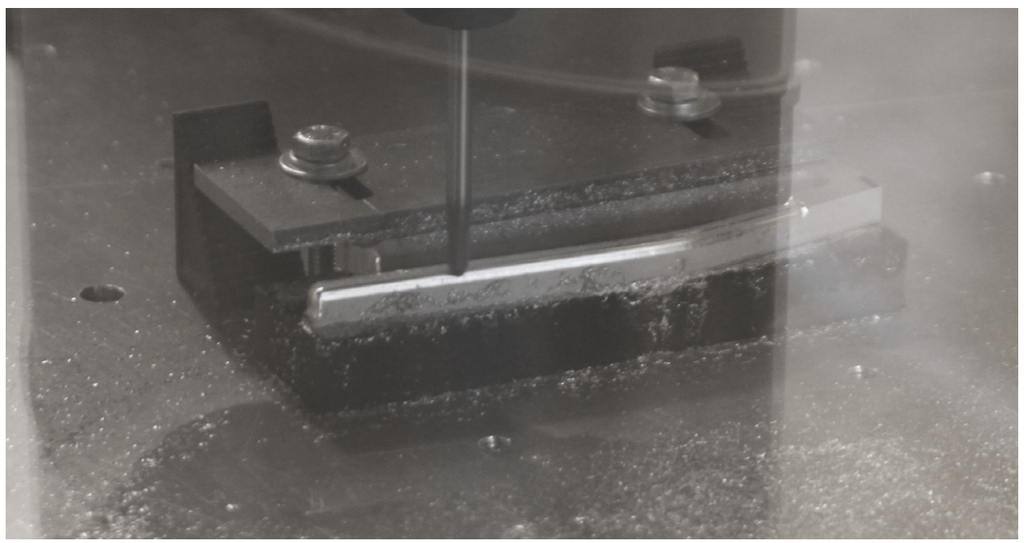
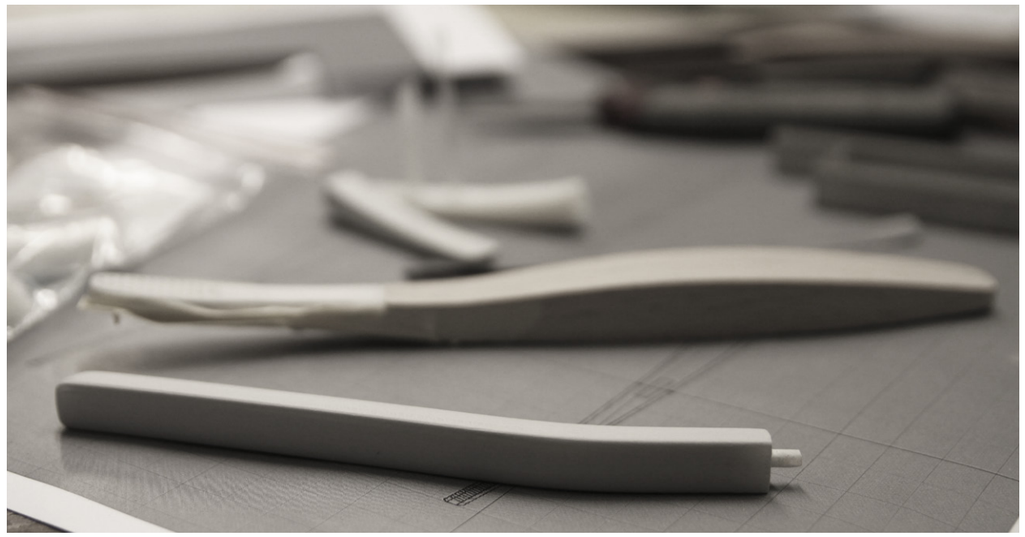
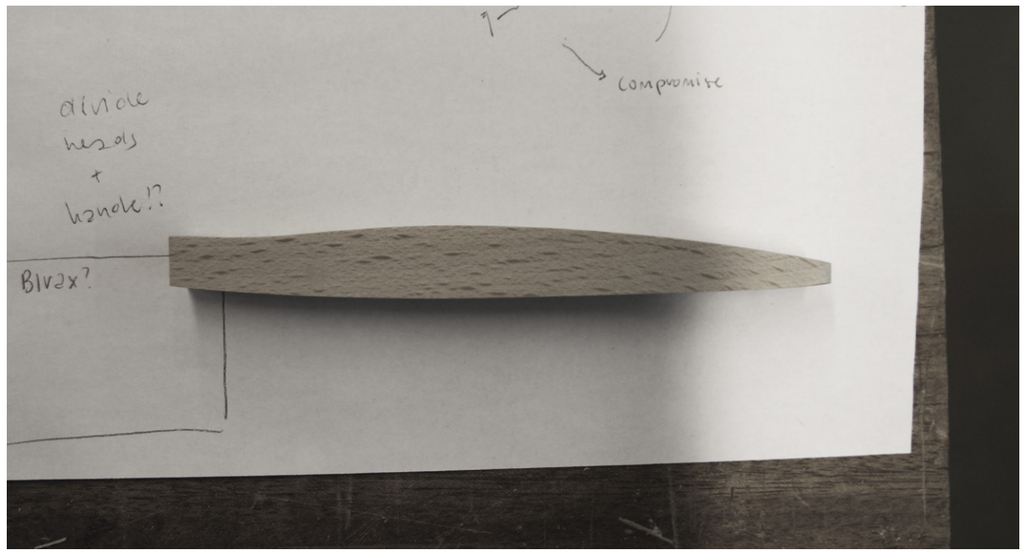
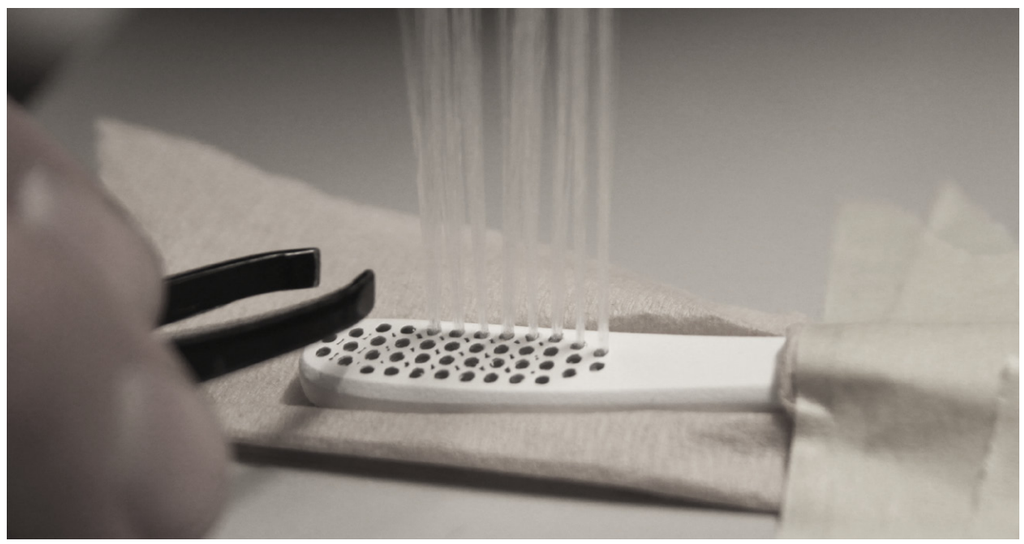







compromise
divide
hexals
+
handle!?
Bivax?



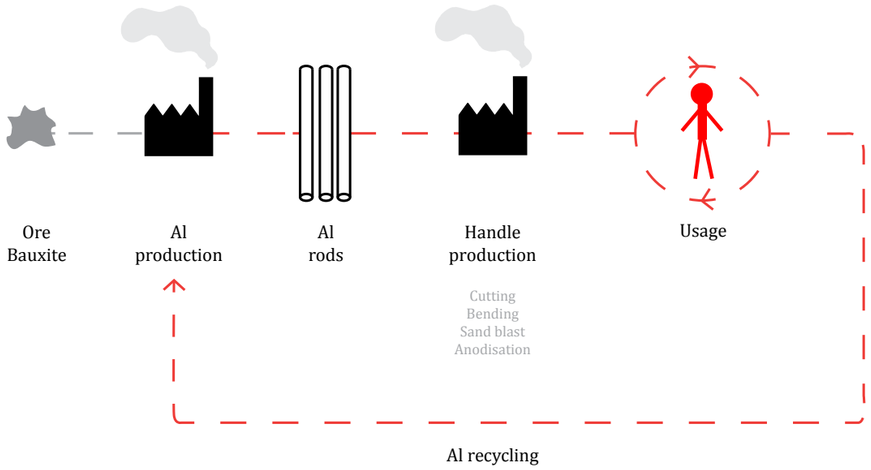
# CHAPTER 10

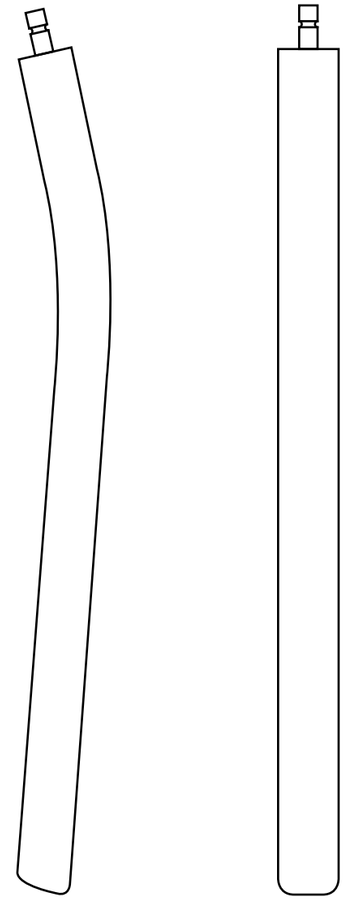
My precious toothbrush

# ALUMINIUM TOOTHBRUSH



# Shape and production of handle



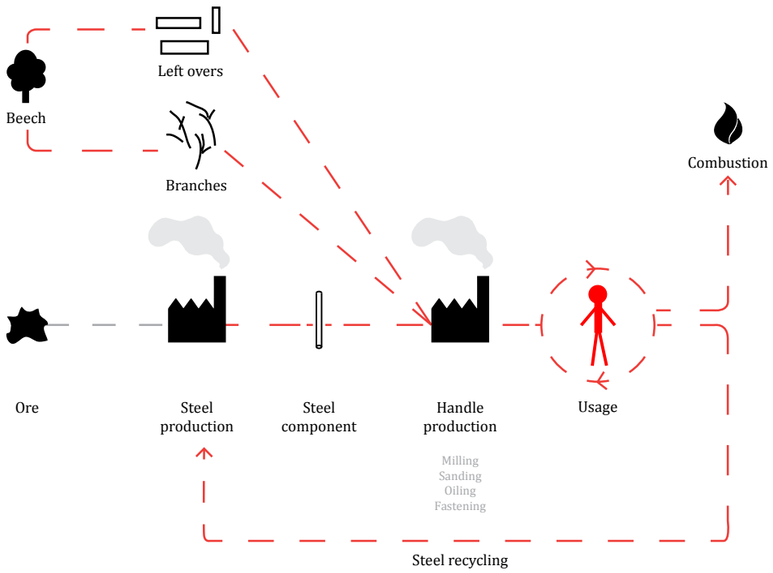



The reusable aluminium handle is designed to provide a good grip when brushing and to be thin and light weight. The fastening detail allows the head to be clicked on and locks it steady. To keep the handle clean it can be cooked or cleaned in the dishwasher. The handle is produced from recycled aluminium that is re-melted in Sweden. It is manufactured in one unit from a solid round 10 mm stick that is cut, bent and anodised to get a strong and even surface. After many years of usage the handle can be 100 % recycled.

# BEECH TOOTHBRUSH

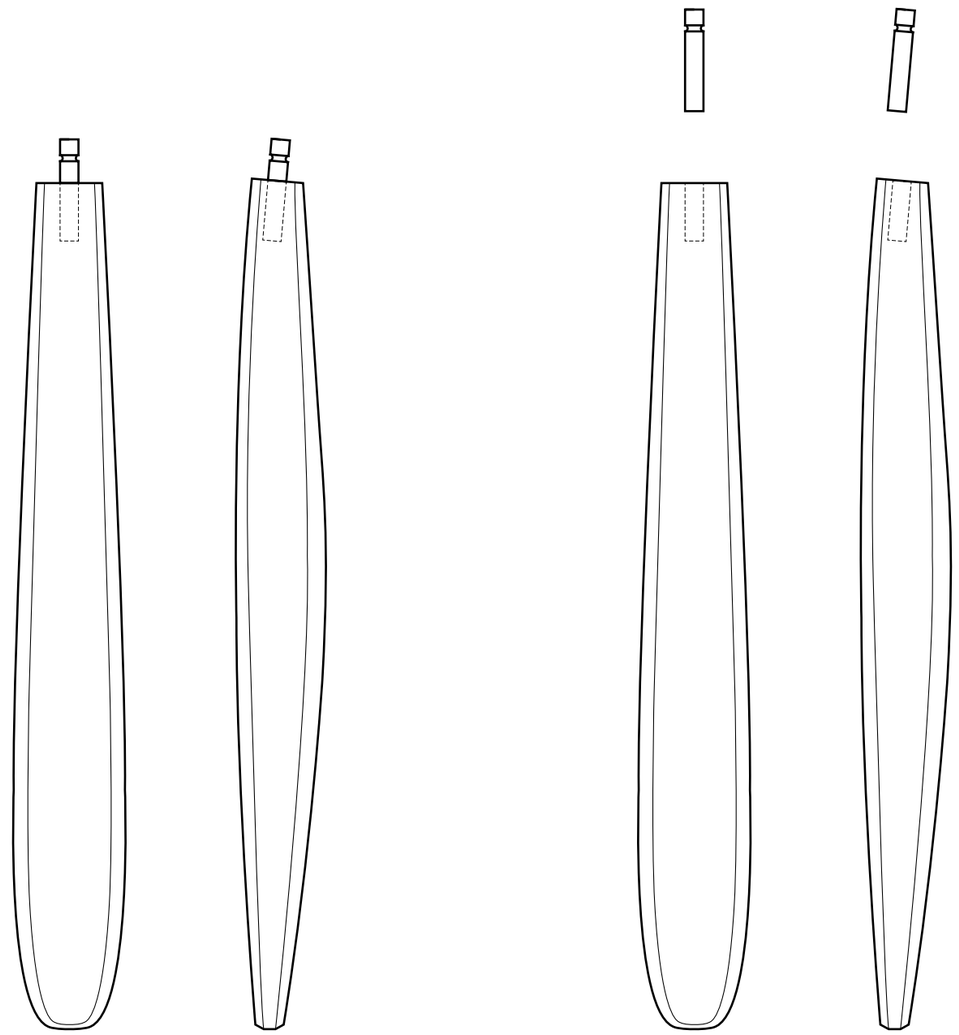


# Shape and production of handle



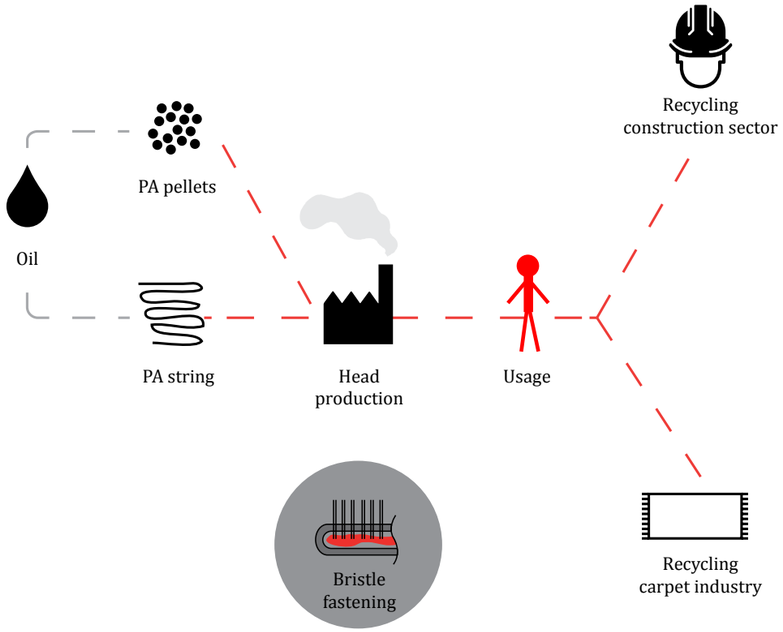

The reusable beech handle is carefully designed to provide a good grip when brushing and to be strong and durable. To fasten the head there is a steel detail inserted in the top of the handle. The handle is locally produced by sawing out the main shape, CNC milling the facets, drilling a whole in the top, inserting the steel detail by fitting, sanding and finally treated with a natural hard wax oil to protect the surface from moisture. In the end of its life cycle the handle can be safely burned, by using energy extension, to separate the wood from the steel. The steel can be 100 % recycled.





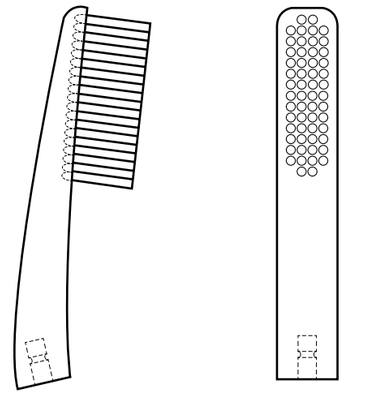
# TOOTHBRUSH HEADS

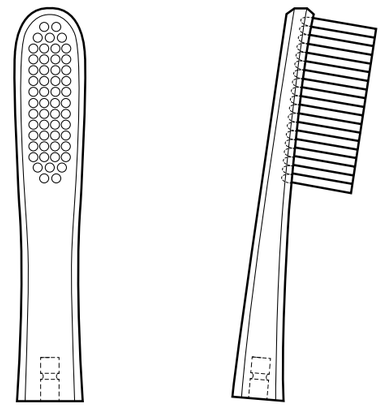
# Shape and production of brush heads




The polyamide brush heads, for the two toothbrush concepts, have a long neck to prevent the handle to come in contact with the mouth when brushing. Thanks to the angled neck the inner teeth are easy to reach and the head keeps above the surface when laid down. The heads are produced in 100 % polyamide according to the anchorless production method where the bristles are fastened without adding any extra material. After usage the material is re-melted and turned in to recycled polyamide pellets that can be used in for example the construction sector where the demand on material quality is lower.









# IMPLEMENTATION STRATEGY

## Take-back service for recycling of heads

In order to successfully implement the planned cycle for the toothbrush production, recycling and reusing a strategy concept was developed. The concept is made for local Swedish distribution, with the aim to make it as efficient as possible.

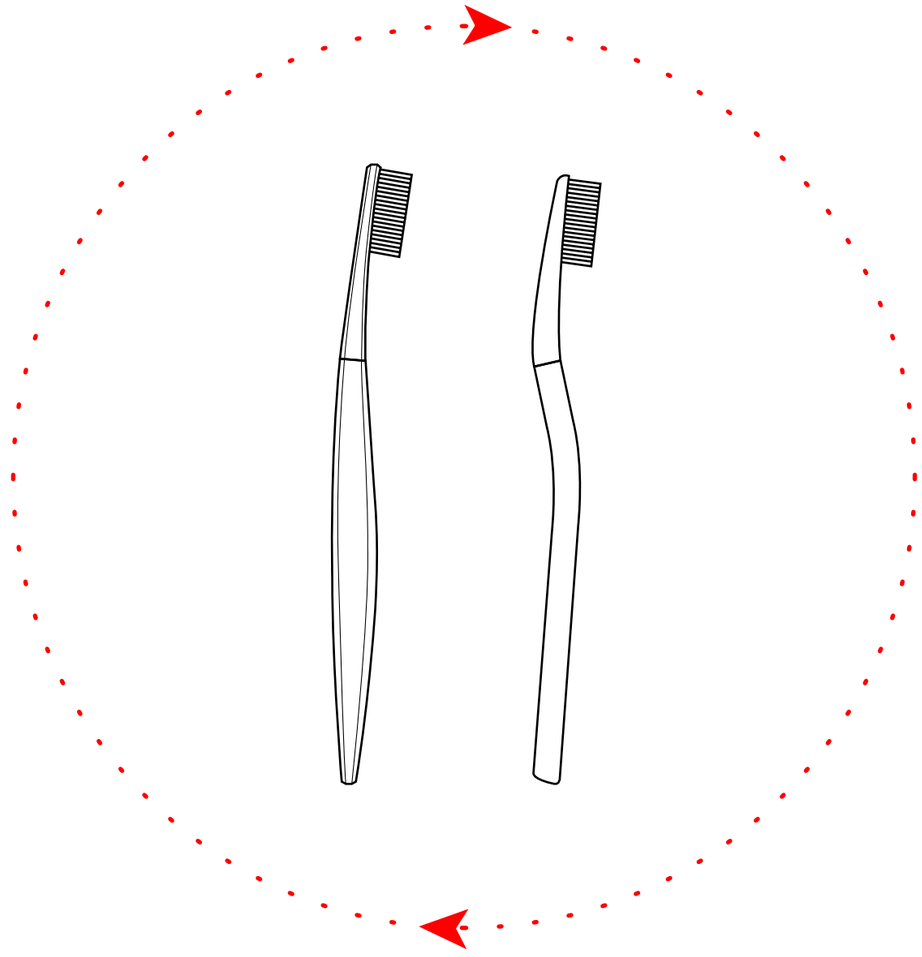
To gain more knowledge about demands and methods for distribution systems in Sweden Fredrik Nilsson, Associate Professor (Docent), Division of Packaging Logistics, was contacted. Because of the complexity of fully developing a detailed strategy for distribution with packaging, communication et cetera I decided to keep it at concept level.

The cyclic system concept strives to prolong the life cycle of the toothbrushes and ensure recycling of the used heads. Important aspect to consider from an environmental point of view where minimizing energy use and $CO_2$ emissions by calculating transportation space and distance, and optimizing material use.

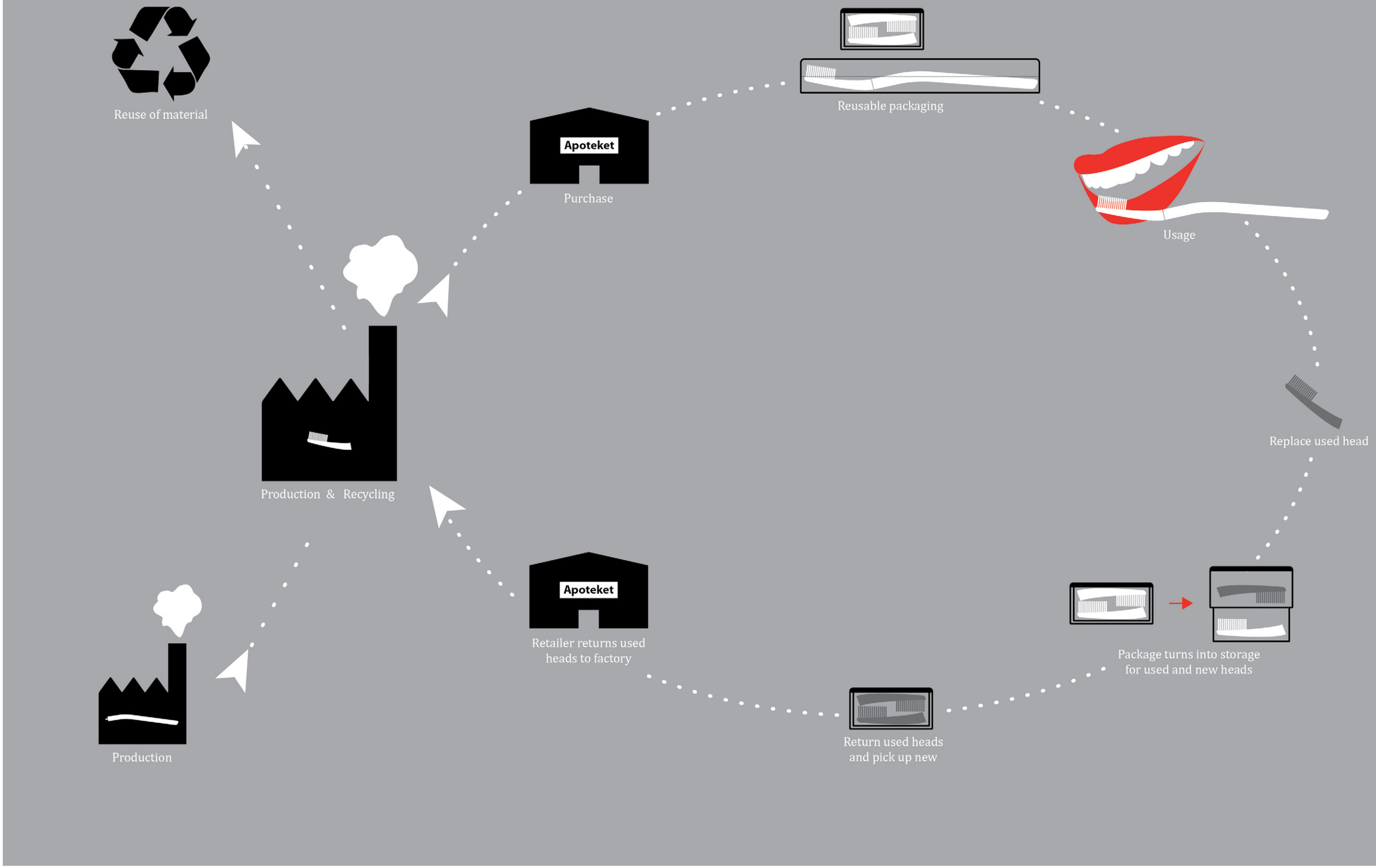
A well designed take-back system is beneficial both for the producer and buyer, with incentives for both parties to bring back the used heads into new production. For the company it is beneficial to get the used heads back for recycling and then selling the material to other sectors. Since the producer knows the exact content and quality of material it is easy to find interested buyers. For the buyer of the product it could be beneficial if a discount is given for new heads when giving back old ones to the purchasing place.

One very important part of the distribution system is a well-designed package. For this system the most efficient method proved to be reusable packaging to minimize production and waste. Another important factor is communication and information to the users about the system. The idea is to be as transparent as possible to inform the user and make them aware of how the system is working. Such information would include material labelling, system descriptions and usage instructions.

**Concept Scenario:**
(Look at the following spread for explanatory graphics and video of the concept). The distribution concept works with two reusable metal cases; one to store the toothbrush, and one as a refill case for used and unused heads. The first thing the client buys is one metal case with one handle and one head. This case works as storing for the toothbrush, when in use, both at home and when travelling. When the first head is worn down the client buys a refill package with the desired amount of heads. This package provides both storing for used and new heads separately. When all heads are used the package is given back to the purchaser and a new one is purchased. The purchaser collects boxes with used heads and sends them back to the producer for recycling where the material is re-melted and sold to other producers.



Watch explanatory movie on: http://vimeo.com/48228313



# PROJECT SELF-EVALUATION

## My precious toothbrush = Ecology + Design?

When starting this project I didn't realise the complexity of the subject and the big risk of entering such a broad topic as sustainability for my bachelor project. In retrospective my naivety was probably necessary for this project to take place, given the enormous challenge it brought. Driven by doubts and questions about how to apply design, I was desperate to find motivation both for me personally and for my professional future. For me the sense of meaningfulness has always been a great motivation and I can simply not work without it.

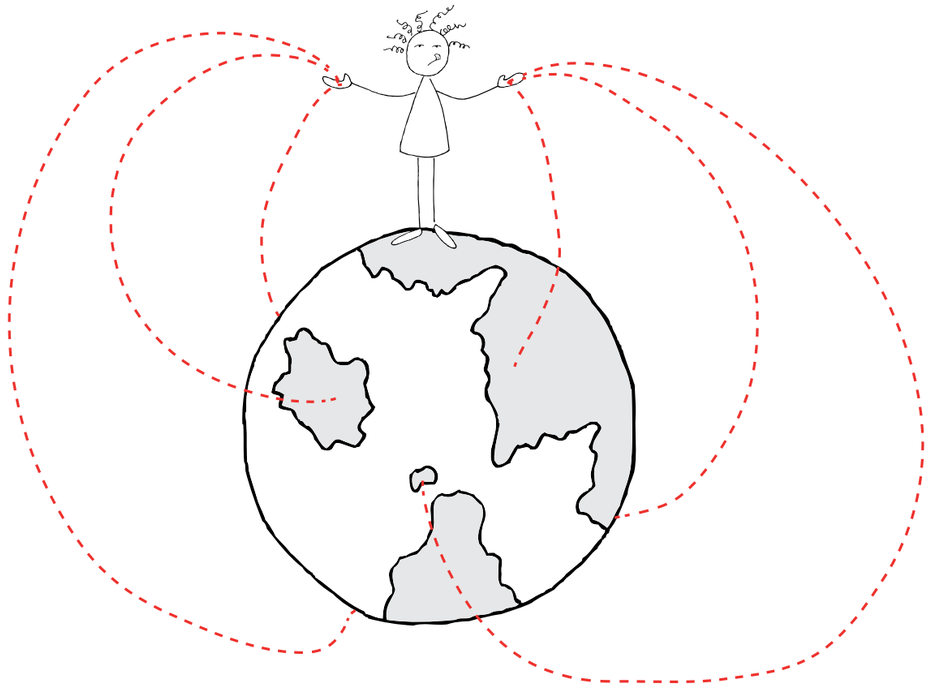
The initial theoretical phase was very rewarding and I noticed that reading, writing and discussing about design was something very crucial for my understanding that I had unconsciously missed during my education. Incorporating experts and other persons for discussion has also been crucial for this project and the different inputs kept me continue questioning. During the process I understood the complexity of the subject I was treating which resulted in a feeling of powerlessness and paralysis. Unconsciously I tried to find an easy way out of the project by applying very general or conceptual visualisation methods. The final decision of trying to apply my thoughts to a functional toothbrush was a very important decision for the whole project. Not until after the practical phase could I view the whole project with critical eyes.

In a way the toothbrush system 'My Precious Toothbrush' is just another attempt to optimize a fundamentally bad and unsustainable system. The life cycle may be substantially improved and prolonged but eventually this system also fails in being totally cyclical. During a discussion with my supervisors we talked about the concept of cradle to cradle and asked ourselves if the method wasn't "Hoppet om en evighetsmaskin" (The hope of a perpetual motion machine). That reminded me about what Johan Persson (environmental engineer) also told me in the beginning; that there will always be leaks and flaws in a cyclic system. After having completed this project  I can see it for myself.

Looking back at the project there are many things that could have been done differently. But at the same time not. I feel that going through this process has been necessary for me to summarize my education and motivate myself for the future. The outcomes and lessons from this project are at so many different levels, both personally and professionally, both generally and more specific.

This report and the whole project is structured in the same way as the design of the final product concepts; by keeping a simultaneous macro and micro focus. Unconsciously I applied a thinking that I strongly believe in to both the project as a whole, and its outcome. After all maybe that is my design philosophy - zooming in and out.

My most important initial goal was to motivate myself and to find a path to follow within design. This is a goal I feel I have reached. During the research phase I discovered many interesting methods and approaches to design, so many that I didn't have time to research and practice them all. This together with the conclusions from the reflective phase have given me new perspectives and ideas for what a designer should and can do. And this is really something I want to continue exploring.



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