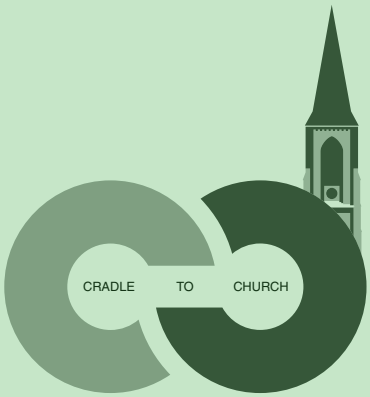
RESEARCH THESIS

CRADLE TO CHURCH

A SUSTAINABLE RESPONSE ON RELIGIOUS HERITAGE

REVITALIZING THE JACOBUSKERK

DINAND KRUIZE



Delft University of Technology, Netherlands
Faculty of Architecture and the Built Environment
MSc 3/4 studio Heritage and Architecture - Revitalizing Heritage

TU Delft

CRADLE TO CHURCH, REVITALIZATION OF THE JACOBUSKERK

- A SUSTAINABLE RESPONSE ON RELIGIOUS HERITAGE

A study into a Cradle to Cradle based revitalization project of a religious object of monumental heritage; the Jacobuskerk in Winterswijk, the Netherlands.

This thesis was written in partial fulfillment of the requirements for the degree of Master of Science (MSc) for the master program Architecture at the Faculty of Architecture and the Built Environment at Delft University of Technology.

Chair
Heritage & Architecture - Revitalizing Heritage

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PREFACE

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STUDIO

Name & theme	Heritage and Architecture - Revitalizing Heritage	
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Choice of the studio

Heritage and vacancy rates are an ongoing problem on a large scale. The revitalization of vacant buildings is essential for a sustainable future building environment. Vacant buildings form a large part of the aspects that make our current building environment unsustainable in terms of unused space and embodied energy. Vacant buildings oftenly contain a set of reasons why they are unsuitable or simply unattractive for a future life-cycle as they are oftenly inflexible and therefore do not require many needs. Vacant buildings usually contain too much space in an inflexible floor plan formed by a building structure that is not designed for change. Furthermore materials and installations are oftenly outdated, require a lot of relatively expensive maintenance and involve a building performance that unable to meet the current standards of regulations. Solutions that may enable vacant buildings to be revitalized into interesting new life cycles through a new function, involve large potential for sustainable implementations. Sustainability forms the answer to the ecological demands towards the future of which the building environment forms an substantial share, here and now. The importance of sustainability in the future building environment enhances my personal view on the essence of architecture in and for society.

GRADUATION PROJECT

Title	Revitalization of the Jacobuskerk – A sustainable response on heritage
Building	Jacobuskerk
Location	Winterswijk, the Netherlands

CONTENT

1. INTRODUCTION

PROBLEM STATEMENT

The decreasing numbers within the Catholic religion result in a large supply of vacant Catholic churches, and therefore represent a new vacant building typology to the existing heritage within the built environment. These churches often match the character of inflexibility as described in the choice of the studio, but do contain an important set of values that form exceptional architectural opportunities within revitalization. Aside from Catholic churches being iconic buildings that contain important religious values, churches often play important roles in the urban fabric and the historical development of the city. This makes (Catholic) churches altogether an building typology that should not become vacant heritage.

With the ecological problems and the influence of the current building environment becoming more and more clear for the future and at rapid rate becoming reality to nowadays society, not only the future building environment in the form of new projects is (slowly) changing but also the existing building environment in the form of transformation projects of vacant buildings is responding. With the vacancy rates being an ongoing problem on a large scale, heritage in particular is an important and influential sector to respond. The revitalization of vacant buildings is essential for a sustainable future building environment as vacant buildings form a large part of the aspects that make our current building environment unsustainable in terms of unused space and embodied energy. Vacant buildings often contain a set of reasons why the building should be maintained and revitalized as it contains highly respected values. However, in terms of circular economy an object of heritage and the values it features are initially not at all designed to be circular. They were initially build for a cradle to grave life cycle in a time of linear industrial systems. What currently makes heritage 'sustainable' is the extended lifetime of the building to maintain the values of the building instead of demolishing and forgetting them. This is however a less-bad approach of dealing with sustainability as it is not solving the source of the problem but merely delaying and minimizing the effect. But how can an existing product become a solution to the root of the ecological problem when this solution would rely on a new way of designing according to the concept of Cradle to Cradle? This is exactly the problem that this graduation project tries to stress on and find answers in, or at least gain attention for. Since heritage is designed as linear product in a significantly less advanced linear economical system that is eco-effective and less bad at best, can it become a circular and eco-efficient cradle to cradle product in a building environment, economy and society slowly but surely shifting towards a circular model? Or is less bad the maximal sustainable potential reachable in heritage?

RESEARCH QUESTION

With the goal of this graduation project being to explore the possibilities of circular heritage as a way of approaching the topic of sustainability for the future of heritage, the following research question is formulated to define and enclose the scope of sustainability towards circularity:

"Since heritage is designed as linear cradle to grave product in a significantly less advanced linear economical system that is eco-effective and less bad at best, can heritage become a circular and eco-effective cradle to cradle product in a building environment, economy and society that is slowly but surely shifting towards a circular model? Or is less bad the maximal sustainable potential reachable in heritage?"

2. STARTING POINT POSITION AFTER Q1

"What values does the Jacobuskerk in Winterswijk contain, and what is the transformation plan in which they result?"

"What are the potentials of sustainability of the Jacobuskerk in Winterswijk?"

3. THEORETICAL CONTEXT
CRADLE TO CRADLE

"To what extent has Cradle to Cradle been implemented in the current building environment and what represents the existing frame of reference of Cradle to Cradle within revitalized (church) heritage?"

"How can the principle of Cradle to Cradle be implemented in the Jacobuskerk in Winterswijk?"

3.1 SCALE OF THE PROBLEM

The scale of the world's environmental problems are linked to the industrial and technological development that has characterized and dominated the global economy ever since the industrial revolution around the middle of the 18th century. Manual production has slowly but surely been replaced by mechanical production, causing society's ambitions to be merely limited by the capabilities of technology of the time. Society's rates of consumption resulted in a faster producing industry and an increased standard of quality, creating an economical model that facilitates the irresponsibly growing demand of society driven by a mentality that 'everything is possible, technology is limitless'. According to the World Commission on Environment and Development (WCED) the rate of industrial production has been fifty-folded in the 20th century alone. As this growth is relating to the development of technology, 80% of this growth has been reached in a time span of 35 years from 1950 to 1985. The future perspective contained little awareness of the longterm ecological consequences of technology entailing the consumption of finite recourses and emission of forms of pollution. (Lee, 2011)(McDonough & Braungart, 2002)(World Commission on Environment and Development, 1987)

After two centuries of developing environmental problems, it became clear in the 1960's that technology might seem limitless in itself but creates inevitable ecological limitations as a result. The Club of Rome, a group of international business, political and scientific leaders, forecasted the eventual depletion of the world's recourses based on the behavior of society and its economy, indicating pressing concerns to create awareness and spark change. Their forecasting expressing the environmental problems through measurable scientific data proved the scale of the problem and the drastic need for solutions truly inevitable. (Meadows, 1972) From this point increasing amounts of sources of intelligence have been pointing out that radical action has to be taken to solve this life-threatening global crisis. *"We have in the past been concerned about the impact of economic growth upon the environment. We are now forced to concern ourselves with the impact of ecological stress upon our economic prospect."* (World Commission on Environment and Development, 1987, p. 5). In 2003 The Club of Rome published a 30 year update of the original findings published in 1972. The original forecast showed clear correlation with the new data results. In conclusions little has changed in the rates of consumption of new raw materials, although the efficiency of used materials has shown improvement. (Meadows, 2004) This shows that short-term gain to suffice economical 'needs' remains to be held of higher importance than the long-term ecological needs. Our economic behavior knows no sacrificing position in 'needs and profit'.

> ***"It doesn't matter what sustainable solutions we implement in our building if you will eat your stake in it anyways - what we can do directly is start with yourself"*** - Greg Keeffe, 2019

The Club of Rome expresses the world's environmental problem to be caused by a collective impact of factors of concern. Along with the consumption rates of society, the scale of consumption by the continuous growth of the worlds population, is expanding rapidly and beyond the capacity that the environment can sustain. Growth of world population does not merely contribute to the exhaustion of fossil fuels and natural material resources but also forms a large impact to climate change, as the living conditions of every human being requires the toxic emission of green house gases. Climate change is the interruption of the balance of the natural ecosystem and the overextending of planetary boundaries caused by global burdens, eventually resulting in the world no longer being sufficient to sustain life. The graphs in image 1-5 are statistics that express some of the impactful factors of concern.

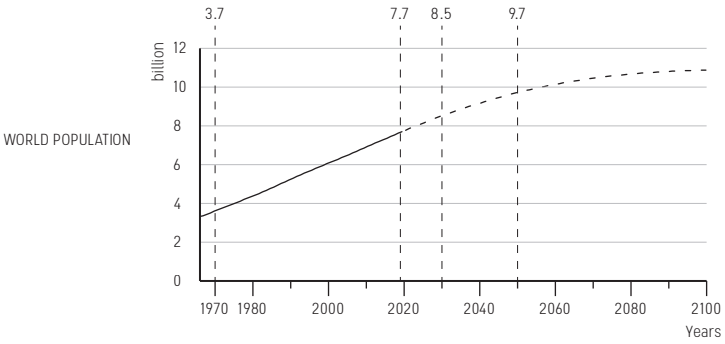

Image 01. World population, measured in billions.
Numbers measured on Juli 1st of each given year.

EARTH OVERSHOOT DAY

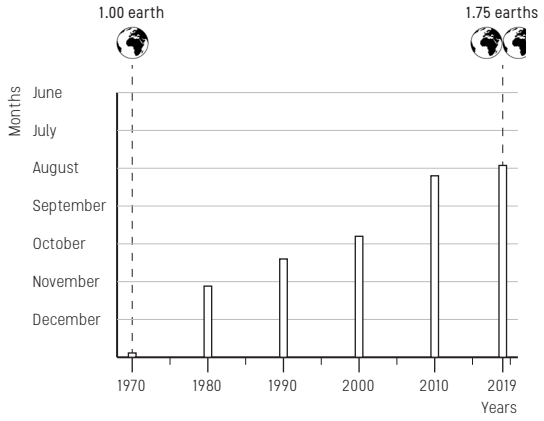

Image 02. Earth Overshoot Day.
Earth can sustain a certain capacity of natural resources. The day this capacity gets overruled is called 'the Earth Overshoot Day'. The first time this occurred was in 1970. In 2019 the maximal natural resources was used on the 29th of July which means that to sustain for the rest of the year we 'steal' 75% of the natural resources from the next year.

DEPLETION OF MATERIALS

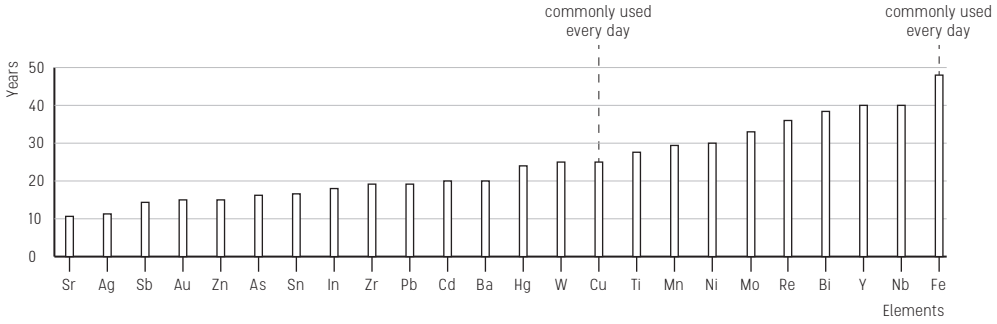

Image 03. Years left of reserves at a sustained annual global primary production growth of 2%.
In the next 50 years, the raw reserves of 24 elements will be depleted (peak points of extraction) assuming an annual increase of production of 2%. Although these elements are not fully depleted, their peak production has passed their extraction rates. Some of these elements are very commonly used in our current economy and building industry, such as copper and iron. These elements are to be considered as rare and therefore valuable, and should be implemented consciously. Raw compounds of these elements can be regained from recycle processes but this is generally expensive and difficult.

GLOBAL GREENHOUSE GAS EMISSION BY GAS

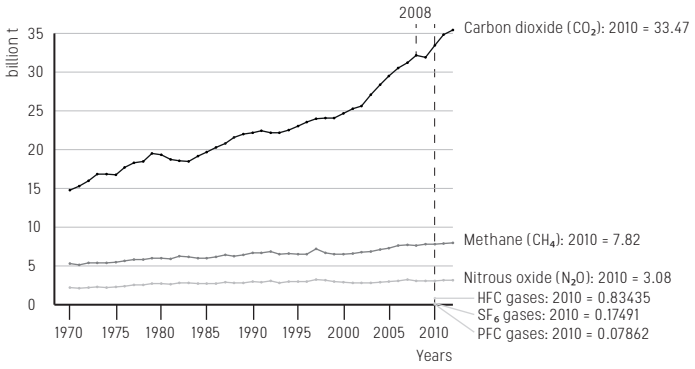

Image 04. Greenhouse gas emissions by gas, World.
Global greenhouse gas emissions by gas source, measured in tonnes of carbon dioxide equivalents (tCO_2e). Gases are converted to their CO_2 values based on their global warming potential factors. HFC, PFC and SF_6 are collectively known as 'F-gases'.
Clearly visible is the impact of the economic crisis of 2008 on the CO_2 emission. The heavily decreasing GPD restricts the technical development. Less money, less production.

GLOBAL CO_2 ATMOSPHERIC CONCENTRATION

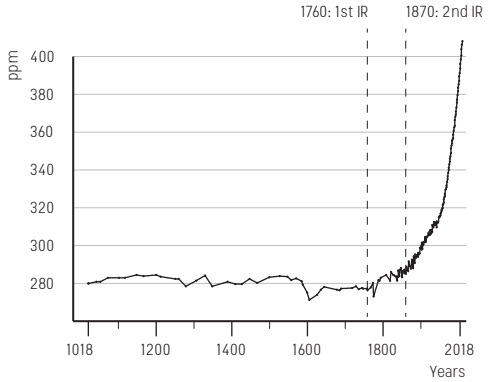

Image 05. Average concentration of carbon dioxide (CO_2) in the atmosphere, measured in parts per million (ppm).
The impact of the industrial development on the natural concentration of CO_2 in the world's atmosphere.

3.2 INFLUENCE OF THE BUILDING ENVIRONMENT

3.2.1 GENERAL

Influence of the building environment as a part of the general problem

- graph carbon emission industries. Delft Lectures on Architectural Sustainability (2019), Sang Lee

3.2.2 HERITAGE AS A SUSTAINABLE BASE

Explain that the fact that Heritage is existing it is automatically sustainable since you safe a lot on all the construction and embodied energy etc.

3.3 DEFINITION OF THE SOLUTION - THE PRINCIPLE OF CRADLE TO CRADLE

With the extend of the environmental problems and the consequences becoming clear around the 1960's, it became inevitable reality that a drastic response had to be given. This response can in broad context be understood as 'sustainable development and is specified according to Brundtlandt as *"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."* (Brundtland, 1987). The world's environmental problem being caused by a collaboration of many different factors that concurrently seem to be connected to a chain of another factors, results the scale of the problem being difficult to tackle with one overall solution. Several approaches have been developed to form a solution from different perspectives, for example through an society perspective by reducing consumption rates, an economical perspective by innovating ways to replace fossil energy resources with renewable energy resources, or an political perspective by governments developing multi-year plans to systematically work towards future goals.

The economical model as explained to have dominated the global economy since the Industrial Revolution is considered a *linear economy* (cradle-to-grave). This means that the entire life-cycle of a product including the pre- and after stages is a linear process in which the product is created by first extracting resources, then shaping into a product, use and finally dispose the product as waste. (Mulhall & Braungart, 2010) The eventual product that we dispose in the bin contains on average 5 percent of the raw material of the total raw material involved in the complete process of designing, making and delivering it.

From the perspective of the building industry, a sustainable building seems to be formed by of wide range of solutions in every stage within the life cycle of an building object, component or context, including the pre- and after stages of a building. A principle that proves to offer a solution to creating sustainable buildings in a sustainable building environment is the Cradle to Cradle concept of William McDonough and Michael Braungart that was designed in the 1990's to introduce a new way of thinking and re-interpretation of the linear life-cycle of the build environment into a circular life-cycle. It states that a linear life-cycle of the building environment can be considered sustainable, as it did not cost more then it uses throughout its lifetime. It is 'less bad' by means that it does not further deteriorating the environmental problems, but remains unable to offer an eventually sufficient solution to the deeper roots of the global environmental problem. Cradle to cradle states that this eventually sufficient solution means improving the environmental conditions through a circular life-cycle that is able to produce more than it uses throughout its lifetime and the next. A circular life-cycle requires a shift of building and designing, which is translated into a set of criteria for the building environment. (Mulhall & Braungart, 2010)

The Cradle to Cradle concept is defined by three principles which are stated as *'Waste = Food', 'Use Current Solar Income'* and *'Celebrate Diversity'.*

Positive footprint is not only producing more then the building uses in therms of energy, water and heating etc (building in itself). It is also in therms of behavior in the sense that simulating sustainable human behavior (building towards context) will be transfered to others in their social circle (on and on -> domino effect IF it can be proven that it works?!). It is all about creating and activating/stimulating more and different social and economical chains and it eventually all comes down to human behavior to safe the future as the future is all based on human creating (innovation and technology). Both social and economical forms eventual building environment.

3.3.1 PREINDUSTRIAL MODEL - PREVIOUS AND CURRENT INDUSTRIAL SYSTEM

Economic markets represent their products as sustainable made from recycled materials but their products contain loads of chemicals to improve the quality of the materials in the product after the downcycling of the recycle process. This makes the materials impure and artificial with the chemicals being harmful for both human and environment. The consumer is not aware of this and the economy makes use of this unawareness by their misguiding market strategies. Some producers might have good intentions as they too are not fully aware and believe they are doing the right thing, but unless designed specifically to recycle, the product will always have harmful effects. (page 58)

> *"Blindly adopting superficial environmental approaches without fully understanding their effects can be no better-and perhaps even worse-than doing nothing."* - McDonough & Braungart, 2002. Page 59.

The current industry is a model that manufactures products and building materials and components that are designed to live a linear life. They are designed to last for a certain period and be disposed afterwards, without a build in strategy of regarding the waste as nutrient for a future cycle. This is a description of a cradle-to-grave model creating designs within a linear industrial system. (page 27)

A profitable economic model relies on the concept of One Size Fits All, which is the designing of a product that is meant to support multiple forms of use. Basically one design that can fit in many situation, which is economically efficient/effective as you only have to endure the economic cycle of inventing, designing, producing, marketing etc. a product once and then sell it in as many possible situation. However, what this model does not take into account is diversity in the sense of different contexts of use, different users, different ways of using, different situations and climates it is getting used in. It lacks a certain creativity that allows the adaptability of a product to its context, which is a crucial aspects of a design for the success of a product (page 29). Also this is bad because a product is made and composed of material quantities and chemicals to work in the worst case scenario's. For example the concentration of chemicals in soap to be able to effectively clean the hardest to remove spots and filths (page 30). Or a construction beam that is calculated on the worst case scenario as it has to endure the biggest tension which decides the minimal dimensions and thereby materials quantity of the entire beam and repetition of the beams within the construction, although this thickness and dimensions are not necessary in every point of the beam to successfully construct a building part and to endure safety. From an economical as well as ecological viewpoint this can be considered as a pure waste of recourses as the material is not necessary and can be stripped away without taking away the successful functionality of the product. It could however be a aesthetical design decisions to implement and support such use of recourses and dimensions, which forms an architectural viewpoint that can also be very strongly present in heritage architecture as it needs to fit certain expressions and values for example.

Current economic industry is generally designed to prioritizes economic growth over ecological importance by implement 'brute force' in for example material resources or energy resources to produce more and more to support the consuming behavior of for society in consuming more and more. Producing behavior of the economy (offer) is the result of the consuming behavior of society (demand), and the consuming behavior of society (demand) is the result of the producing behavior of the economy in return, forming a constantly growing cycle with the increasing population. This way of prioritizing economic development is a contrast to ecological development (page 31 & 32). We cant expect the economy to adjust its behavior as they are making money on the current system, so therefore we as consumers have to adjust our consuming demand. As had been said in chapter 2 the consumption rates of society and the scale of consumption by the continuous growth of the worlds population, is expanding rapidly and beyond the capacity that the environment can sustain. But we have already been exhausting the earth for a long time manipulating natural processes with chemicals, which is again an example of brute force. Not only are these chemicals harmful for the health of all forms of biodiversity, humans and animals but also plants and top soil, bacteria and pesticides are growing resilient for the chemicals causing our food intake not to contain these chemicals but also resilient pesticides. (page 34)

The design intention of the current industrial system is to create a One Size Fits All and afterwards disposable product that

looks attractive for the consumer, is affordable, meets the minimal regulations, performs well enough and lasts long enough to meet market expectations. This way the manufacturer makes the most profit with least effort and sufficiently fulfills the customers expectations. These products are specifically designed for economical efficiency and are not particularly designed for ecological and human health. These products are called 'crude-products'. Some of these products may contain additives to replace a certain material that is otherwise expensive or inaccessible, with something cheaper and easier to implement. Cheaper materials often contain added substances to artificially improve the low-quality to a higher quality to reach the product standards. However, these added substances can be harmful and in the form of banned substances in some parts of the world. Although in some countries regulations and governmental instances are strictly against this and regulating as well as they can, manufacturers often are able to integrate such low-cost and low-quality materials or components from other countries where these governmental restrictions are not that strict.

Some of these substances appear in materials used within the building environment, such as insulation material, paint, coatings, and interior fabrics of carpets, curtains or furniture and can contaminate the air quality in- and outside the building with harmful particles that humans or animals breath in. These substances might not be proven to be the direct cause of health effects, they can still have indirect impact. The possible health effects by many chemical substances have not been studied and tested yet. According to McDonough & Braungart an estimation in 2002 is set of approximately three thousand of the eighty thousand chemical substances and mixes used by industries are tested on the possible health effects of living systems (McDonough & Braungart, 2002, page 42). Unfortunately to replace artificial substances by natural substances is not possible as natural processes of growth of these substances can not sustain the growing demands of society. The waste, pollution, crude products and other negative effects of the economic focus of the current industrial system are consequences of outdated and unintelligent design (page 43). This is a reason why the current system is no longer able to work in the future and is beyond repair as the system over time has rooted an irreversible cycle. We have to design a new system...

> *"Poor design on such a scale reaches far beyond our own life span. Our tyranny over future generations through the effects of our actions today... We say the point of leaving behind a positive design legacy is today, and negligence starts tomorrow. Once you understand the destruction taking place, unless you do something to change it, even if you never intended to cause such destruction, you become involved in a strategy of tragedy. You can continue to be engaged in that strategy of tragedy, or you can design and implement a strategy of change."* - McDonough & Braungart, 2002, page 43-44.
> (Although this sounds harsh and sounds like a direct manifesto which I don't want my paper to sounds like, this is a quote that forms my motivating me as a designer to make this my subject of graduation.)

3.3.2 ECO-EFFICIENT 'LESS-BAD' MODEL - CURRENT AND IMPROVING INDUSTRIAL SYSTEM

Sub-chapter 3.1 The Scale of the Problem has described the development of awareness and the scale of the problem. Starting with the notion of dangers of overpopulation by Thomas Malthus as early as 1798, confirmed by other environmental artists such as painters and poets. But this kept on a level of realizing concerns but not directly taking action on it. With the scientific confirmation of these concerns of the human influence of the natural world become more clear and direct with the publication of Silent Spring in 1962 by Rachel Carson. This brought to light scientific data and activated a chain of serious awareness and sparking to take of action within multiple scientific fields and also political fields forming organizations and groups to start thinking seriously about possible solutions. The scientific data presented by Silent Spring and other publications such as The Population Bomb and The Population Explosion by Paul and Anne Ehrlich presented the roots of the problems more specific and direct concluding problems regarding population growth, development of industrialization, in trends of recourse depletion, pollution and food production. Solutions to these environmental problems were introduced starting by suggestions of reducing the increasing consumption of goods and services, and to produce and dispose less. When industrialists expressed perspectives in 1990's solutions were sought not in creating less but creating the same development of quantity regarding production

but more 'eco-efficient'. Eco-efficient industrial solutions were optimizing the industrial system by compromising strategies such as cleaner engines of machines to produce less pollution. The willingness was expressed by the industry in adjusting and optimize the current system with certain environmental benefits but without relinquishing the prioritizing of economic development in costs of profit. McDonough and Braungart describe this economical term of eco-efficiency as "doing more with less". For the industry eco-efficiency aims to reduce waste in a more efficient system regarding time and money. So their perspective on growth is from specifically viewed with economic interest viewing environmental solutions as benefits. Keywords that expresses eco-efficiency are for example reduce, avoid, minimize, sustain and limit. (page 45-51)

A successful business strategy of eco-efficiency is The Four R's industrial strategy, with the four R's standing for Reduce, Reuse, Recycle and Regulate. Reducing resource consumption, energy use, emissions, and waste without doubt has positive effects on the environment. However, it is merely slowing down the still destructive consequences for the environment of polluting emissions, possibly harmful chemical additives, irreversibly using finite recourses. Even though in smaller proportions and quantities, these consequences are still harmful over a longer period of time. It appears to be directly beneficial, reducing is not a way to solve the core of the problem and thereby is a 'Less Bad'. Ways of reducing waste has been commerced as positive but, unless specifically designed to be biodegradable, will remain to influence negative effects on the environment. Similar for reuse of materials, unless material components of a material are specifically designed to be a biodegradable, in itself but also in the process of recycling. The recycling process of products that is consisting of materials that are not designed specifically to be recycled will resolve into a downcycling process. This means that the quality of a material being recycled is being reduced over time. (McDonough & Braungart, 2002, page 56). This reduced quality is the result of the materials being combined into a products without the specific intention of reversing the combining through disassembly. Therefore the result of regaining the unmixed raw and pure starting materials will be impure materials that still have material components of the former product mixed into it. The impure combination of materials causes loss of the original quality of material. For example the recycling process of a valuable metal such as high quality stainless steel of a facade panel. If this panel is recycled without being designed to be separated from its coating and paint, the stainless steel after the recycling process will still contain quantities of chemical substances used in the paint and coatings (as also these might not be specifically designed to be recycled), making the stainless steel an impure mixture, and harmful chemicals to remain in this mixture. This means that the original quality the stainless steel originally had is now less. To bring the downcycled material back to its original quality, more chemicals are often added to make the material useful again to function in another life cycle. The quality and impurity of the original materials will reduce exponentially with the repeating of downcycling into multiple life cycles, until it is eventually too impure and low quality that it is not useful anymore for a new life cycle and will be discarded as waste in result. The purity of the stainless steel not being 100% anymore means that the product is not endlessly recyclable, although it does significantly increases the lifespan of the material it is a form of a 'Less Bad' approach. Despite good intentions of the industry towards the environment, commercing products based on recyclable products and materials can be a misleading business strategy for consumers. Because manufacturers present their recycled products as creative, intelligent and purely beneficial (logically) without mentioning or making visible the downsides of the recycling process, despite of themselves being aware or unaware with good or less good intentions, manufacturers and companies are able to make use of the unawareness and good intentions towards the environment of consumers that believe to 'do the right thing' by buying the product. Representing products as sustainable can be a misleading business strategy which is not only economically unfair but can also form ecological harm for the health of nature and humans. For example when people believe they are using a good product not at all harmful for the environment because it is what they are told by the manufacturer, users could for instance dispose it wrongly or expose it to sensitive organisms like young children or pets for which breathing in small particles of a chemical impure mixture can be harmful for their health. Especially on a large scale (global behavior of economical and society), less aware adoption of environmental approaches by both the economy (producers) and society (consumers) without fully understanding the effects can still lead to harmful influence.

> *"Blindly adopting superficial environmental approaches without fully understanding their effects can be no better - and perhaps even worse- than doing nothing."* - McDonough & Braungart, 2002, page 59.

With the development of technology the possibilities of recycling processes are increasing rapidly and are becoming more efficient. Reaching 100% recyclability is currently possible for materials and products that are specifically designed to be recycled (page 57).

The movement of eco-effectiveness through such strategies present direct solutions in slowing down the negative effects of remaining to be unsolved long-term problem, by introducing solutions that are 'Less Bad' then doing nothing and keeping the old system. Although it appears to do good on the short term, relying on eco-efficiency nevertheless represents a finite linear cycle for the natural planet, however an extended and slowed down cycle because of 'Less Bad' integrations in the existing system. As long as the current industrial system will remain, however optimized, the roots of the problem too will remain. Implementing changes in the design of the system by enabling a shift of priority from economical efficiency to ecological efficiency that can instead of being 'Less Bad' actually be an eco-effective solution to truly form a solution to the large scale root of the long-term problem, provided that they are designed specifically as eco-effective. Also policies has become more and more strict and have become effective now, as political restrictions from governmental instances, in forms of law reinforcement, sanctions, and sharper requirements for official certifications and licenses, are a way to regulate the economical efficiency of industries. An example of regulation could be a change of certifications like BREEAM or LEED being a requirement instead of a reward by governmental instances. The downside of governmental regulations is that they work best in general contexts, it is difficult for regulate divergent, distinctive and unique contexts. (page 59 and 85) That means that there are plenty of eco-effective opportunities now (especially in comparison with the publication date of the book in 2002). Information regarding this is provided by data basis that give specification on what materials and chemicals are harmful and should therefore be avoided by designers and consumers etc...

Going to Mars to start colonies on a different planet appears to be the latest and maybe largest and most revolutionary example of human Less-bad behavior. It doesn't matter if our destructive behavior is on planet Earth or on planet Mars, if we don't adjust our behavior it is inevitably a matter of time until we will run into the same problem we ran into on depleting Earth. Having witnessed how quick the destruction of a planet can go based on the development of technology within the economy our society supports, which is a matter of a few decades, it will not take long until we have to find yet another planet to move to and exhaust is result. 'Fleeing' to another planet is simply delaying of our own destruction but now on a different planet, it is not solving the root of the problems and will again spread like an infection but now simply supporting the same unsolved problems on a different planet. From that perspective this would be the current ultimate case of Less Bad behavior. This example shows that we do have all the recourses available to develop evolution; money, time, ambition, creativity and intelligence, but maybe in a 'less-bad' design of thinking.

3.3.3 ECO-EFFECTIVE MODEL - IMPROVING AND FUTURE INDUSTRIAL SYSTEM

Eco-effective, how to create an environmentally responsible, durable and infinite design, without taking away aesthetics or user comfort and convenience? The principle of the cherry tree is a model that explains the definition of eco-effectiveness based on the natural cycle of a cherry tree.

> *...thousands of blossoms create fruit for birds, humans and other animals, in order that one put might eventually fall onto the ground, take root and grow. Who would look at the ground littered with cherry blossoms and complain, 'How inefficient and wasteful!' The tree makes copious blossoms and fruits without depleting its environment. Once they fall on to the ground their materials decompose and break down into nutrients that nourish microorganisms, insects, plants, animals and soil. Although the tree actually makes more of its "product" than it needs for its own success in an ecosystem, this abundance has evolved (through millions of years of success and failure or, in business terms, R&D), to serve rich and varied purposes. In fact, the tree's fecundity nourishes just about everything around it."* - McDonough & Braungart, 2002, page 73.

The example of the natural cycle based on the cherry tree is visible in all other cycles of biodiversity. In species of animals, plants even the tiniest of organisms have their function and position in the natural cycle. All life forms have a purpose that are intertwined to each other. If a life form or specific species falls away by extinction, so does its function and position in the ecosystem. This can have lots of influence of the cycles of other forms of biodiversity. The cherry tree is a mere example of any other natural cycle that produces in its own exceptional way from which is influences other natural cycles but is on its own turn depending on the influence of the products of other organisms. Every system supports each others essence, without this support an system might longer be able to exist causing this organism and all other organisms depending on this system to seize to exist. (See BBC One-Planet for quote and examples)

The principle describes a manufacturer of products designed for different forms of use and benefit for different consumers. The products that will not enter an economical cycle or will simply not be sold will 'fall on the ground' to form a nutrient for another cycle. So unused litter that does not get used is not litter but stimulates nutrients for the same process to repeat. This means that the manufacturer would not be producing waste products anymore but merely forms nutrient for the same production cycle or another. The manufacturer is able to make a wide range of products as many to suffice the demand of society without depleting the environment. In fact the quantity of production may be unlimited and even encourages to produces more then the actual demand for the product as the process of production stimulates the environment. Economic growth and productivity does not necessarily have to sacrifice itself to environmental growth as the production and consumption can enforce and improve the health of our planet provided that we our system is specifically designed to do so. Economic growth should not be gained (through brute force) on the expenses of the ecosystem and the quality of life, and environmental growth should not be gained on the expenses of the industrial system. There should be a balanced aim for both systems of growth. Both economical and environmental should not focus on an individual benefit but have to engage with each other to reach a balance. Not designing for a single purpose but beneficial effects for others in its process, just as in the balance of interdependency of every organism within the natural cycle. (page 79) This way we could still strive towards gain, benefits and growth both economically as environmentally with regards on species, habitats and human health (page 90).

> *"The key is not to make human industries and systems smaller, as efficiency advocates propound, but to design them to get bigger and better in a way that replenishes, restores, and nourishes the rest of the world."* - McDonough & Braungart, 2002, page 78.

> *"Just about every process has side effects. But they can be deliberate and sustaining instead of unintended and pernicious. We can be humbled by the complexity and intelligence of nature's activity, and we can also be inspired by it to design some positive side effects to our own enterprises instead of focusing exclusively on a single end."* - McDonough & Braungart, 2002, page 81.

Example is deforestation? It is fine to cut trees and enjoy the gift of nature through to possibilities of our technology. It is fine to enjoy such natural products in the responsible quantities that nature can offer them instead of trying to provide what we 'want', which is not the same as what we 'need'. For example cut specific trees in regulated amounts not only based on what we economically want to produce but also based on what nature can produce back what we use, without taking away all habitats for arboreal species. Economical system of demands of society and offer by industries, should be in balance with ecological system to be able to use renewable resources that in response can be endlessly recycled for efficiency or biodegraded (technical or biological cycle) (based on Menominee example page 88). Use what we need, not simply what we want. Data throughout history has proven that exploiting behavior of recourses is simply not supported in availability, Earth's recourses are finite and we have to deal with it in use, or modify it through eco-effective design (waste = food). Without using modified natural system by aim for economical growth by implementing brute force through the use of chemical additives and synthetic fertilizers. Partially caused by general unawareness? page 95

Evolutionary shifts are heavily time-relating and are impacted largely by tastes and trends in society, economical progress and the position and development of technical, political situations and decisions such as regulations, crises or tensions (war). (page 86, will return later in the triangle image).

An eco-efficient building is to be described as:
An energy saving building through measures integrated in the design. For example reduction of thermal leakage and the reduction of solar income by small dimensioned windows to prevent the building from heating up during summer season. This way reducing the cooling load of the building by active systems that run on fossil fueled nonrenewable energy sources and are made by downcycling materials and chemical additives that delivers polluted emission in the inside air that is afterwards send into the environment. Other materials in the building such as construction and building materials or materials of interior furniture are made of depleting raw materials mixed with possibly harmful chemicals that may or may not be tested for its influence on surrounding environment over time of use. Some materials have been imported and transported from countries far away where labor is cheap and in poor working conditions. Though the lower costs of these imported materials save an financial sum that is now free to be spend on a heat recovering system that needs to be dug in the ground in the relatively dense urban surrounding that forms the context of the building which will produce a lot noise and the company that does the digging needs to travel a hundred kilometers with the companies van that runs on a benzine engine... (page 75)

An eco-effective version of this building could be described as:
An eco-effective building produces more nutrients than would go into the building. This building features large dimensions increasing the solar income into the building heating system in a natural way from a renewable energy source. The dimensions of the windows support plenty of view perspectives onto the vegetation of the surrounding causing an enjoyable atmosphere inside the building that stimulates creativity and productivity by the users of the building, but also allows and stimulates users to go outside to have lunch, meetings or other socializing events outside. Windows are able to be manually opened and temperature and fresh air is manually controllable for the users personally preferred comfort and is backed up by sensors that automatically detect and regulate the input of heated or cooled fresh air to ensure a balanced and healthy indoor climate. The climate system is powered by solar energy from a solar-plantage on a nearby field just outside the urban context, that produces enough energy to not only sustain the need of the building but also provides natural energy for the neighbors. The materials used to fabricate the system is made of fully recyclable (upcycling) or biodegradable materials that do not include chemicals possibly producing harmful particles polluting the inside air of the building. And come from a local manufacturer within a radius of thirty kilometer. The roof contains a green roof to insulate the building by absorbing solar heat, absorbing and filter rain water enough to suffice the sanitary needs of the building and to water indoor or outdoor vegetation, forming a habitat for animals and forming healthy top soil for vegetation to grow without artificial stimulant. (page 75)

This eco-effective design of the same building is in comparison just as energy efficient and goes further in generating a little extra (more then the building uses in its complete life cycle). Instead of eco-efficient focusing on what not to do and making the wrong things less bad, aim for eco-effectiveness; a more intelligent and creative design specifically designed to function in the unique context of this particular building providing comfort for the economical and natural context and enhances the quality of live for a diversity of living organisms in and around the building. This example doesn't fully cover all principles of eco-efficiency but can spark future evolution and form a representational model of creative design strategies and solutions that could be a reference and form of inspiration to others (architects, manufacturers, consumers etc.)

> *"It's not the solution itself that is necessary radical but the shift in perspective with which we begin, from the old view of nature as something to be controlled to a stance of engagement."* - McDonough & Braungart, 2002, page 84.

3.3.4 WASTE = FOOD (NUTRIENT)

As the Cherry Tree principle pointed out earlier, natural systems operate through continues cycles of nutrients and metabolisms, disregarding the concept of waste. The natural balance of such continues cycles instead of linear waste cycles has ruled

Earth from existence, until the development of industry in the second industrial revolution. The impact of this development changing the natural system of waste causing imbalance of resource use and waste cycles is clearly visible in ... image (look at waste graph Gerding - part 1 page 17). The natural system was able to suffice both environmental and economic demands, which changed with the development of technology being able to support the growing demand of society driven by the focus on eco-efficiency by the industry. In contrary to the natural preindustrial system, technological development enabled more efficient manufacturing processes which became mechanically driven and therefore able to do more in less time (eco-efficiency) along with enabled the accessibility of recourses needed for this process to demand the growing demand of society. In these eco-efficient industrial processes, products are designed to become waste after its life cycle and not nutrient. This linear cycle is called a 'cradle-to-grave' cycle in which the waste is the end of the life-cycle of a product without being treatment as nutrient for another life cycle. This features the cradle-to-grave approach and forms the typical eco-efficient waste system. Linear production processes are designed to discard and neglect the value of limited accessible raw resources in outdated bad or less-bad systems possible encouraged by the possibility to synthetically and chemically improve downcycled materials by fossil fueled mechanical systems (explain more specifically with earlier description). Industrial production are overly accessible, causing the economic demand of society to be unlimited in this sense, which allows irresponsible consuming behavior to take place and the wanting demand for more to be economically supported and commercially encouraged. Currently considering waste as nutrient is possible with the developed technology we have access to today. Yet for the industrial system, these nutrient flows of products designed to become waste are often viewed as an expensive and inconvenient way of treating waste in comparison with their existing waste treatment system that is simply designed for optimal eco-efficiency and not for environmental health. Waste treatment in such industrial systems is often more direct by disposing it quick, easily and conveniently considering it 'gone' without further having to mind about what is next, 'out of sight is out of mind'. Is this general lack of interest or lack of knowledge and awareness both by manufacturers and consumers (page 95)? Although the consequences of such waste treatment includes materials no longer being economically valuable since the material is not being used anymore, nor being ecologically valuable since it is contaminated and harmful for the ecosystem, never being able to regain that value as it is not designed to. Both traditional and eco-efficiently improved production cycles are designed to consider waste as end of the linear cycle and are therefore cradle-to-grave approaches.

In opposition of the linear cycle of the cradle-to-grave approach, the cradle-to-cradle approach suggests a fully repeatable cyclical cycle, referring back to the natural principle and preindustrial balance of biodegradable waste cycles. It suggests the reintegration of natural biodegradable waste cycles into the material flows of current industrial cycles. Based on this natural principle, current material flows can be divided into two categories of material flow cycles; the biological metabolism and the industrial/technical metabolism. Unless specifically designed for an eco-effective process in which waste is 100% recyclable (upcycling) forming an infinite nutrient cycle in either the biological metabolism and the industrial/technical metabolism, a fully repeatable cycle can never be accomplished, the destructive eco-efficient an harmful linear process remains to dominate. Based on the substances and components from which a materials or products is made, materials can either belong in the biological metabolism or the technical metabolism. The biological metabolism uses strictly biological nutrients useful to the biosphere, where technical metabolism uses strictly technical nutrients useful to the technosphere.

A biological nutrient is to be defined as a material or product that is designed to return to the biological cycle, by becoming food for organisms such as microorganism in the top soil (McDonough & Braungart, 2002, page 105). Products for temporary use such as packaging material (forming about fifty percent of the municipal solid waste streams according to McDonough & Braungart, 2002) can be an significant example of a biological nutrient that could be designed as biodegradeable to be tossed away in nature to form safe and health compost for top soil (McDonough & Braungart, 2002, page 105) (For example of natural nutrient is Styrofoam in China where packaging is designed not only to be biodegradable but also contains nutrients in itself to benefit the top soil. So it is designed to not only be safely and quickly decomposed in biological metabolism but to do more in the process and truly benefit the environment (for technical metabolism this could be safely degradable to form nutrient as fuel - page 145). With this it becomes better to dispose your packaging in nature than not to, so yes please throw in nature as much packaging waste as you can! page 140). A product designed as biological nutrient is called a 'product of consumption'. A technical nutrient is to be defined as a material or product that is designed to return to the technical cycle, by becoming food for the technical metabolism of an industrial process. Isolating these nutrients in technical cycle within a recycling process with pure materials able to be disassembled, allows the recycling pro-

cess to result in upcycling instead of downcycling maintaining the original quality- or even improving the quality of the material. This way the material is 100% recyclable and can function as nutrient in an continues and infinite technical cycle. To effectively be able to take part in these metabolisms materials belong to the one metabolism should not be mixed with materials from the other metabolism. Mixtures as such are called 'monstrous hybrids' and should be avoided as they are unable to effectively take part in a metabolism, as mixing of materials can cause impurity of other nutrients in the cycle resulting in eventual downcycling thereby disturbing the closed-loop metabolism (page 98 and 104).

With the importance in mind that the nutrients in both cycle remain pure and unmixed, it is good to ensure that the products are safely discarded and separated in the right way. For the technical cycle this would specifically mean to ensure that after use of the product the product comes safely and pure in the recycling process. A concept that supports this is for example the concept of 'product and service' or 'eco-leasing'. This concepts proposes the change of the conventional transfer of ownership that comes with the process of selling of a product. Instead of the consumer becoming owner of the material after purchase, the manufacturer that sells the product will remain to be owner of the material. In other words the consumer leases the material in the product to use through service and after service hands it over to the manufacturer again for him to safely discard in the most convenient and optimal way for the manufacturer to disassemble the materials to become usable nutrient for the recycle process. This way the owner is not burdened with this responsibility of a certain way of discarding the product that is often inconvenient for the user and thereby doesn't always happen, let be on a larger scale where the consumer remains to have this responsibility for many other products of daily use. And although people are comfortable with the idea of being owner of a product or object, the materials that the product is made in itself is without value and wasted in ownership (linear process) and otherwise remain valuable for both industry and environment to eventually ensure the quality of life which is also benefiting for humans. Without becoming owner the consumer can still be provided with comfort, flexibility and fulfillment of new demands, either necessary or just wanted. The manufacturer in response would be happy to on the one hand provide service gaining social status and economic growth as result and on the other hand is valuable as he can ensure the quality of the product to stay useful for the production or development of a different or new product to make the next costumer happy with. This means that the manufacturer has interest is discarding the product the right way resulting in pure and quality materials without chemical toxins for the recycle process, which is a lack interest for the consumer that would otherwise be owner as the consumer after use no longer directly benefits from the product and its material. This principle could also work very well for building materials and products with a limited life span or elements you might want to change over time (for example the facade, to provide a new expression in a changing context), and could also be suitable on the interior in regard to furniture such as chairs, carpets, curtains and printers.

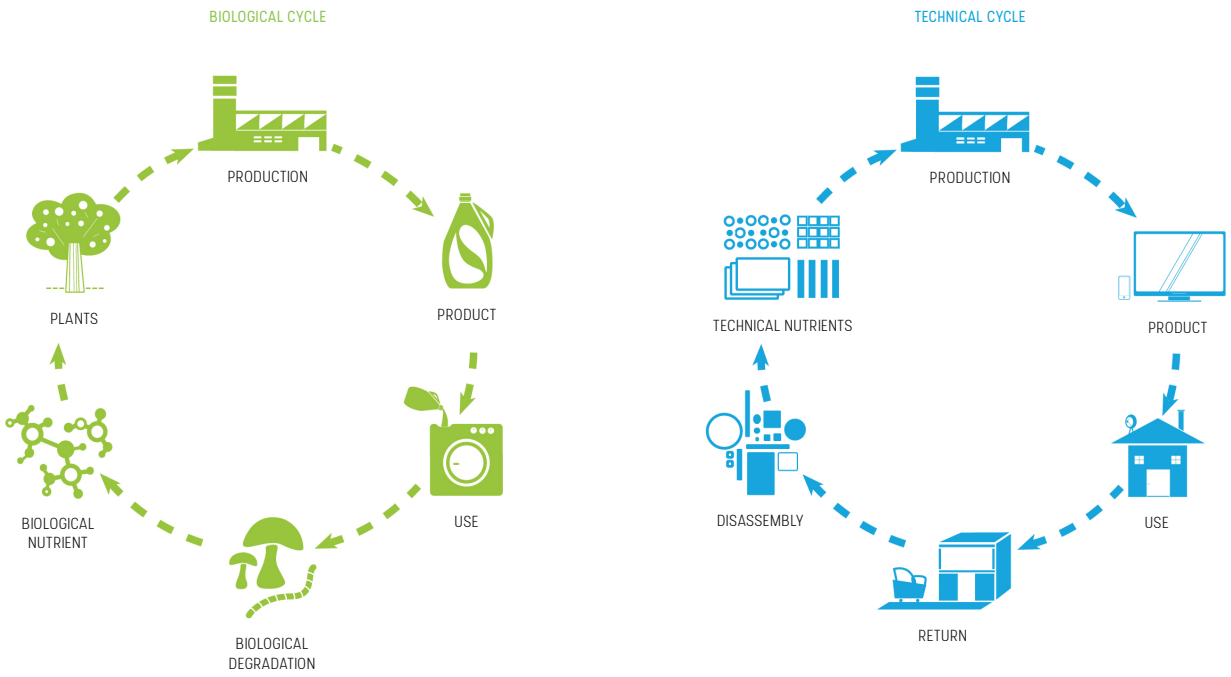

Image 06: The biological and technical cycle.
The cycle of metabolisms according to the cradle-to-cradle approach to form a continuous closed cycle instead of the linear cycle of the cradle-to-grave approach.

At the 'end' of the cycle such a concept that redesigns the traditional system, which is in this case ownership of materials in products, contains benefits of all systems by providing economic interest for the manufacturer, interest in the quality for both the consumer and the manufacturer and environmental interest for all people, organism and natural systems within the ecosystem. Considering waste as nutrient within the cycles of metabolism results in benefits in both economical interest and environmental interest as there is no useless and potentially hazardous waste produced and discarded, manufacturers can safe billions of dollars in valuable materials over time, and the extraction for raw materials is significantly diminished since material will maintain its original value in continuously repeatable cycles. It is therefore both economically and environmentally responsible to consider waste as nutrient.

With the development of technology the possibilities of recycling processes are increasing rapidly and are becoming more efficient. Reaching 100% recyclability is currently possible for materials and products that are specifically designed to be recycled (page 57). For existing materials and products that are designed to become waste and manufactured in a cradle-to-grave system, materials that are called 'unmarketable', a solution needs to be developed to best be degraded or recycled as possible without forming hazardous monstrous hybrids (page 116). With the right technical development the existing stock of products and materials can get purified as best and pure as possible to form the most optimal output of the old linear system as possible and the most useful input for the new continuous system, forming a shift from a cradle-to-grave system tot the large scale implementation of the cradle-to-cradle system. How far is such technology currently developed, also in comparison with 2002 which is the year of this book being published??

To shift from to a cradle-to-grave system to an cradle-to-cradle system we have to change our mindset and rethink the way we design, manufacture and use things. We have to become aware, learn to integrate and support the change of our mindset (that is the function of the Jacobuskerk)(page 103). From the inevitable ecological essence for Earth to sustain life that can no longer be ignored in respect and balance with the economical aim of responsible growth, both systems profit form the benefit of eliminating the concept of waste in a linear cradle-to-grave cycle but adopt the idea of waste as nutrient for the metabolisms in a continues cradle-to-cradle cycle 'form follows evolution' (page 104).

As has been explained by The Cherry Tree principle, the Earth offers a limited amount of material resources and should therefore be considered as valuable. Everything man made material product is designed to become waste unless designed otherwise.

> *"The organizing principle for meeting human development goals while at the same time sustaining the ability of natural systems to provide the natural resources and ecosystem services upon which the economy and society depend. The desired result is a state of society where living conditions and resource use continue to meet human needs without undermining the integrity and stability of the natural system. (Brundtland, 1987)."* - Delft Lectures on Architectural Sustainability (2019), Kristel Aalbers

3.3.5 SUPPORT DIVERSITY

Nature grows where there is no influence by human creation or where there natural growth is considered in the design of human creation. This makes natural growth contain ultimately abundant, flexible and diverse characteristics. Human behavior of producing and using allows less space for nature to grow, especially the build environment. We build infrastructures and urban contexts so dense that there is almost no room for nature to thrive. We thereby not only have negative impact on the ecosystem and biodiversity but also for our own quality of living as we ourselves as humans ourselves are also a product of nature depending on natural qualities to function optimally and live with the feeling of happiness. With the evolution of our human created world we have contradicted with the evolution of ecology, since it was never designed with ecological growth or sustaining in mind. Not including this in the design of our economical creating behavior and development means that our design lacks the natural character of abundance, flexibility and diversity. It lacks the principle of 'respect diversity' with which McDonough & Braungart mean the including of not only biodiversity in our design of human creation, but also diversity of place and of culture,

of desire and need, the uniquely human element (context) McDonough & Braungart, 2002, page 119.

As explained before with natural cycle based on the metaphor of The Cherry Tree principle, the vitality of the ecosystem had been pointed out to be depending on the diverse roles, positions and relations of different species and life forms in the balance of the ecosystem. Every species and life form is essentially responsible for their own unique function and position in the ecosystem in a chain of interdependency for organisms to survive and fulfill their own unique role in the ecosystem. When this chain gets interrupted or broken it means the another species that is depending on this link can not longer sustain his role in the ecosystem and will not survive, with extinction is possible result. The more species there are in the ecosystem to back up and fill in this interruption in the chain as a result means that this chain in the ecosystem is less fragile, enduring stronger resilience and a healthier balanced ecosystem. This means this cycle is not only able to maintain to exist but it also determines the success for growth and survivability for this specific chain in the ecosystem and therefore the ecosystem as a whole. In other words, dependency on a small and limited amount of species makes the ecosystem fragile, greater biodiversity ensures the resilience, health and success essential to the ecosystem to survive and grow (page 121). Supporting biodiversity means respecting local context and ecosystem to positively influence the global balance of the whole (page 125).
(See BBC One-Planet for quote or example and maybe an image)

The economic growth and development of our industrial system and building environment should respect the essential evolution of ecology and ensure the biodiversity on which the ecosystem relies possible. "Industries that respect diversity engage with local materials and energy flows, and with local contexts social, cultural, ecosystems and habitats, and economic forces, instead of viewing themselves as autonomous entities, unconnected to the culture or landscape around them." McDonough & Braungart, 2002, page 122. Human systems and industries should recognize that the source of sustainability is the local context. Use local materials, energy flows, social and cultural needs, trends and tastes. This also means aesthetic fitting or distinctive in the local context of the building environment forming the context. "Recognize interdependence. The elements of human design are entwined with and depend upon the natural world, with broad and diverse implications at every scale. Expand design considerations ad recognize distant effects." McDonough & Braungart, 2002, page 123.

Using local material recourses, production processes and services supports local businesses, manufacturers and craftsmen. This means that local economy is supported, as low as possible emission of transportation and supporting the balance of the local ecosystem. Aside from emissions of transport, emissions and possibly hazardous pollution of chemicals in mixtures should be avoided. In some scenarios of purifying systems such as rainwater, a way of replacing conventional chemical additives as purifying treatment can be through a natural process of living organisms such as plants, fish or algae. These living organisms use particular toxins that has integrated rainwater through air pollution as nutrients to feed on and thereby purifying the water for further use. Such a process can naturally function throughout all seasons of the year and can be made visible in a building for people to pleasantly see and become aware of the natural water filtering system with which they flush the toilet, or even safely drink (page 125 and 126). Since the purification and its benefits becomes directly visible and useful it becomes closer to you as a human influencing the pollution or air and water through emissions. This makes that a consumer in society has an interest in forms of direct use, to keep the water clean and pure. Aside from pollution thereby becomes not so bad after all as it can form a nutrient to natural organisms, not all forms of current pollution or chemicals are purifyable in a natural cycles, and should nonetheless be avoided.

(are these paragraphs not also renewable energy sources?) With the possibilities technology provided to overrule the natural system with 'brute force', the preindustrial connection of human and nature became disconnected, as people were no longer depending on the natural balance since they could modify and overrule it with technology and machinery. As McDonough & Braungart beautifully phrase *"Our structures might be machines for the living, but there was no longer much about them that was alive"* (McDonough & Braungart, 2002, page 129). By this they means to say that buildings became optimally efficient like a machine, regarding functionality of use and space but the functionality is not all that makes a space in a building successful and a pleasure to be in as user of the building. Would a human feel more comfortable, creative and productive in a natural environment then a technical environment? (although this comes to the issue: "what is a natural environment? natural materials such as wood and stone?).

Also the comfort and convenience provided by technology can generally prevent the human ability of creative thinking with the materials and knowledge at hand. Smart and intelligent systems of technology take us so much out of hands that we

otherwise have to think of and enable the spark to creative thinking. There are very creative solutions designed through inspiration of very primitive natural processes or preindustrial systems just because people at that time had no other choice than to think creatively to come to a solution as there was no machine that could think for them. Industrial efficiency prevents creative natural processes to take place as they are overtaken by much more economically efficient systems. To spark creativity and intuitive thinking, could it hurt to bring back more manual processes, in stead of automatic processes taken over by technology? This could save electricity and valuable materials necessary to produce these automatic systems, although we could also do it manually without problem, for example closing blinds or opening door and windows. Some tasks that technology has taken over are unnecessary 'convenient' besides they can take away interaction of human and the building and take away the feeling of control in and a connection with the building and its facilities/services through manual interaction.

We should think about how to merge the environmental efficiency of ancient and preindustrial processes (human intelligence) and design with economically efficient technological processes and design (artificial intelligence)? To do this because it will be a long term shift on large scale a transitional solution in the future could be to combine both efficiencies in a hybrid model based on the existing technology and products, which are not designed as valuable to recycle (down-cycle), draw upon local renewable energy flows and sources in addition to existing artificial sources in the mean time that more optimal solutions are being invented and implemented (page 131). Is such technology in the meantime already developed???? - Not sure if I agree. Also design a building as much and efficient as possible as passive climate systems, using renewable energy sources like the sun, rain, temperature of the earth (all depending on what the context naturally provides) through architectural design, that can be supported in remaining need and peaks by an compensating active but eco-effective system. So a hybrid system can be cradle-to-cradle if it is optimally designed as passive system supported by an eco-effective active system (page 136). With the design take into account that every context is unique and according to different circumstances (habitats, climate, culture) provides different opportunities. Therefore every design is unique and designed specifically for its own context.

In this transition from the existing technology to renewable energy flows it is important to recognize that *"the eco-effective perspective, the greatest innovations in energy supply are being made by small-scale plants at the local level."* (McDonough & Braungart, 2002, page 132). In regards to a local system facilitating a building directly, there is no efficiency reduction by the energy being lost through transmission during the traveling distance from plant to building. In addition to that, it being a small and local scale system is beneficial in the sense that smaller utilities provide with direct usability and adjustability of control because the system can directly react on the building own supply need and peaks. It is also convenient in maintenance as it is compact, low tech and less depending on difficult factors causing problems in large scale systems. So instead of becoming dependent on large-scale power-generator designed to meet peak energy loads (therefore inefficient in generating non peak energy loads), it might be both economically better for the energy producer (less loss means he has to produce less) and better for the user (more convenience). Leasing the system such as solar collectors, which are build from many valuable recourses that are becoming rare materials, means that the manufacturer is interested in recycling the products, which is important since systems such as solar collectors are still undergoing many technical developments to make them more and more efficient, which is in response for the benefit of the consumer as he wants to have the latest more efficient model, and beneficial for the environment because the new model will be eco-effectively designed in the cradle to cradle system. Local residents and businesses can make use of their own roof surface to integrate the small scale local system of solar-collectors and can ask to rent the surface of other local roofscapes as well, to still make use of these otherwise unused surfaces (unused = waste). (Is the technology for solar collector systems already developed to be designed for disassembly of these valuable and rare materials, such as cadmium, aluminum and copper? Otherwise, they are not cradle to cradle as they are not designed for the technical metabolism. Ultimately the cradle to cradle approach strives to design processes and products that not only are eco-effective to be fully returned as nutrient into the biological and technical metabolism (using 100% of what we produce, and produce 100% of what we use), but to create more (using more than 100% of what we produce, and produce more than 100% of what we use).

Attractive and useful architectural design enables a building to be suitable for future life cycles as it maintains the opportunities and values (the case in heritage). Successful architectural design is in that sense future-proof. Like the church, successful design consists of a set of values that will not go to waste as it is successful architecture and useful design. This makes a building after its life cycle suitable for another life cycle, if it is designed that way (eco-effective, disassembly for nutrient in endless cycle, celebrating diversity and flexible to adapt to changing needs and contexts etc.) (page 139). In particular this adaptability to future changes is important for successful design. The eco-efficient concept of one-size-fits-all, for industries

to design for mass customization, is explained to be a conflicting way of designing with the aim for diversity in the essence of local designing fit to unique and distinct context. Eco-effective design demands a coherent set of principles based on nature's laws and the opportunity for constant diversity of expression to fit in its current context and any future contexts. The context of the building environment is constantly changing over time based on the economical situation and the development of technology, political circumstances, ecological needs, changes of the surrounding building environment, cultural preferences from society, and social tastes and trends. Therefore buildings must be designed to adapt to future changes of contextual circumstances in an eco-effective way, 'Form Follows Evolution' - McDonough & Braungart, 2002. Page 141. This applies for a buildings aesthetics, materials, structure, ability to disassemble, use, function, spatial layout, atmospheres etc. So don't limit designing by basing it only on previous and present circumstances and needs, include possible future circumstances and needs in eco-effective designing. Design for a future world of cradle-to-cradle human behavior, as it could well and hopefully be the future (industrial re-evolution).

Similar as ecological diversity earlier described to be essential in the resilience of the ecosystem, resilience through diversity also applies for the economical system. An distributed industry with many different businesses and manufacturers create a more stable system for both provider and consumer. As both the manufacturer and the consumer are less dependent on a certain provider to deliver a certain demand for product or service. This creates more flexibility and a better balance of price and quality through an economic market model that is less controlled and decided by big oppressing companies and cheap manufacturers.

- Respect diversity. The design and concept of the church should engage with local materials and local reuse cycles, local services of labor (business, manufacturing, craftsmen - supporting local economy), and local energy flows. These local materials should be design to take part in either biological or technical cycle (disassembly) which should be locally sustained and visible. The building should respond and interact with its local contexts socially (community, businesses and public on the location), cultural (heritage existing building environment) results in the fact that it takes part in the existing spirit of place, supporting habitat of biodiversity, aesthetically fit in or **distinct** itself from expression in its context (material, techniques and style etc P1), creating own and unique spirit of place and ecosystems and habitats. Instead of viewing themselves as autonomous entities, unconnected to the culture or landscape around them. Such a design and concept can be passed on by local next generations and grow uniquely.

The growth through the balance of economical and environmental systems needs to respect the specificness and diversity in context...

From 'triple bottom line' to 'triple top line'. Conventional design criteria being: cost, aesthetics and performance, are mainly deriving from economical perspective. The balancing of this traditional economic focus with ecological and social focus proves to have positive effects for integrating sustainability on the business agenda. Unfortunately, through integration over time, the triple bottom line merely created minimal accountability of ecological and social concerns. In practice the design is often created from the central focus of economical benefit, with ecological and social benefits as an afterthought without being weighted equally in the design from the beginning of the design process. In other words, the design process is often started from an economical primary perspective, and the ecological and social from a secondary perspective later in the process. By doing this ecological and social concerns (not being less important than economical), are becoming a design criteria in a stadium too late in the process to become of influence in the eventual design (maybe want to add the graph that shows the influence of the design in the design stage). The triple bottom line design strategy focusing solely on economical perspective thereby can obscure opportunities that an innovative and creative design process can offer. Ultimately the accountability of all three perspectives should be considered from the beginning of the design stage. The triple top line concept shifts the accountability of all three design perspectives, economical, ecological and social, to the beginning of the design concept. By integrating ecological and social perspectives it becomes possible to design products that enhance the health of the ecosystem and culture while generating economic value. When the principles of eco-effective design are applied all three perspectives can benefit and grow as result (McDonough & Braungart, 2002. Page 251)

In image 07, a visualization tool is shown based on the Fractal Triangle as a model described by McDonough and Braungart [4] (McDonough & Braungart, 2002). This model expresses the relations between the three perspectives of economical, ecological and equity, to help designers from the start of the design process in setting balance the aim and strategy of the product and its process. In applying so, this tool help designers to apply triple top line thinking throughout the design process, and to work towards dynamic, intelligent and fertile design for the benefit of all three sectors [5] (McDonough & Braungart, 2002).

3.3.6 INTEGRATE RENEWABLE ENERGY

> *"For the majority of our simple energy needs, humans could be accruing a great deal of current solar income, of which there is plenty: thousands of times the amount of energy needed to fuel human activities hits the surface of the planet every day in the form of sunlight."* - McDonough & Braungart, 2002. Page 32. This is confirmed by Peter Lescuere in Delft Lectures on Architectural Sustainability (2019), Peter Lescuere.

3.3.7 INDUSTRIAL MODEL OF THE FUTURE

The ultimate aim of the Cradle to Cradle manifesto is to shift from the current eco-efficient industrial system to a future eco-effective industrial system. This shift is suggested to be possible from the small scale (local) implementations to large scale (global) development of a new behavior of designing based on the C2C aspects explained in this chapter to eventually be able to maximally develop the multiplicity growth of economy, environment and equity. The transition from the current traditional way of thinking and designing to an eco-effective way of thinking and designing is suggested as an 'industrial re-evolution' to integrate this shift globally over time. According to McDonough & Braungart this industrial re-evolution is a process that implements the aspects of eco-effectiveness over time from local to global, which requires an gradually organized set of changes into practice. Although it might be inconvenient and therefore seem undesirable on the short-term, it enables opportunities towards long-term benefits and growth that are never possible with the maximizing of the current system of designing. A new way of thinking than the way of thinking that created the problems is an inevitable challenge toward a livable future (McDonough & Braungart, 2002. page 165).

Step 1. Get "free of" known hazardous substances

Eliminate the substances recognized as harmful. However, commercing the product with 'free of the particular substance' can be misleading as it then becomes the question what the hazardous substance is replaced with. Replacing it with another substance or adding something else might resolve in new unwanted effects. Eco-effective manufacturers should be honest, and most likely will want to be honest, about the substance it is getting replaced with. It could be that with removing a particular harmful substance from the product could lead to the original product no longer functions. To make the old product function again it means that the process of manufacturing it has to be redesigned. From the beginning of the redesigning of this process it should be included that no harmful materials are going to be involved in the process. Include this with other eco-effective design principles or particular positions in the 3E Fractal Triangle at the beginning phase of the designing.

Step 2. Follow informed personal preferences

For the nutrient equals waste concept of eco-effectiveness it is important to understand which substances a material is made of and what the potential dangers are of chemicals or additives in the product. As described earlier in this chapter (where?), there are large number of chemicals that are potentially harmful but not yet scientifically researched. In addition this number rises exponentially since new chemical substances are discovered in a higher rate then is researched, as a mixture of chemicals can easily create a completely new chemical or new effect between existing chemicals, causing new possibilities of harm. Therefore detailed information of some substances of materials, chemicals or other additives could be unknown or undefined, and could either take long over time or remain unknown because of constant creation of new substance mixtures. Most available information about substances, materials, chemicals or other additives of products is made accessible for designers in material databases. These can be used to help designers make choices in what materials can be implemented in accordance to

the concept of eco-effectiveness within cradle-to-cradle. Designers must work with the information there is to which material databases are an accessible platform. If information shows to be not yet researched or not accessible in a material database than specific certifications or approving seals of a material or product can support the design choice.

Make sure to learn about the validity before implementing. Designers choice or consumer choices are sometimes be very relying on what manufacturers commerce through marketing, although this can have manipulating effects. Manufacturers could make the truth or possibilities of unknown effect though for example undefined chemicals less visible.

Step 3. Creating a "passive positive" list
Continue from page 173...

Step 4. Activate the positive list

Step 5. Reinvent

Explanation of 'For, Follows, Evolution' that can be added to the image of the stripped Volkswagen car mentioned earlier in the chapter (McDonough & Braungart, 2002. page 185).

3.4 IMPLICATIONS FOR HERITAGE

- Why is heritage sustainable -> images carbon emission and embodied energy (presentation Sang Lee slide 6 and 7)
- Which aspect of heritage make dealing with heritage different from dealing with new buildings? -> circularity and the lifetime and valuing of the Brandlayers.

Certain design decisions must be made in able to fit in the very specific and strict context of monumental heritage. For example the earlier meant example of design decisions for the dimensions of the construction. This means that sometimes design decisions that you want to implement to achieve certain cradle to cradle goals and perspectives have to make space for the

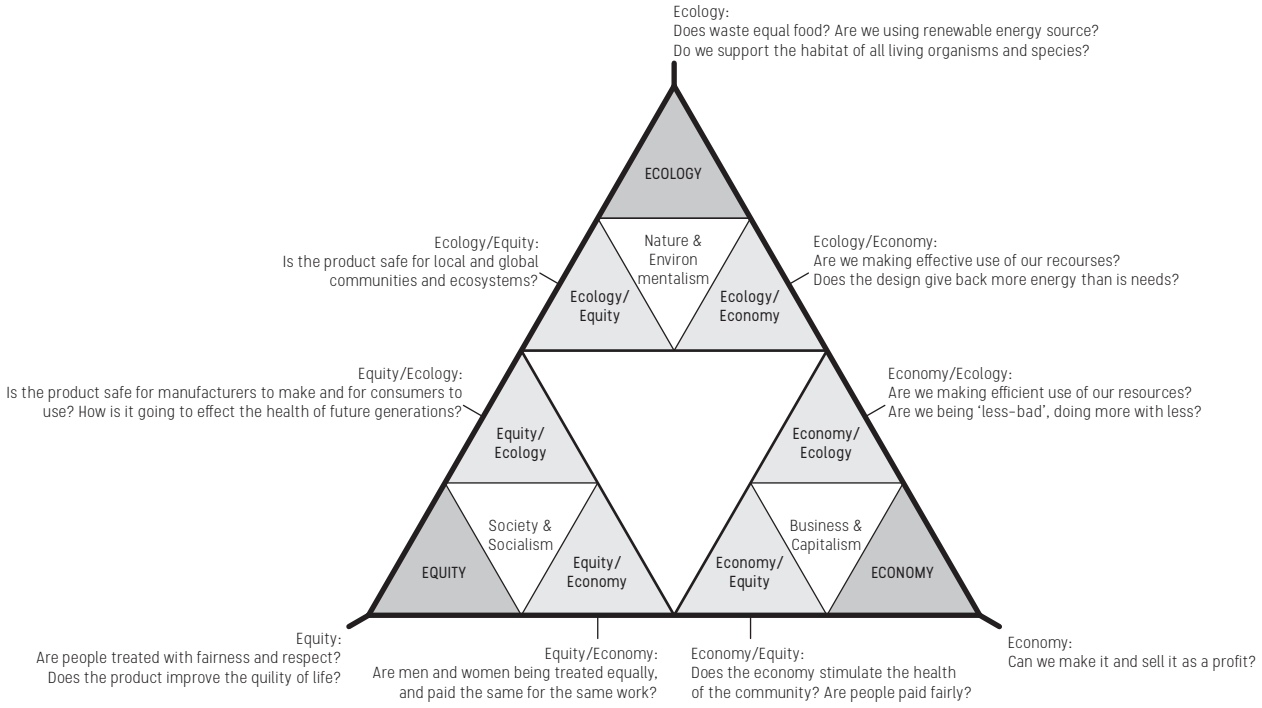

Image 07: Fractal Triangle - 3E product designing.
The model of a balanced relationship of economical, ecological and equity in a circular process according to the aims of cradle-to-cradle.

aspects or respecting the existing values and fitting in. This means that priorities in the design sometimes have to shifted from maximally eco-effective towards respecting values, to get a successful balance of sustainable architecture. This could also be seen as respecting diversity in the sense of respecting the design context and heritage forms a specific context. One could consider this as 'becoming native' to the existing context.

The difference for heritage becomes that the aim to shift this cradle-to-grave system towards a cradle-to-cradle system includes the redesigning of the product to be able to create a eco-effective product instead of an optimized eco-efficient 'less bad' product. Existing buildings and heritage is designed as cradle-to-grave product, which means that they are not designed eco-effectively, which is also not possible until completely redesigned. Because heritage includes certain existing values that crucially need to remain to exist. It is therefore not possible to redesign the entire product in the case of heritage, which makes it 'technically impossible' to create a 100% eco-effective building. However, considering the existing values of heritage as compensationally sustainable in its valuable for the benefit of human enjoyment along with the embodied energy it already included (ultimately 'less bad' nonetheless). Heritage would be the only aspect of the transition of industrial system for heritage to stay heritage and it would be unacceptable for cradle-to-cradle not to respect. The new adjustments and implementations of the existing building in case of revitalization however can and should be newly designed according to cradle-to-cradle. It would remain to be a 'less bad' compensation as it can never be 100% since the existing heritage values will always be cradle-to-grave designed, and therefore the position of this within the future of cradle-to-cradle is debatable. Newly designed eco-efficient product or materials can be replaced in same cases of existing values but not when these values are embodied or an effect of the particular material or implementation itself. At this point cradle-to-cradle must respect this and make way for this. That is what makes heritage and that is what can never be changed for it to remain heritage. Even cradle-to-cradle can't take the values that create heritage away from 'heritage'...

4. PRACTICAL CONTEXT FRAME OF REFERENCE

"To what extent has Cradle to Cradle been implemented in the current building environment and what represents the existing frame of reference of Cradle to Cradle within revitalized (church) heritage?"

"How can the principle of Cradle to Cradle be implemented in the Jacobuskerk in Winterswijk?"

5. CONCLUSION

"What is going to be the new function of the Jacobuskerk in winterswijk?"

"What are the Cradle to Cradle based design principles for the revitalisation of the Jacobuskerk in winterswijk?"

"What is the design concept; how are these C2C design principles going to be integrated in the existing values of the Jacobuskerk in Winterswijk"?

DESIGN GUIDELINES AND STRATEGIES

- Use local materials/as less as possible fossil fueled transportation is required. (Construction material wood and not concrete or steel?). Use materials whose quality and content are measurably defined in technical or biological pathways from manufacturing through use and recovery. Use materials whose impact are measurably beneficial for human health and the environment both respecting diversity (McDonough & Braungart, 2010. Page 8). Celebrate diversity in this aspect of local material. What range of distance is to be considered as 'local' for importing materials?

- education about materials, databases, the way of processing, packaging, transportation, market strategies, certification etc,etc could be all implemented in the function of the building through books, lectures, documentaries, business meetings. This forms a platform for businesses, consumers through all age groups etc.

- In the sense of flexible use function in the ground floor church hall the library furniture should be moved or able to adjust and make space for market stand of manufacturers and startups etc, but could also be seasonable temporary art galleries in which artists can exhibit pieces of art for instance made of 100% recyclable (upcycle) material featuring creative and inspiring design solutions regarding furniture and clothing. Or picture galleries of inspiring projects or creative product design by manufacturers and designers.

- The exterior and interior of the building must express 'sustainability' through its material and maybe through the visibility of connection and through the flexible use of the building. The building must welcome from the outside and stimulate productivity in a healthy surrounding and atmosphere inside the building that can be controlled flexibly and manually by the diversity of types of users. (page 75)

- Make eco-effective design implementations and processes visible (for example water filtering system by algae and microorganisms in a big pond outside or aquarium inside, or make users aware of materials or disassemble connection through interaction of objects with user, by enabling the user to disassemble a piece of furniture to his or her own personal liking). Humans like to have control over situations and their surroundings.

- Green roof visible from far (aesthetically pleasing and iconically expressing sustainability in form of a healthy natural environment). Contributes to solar heat absorption (heat stress in dense cities). Cools in summer, insulates in winter. Absorbs and filters rainwater and air. Supports habitat for biodiversity (animals, plants, micro-organisms etc). Can grow food (example City Hall Chicago - produce energy? biomass? or Ford Factory building) page 83.

- educative function involving users of different ages and different interests. For example kids could visit the building on an elementary school trip to read or watch a documentary. Or students, adults or parents to educate themselves here by studying through books, lectures, documentaries, open discussions or orientation of materials of markets being held. These users can express this newly learned information to their surrounding, friends, relatives, family etc. to spread the knowledge and awareness. Supporting a platform for companies and start up companies and organizations that want to present their product in a fair way. Maybe the building could have an instance housing it that tests and certifies these products that are presented and commerced in the building, a wish by the current owners of the church so that the building wont be fully sold and still can stay a part of the city and the community (see phone call documentation for exact words). The old community of the church can still find place in the building by joining enjoyable or educational courses such as cooking with local materials or with less meat, and educate about a healthy food pattern etc. They could also find space in the building to gather and socialize under the enjoyment of a cup of coffee brewed in the restaurant with coffee beans imported as nearby as possible from fairly payed farmers working in good and healthy working conditioned etc.

A non profit organization that can become rental owner of the church as was described in the phone call with the church committee, is an organization that does research in cradle to cradle related aspects, for example updating a database with adding new information and research, or processing certificated and licenses of Cradle to Cradle products and buildings through the municipality of Winterswijk or a larger governmental organisation (such as BREEAM).

- Respect diversity. The design and concept of the church should engage with local materials and local reuse cycles, local services of labor (business, manufacturing, craftsmen - supporting local economy), and local energy flows. These local materials should be design to take part in either biological or technical cycle (disassembly) which should be locally sustained and visible. The building should respond and interact with its local contexts socially (community, businesses and public on the location), cultural (heritage existing building environment) results in the fact that it takes part in the existing spirit of place, supporting habitat of biodiversity, aesthetically fit in or distinct itself from expression in its context (material, techniques and style etc P1), creating own and unique spirit of place and ecosystems and habitats. Instead of viewing themselves as autonomous entities, unconnected to the culture or landscape around them. Such a design and concept can be passed on by local next generations and grow uniquely.
What range do I regard as 'local'?

-respect diversity concept for use. People can be motivated and stimulated in coming to the building (or surrounding context of city center) not by car but public transport and bike. You could for instance show your bike keys or train ticket to get benefits and rewards in the building as user. For example showing it at the restaurant can give you free organic coffee or tea provided ofcourse by fairly treated and paid farmers as local as possible, with a piece of fruit or maybe pastry from the cooking and baking workshop course in the restaurant from the evening before. The coffee can be provided by a company or manufacturer not directly gaining money from sales but getting social image (brand name and people get familiar with your product and quality), and maybe can get payed a bit compensation by the non profit organization in the building or the municipality that want to support its image too and supports this rewarding eco-efficient local system not to come by unnecessary car (no emission in the city and less parking space needed for example erasing the parking spots at the back of the church). On the long term the manufacturer would of course have large economic benefits with his name and quality being familiar so that people want to buy his product so that he can make significantly more money, status and success in the near future in stead of direct sales. This makes it very interesting for businesses or start-ups and will also be in the benefit of the building as it wont cost them money and people are more attracted to come to the building. Businesses will be in line to show initiative and to be the first to show good will and how intuitive they are as a brand. It will be a new and interesting system economically and environmentally. The offering food and coffee you refill the energy people burned and used to walk or bike to the building and keeping the body cycle up. Replacing the used nutrients and giving back more in service and maybe energy in calories in the food. The creativity, trendy and uniqueness can form an iconic image for the cradle-to-cradle approach and evolution as it will be shared all over public platforms of social media and will spread from local scale to bigger and bigger scale.

- entrance of the new extension might find use in reference Patrimonium Technical School - page 98 'Designing from Heritage'

- support concept of service, by using leasing building material and component also in the interior, and by integrating this in the function by inviting manufacturers or start-ups to present their lease product.

- design a building generated by local small scale power system, only designed to facilitate your building. You can lease the system to enjoy the 'product of service' and support the eco-efficient nutrient cycle, supporting local economy etc. Leasing space within the local context outside your own plot is perfect to make use of the existing opportunities (space or powerlinks) that are currently unused and go to waste.

- Don't use or lessen materials that are difficult to recycle or re-use (etc. glass, concrete, steel, copper). *Unless* the value is so high that a material MUST be used to blend into the existing of needs to be replaced/restored.

- reuse existing structure (don't create new things if the existing is functioning sufficiently). -> make it fit in your design, give it a place.

- reuse existing embodied energy as much as possible (when it is still in good condition and useful then work with it).

- Recycling: Design for disassembly but also take in consideration that mixing of a material with other material components or chemicals make the recycled product impure and downcycled. Therefore the cycle is finite and truly sustainable would be an infinite recycle cycle. Therefore try to design for disassembling and not to work with glue, coatings, paint or other chemicals that make materials unrecyclable without downcycling.

- Use the maximal sufficiency and efficiency of renewable energy sources to minimize the need for artificial source. **Maximize passive before active systems!!!**

- LIGHT/ENERGY: daylight VS artificial light. Use less artificial energy in form of light and therefore maximize daylight but to produce more then the building uses (positive footprint) solar gain must be made. But solar panels contradict with monumental value (no space on the church maybe external but does it then still 'belong' to the church?), and also solar panels cost a lot of extinctive raw materials that are also difficult to recycle or reuse later (S. Lee?, in lecture). Such as the Tesla battery for example.

- WATER: from natural source (ground or rain) favorably passively gained VS actively gained from somewhere else

- HEATING/COOLING: also from natural source. Solar heating, heating by mass, heating by ground (passive). Heat recovery to maximize efficiency (active). Cooling by blinds. Based on the position of the sun (winter = low, summer = high) maybe use vegetation of trees outside to block direct sunlight and concomitantly give the pleasure of environment.

- Stimulated/educate sustainable human behavior while in the building or as expression:

- Expression should be iconic and should be associated as 'sustainable' outside and inside. How can this association be divined? By for instance showing vegetation, showing green, showing wood and other natural materials, showing the recovery process of the climate such as rainwater into toilet or cleaning water or water for the dishes in the restaurant.

- Implement functions based on stimulating sustainable behavior - > local ingredients in the restaurant, cooking workshops (for the community) for vegetarian or lessening meat cooking, healthy recipes and the essence of the nutrients in it (educate where it comes from and how the ingredients stimulate health). Food of the restaurant doesn't get thrown away but is nutrient for something else animal or plant. Or sewing workshops for the community to repair or make own clothing in stead of buying new commercially (pass on to other generations, to children and grandchildren -> towards future behavior!)

- implement function for public lectures for raising awareness, information days and courses for what you can do and how you can implement daily behavior and patterns, presentation by start up companies, freelancer or product manufacturers and product leasing companies, market days for manufacturers to present products for companies to gather and communicate. So the building is not only for daily public but also for economic public and businessmen, spaces can be leased for such (then maybe the ground floor must be able to be cleared as flexible space?)

- So not only the books in the library should educate about sustainability also the building should educate this.

ARCHITECTURE (physical) TO CHANGE/TRIGGER HUMAN BEHAVIOR (mental) INTO SUSTAINABLE -> THE NEW MOVEMENT!
Does it needs to become a revolution like 'De Stijl'? I think this could in fact be, and should be for the sake of a livable planet, a form of Art and Architecture that needs to make a statement and become fully integrated in the deepness of systems and society.
VIVA LA REVOLUTION -> THE ONLY WAY TO SAFE THE FUTURE OF OUR PLANET AND OURSELVES?!
SUSTAINABILISM...
A new scientific religion -> religious replacement in the church. The church stays a center of education and belief/religion.

Start small to eventually come out big. (it starts on the small scale of a person and from here it will grow to bigger scale of social groups, villages, towns, provinces, nations...). we can all make a difference together. From one person in a society can together with all society change the needs of the economy and from there will make changes on bigger political aspects.

- Education not only by books about sustainability indeed social behavior (cooking, traveling, using fossil fuels through daily habits) but also economy in commercial consumption or economical model from farmer to shop shelf (for example what it takes to produce coffee from farmer to cup) industrial sectors such as building environment but also show movies such as BBC Our Planet.

- If people will know the damages and influences (resulting from education) then they would care, it is morally impossible to not care or try to ignore it. It damages yourself.

"At some point a manufacturer or designer decides, *"We can't keep doing this. We can't keep supporting and maintaining this system."* But when is that point? We say that point is today, and negligence starts tomorrow." "Once you understand the destruction taking place, unless you do something to change it, even if you never intended to cause such destruction, you become involved in a strategy of tragedy. You can continue to be engaged in that strategy of tragedy, or you can design and implement a strategy of change." (page 43 and 44 of cradle to cradle).

6. DISCUSSION

The content of this document and in particular chapter 3 is mainly based on the book Cradle to cradle: remaking the way we make things by William McDonough and Michael Braungart. This book is written in 2002. Some of the viewpoints and descriptions are strongly and based on the development by the industry depending strongly on that period time some of the viewpoints have developed overtime. For example material databases that change behavior in some cases already in the building environment, governmental regulations of product making, rights between farmer and manufacturers etc etc. In the 17 years the book got published until today some priorities and behavioral issues have been adjusted and maybe shifted throughout time. This has to be taken into account with the positioning of statement for this project. Also the scope of this graduation concept is limited and guarded in time. This project will limit itself in mostly implementing existing technology and developments in creative ways of implementation. This project will not further involve itself into starting new evolution in the sense of designing new concept or products (as described in step 5) but hope be able to form a project of reference forming a step to the right direction as a start or spark to a future eco-efficient system.

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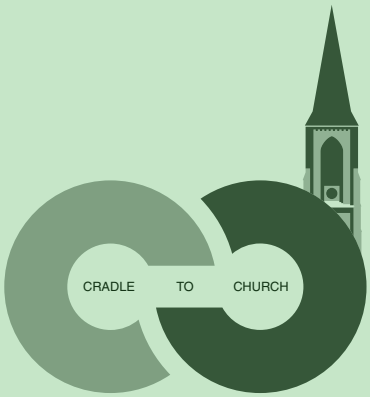
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