SUSTAINABILITY;
From Theory to Site

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ABSTRACT

This master thesis aims to examine the theory of sustainability. A concept that has become an integrated part of our lives and for the landscape architect and architect an ever more important factor to consider. But what does sustainability or sustainable development mean, where does the theory come from and who came up with the ideas? And how is this elusive and complex theory to be implemented on site?

This thesis is divided into three parts. The first part will examine the theoretical aspect of the subject through contemporary, as well as historic perspectives. The second part aims to take the discussion down to site where the implementation of one sustainability theory is tested. The last part will draw upon the conclusions made and formulate visions regarding a sustainable future.

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ACKNOWLEDGMENTS

I am new to the profession of landscape architecture as well as the issues of sustainable development. I also recognize that I am born in a country which has not seen war, famine or natural disasters in a long time. This is all things that I have to take into account when I begin this journey into the subject of the sustainable future. I also realize that the views I voice in this theses will most certainly change as my knowledge in these questions will grow over time.

To engage a subject like this I believe it is important if not vital to be humble regardless of your background and knowledge. You need to think of yourself and your own context and compare that to the greater context of the world we inhabit. If you fail to do so I believe that the answers you seek, related to a sustainable future, will most certainly elude you.

I also want to take this opportunity to thank some people without this thesis would never have been written.

Thank you to:

Tiina Sarap who have kept me on track in this from time to time rather daunting task.

My family who have been supportive in so many ways.

My friends especially Patrik and Martin, who have kept my spirits up.

The people at Whitelaw Turkíngton Landscape architects in London who gave me a chance to prove myself.

Everyone else who have helped me along.

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Introduction

Background

This thesis is written in a time of great change and fast transformation. The old social structures and political power bases from the 20th century is rapidly giving way to new emerging economies and trends. In the beginning of the 21st century each person is now more connected to the global community than ever before. At the same time issues like that of climate change are predicted to have huge impact on our common future. Having spent 15 months working in a landscape architecture office in London, I have had my first contact with the profession I have chosen to peruse. During this great experience I still came to feel, like many others do, a strong frustration when I look upon the difference between theory and practice today.

Objective

It is in order to better understand this discrepancy between theory and practice that I have chosen write this thesis on sustainability. It is also my hope that in gaining a better understanding the issue I can help others to understand this elusive concept regarding our common future. Futher it has been my goal to aproach the subject as a whole, from theory to site, in order to better understand the whole contect. It is my view that this is a level of understanding that often is the missing link in contemporary projects.

Methods

The method for this thesis has mainly been literature studies. Since the aim of the theses was to gain a general global understanding of the subject, stretching from theory to practice. A wide range of authors and disciplines where studied. Most of the literature used I came into contact with during my time at the university and my time at Whitelaw Turkington in London. Some additional literature that was needed was found at the library at SLU Alnarp with the help of computer search systems.

To be able to present this diverse material the book *Cradle to Cradle; Remaking the Way We Make Things*, was chosen as a “bridge” between the theoretical part one and the practical orientated part two. Further a strict conclusion-based discussion format was chosen to simplify the understanding of the subject.

PART ONE

THE SUSTAINABILITY THEORY

SUSTAINABILITY THEORY

Introduction:

Sustainability theory has gained global recognition today. For the contemporary landscape architect or architect it has come to have a major impact on design and planning. But what is sustainability theory and why is it such a desired vision for the future society? Also; who created it and when? And finally; how is the theory implemented today and how will it be used tomorrow?

PART ONE

Chapter 1: **THE STATE OF THE PLANET**

Chapter 1: THE STATE OF THE PLANET

To approach the subject of sustainability there is a need to first establish its general idea and under lying reasons to exist. Without comprehension of these questions the meaningfulness and effects regarding its implementation could otherwise be put into question.

The two arrows

Most people alive today are aware of the fact that humans have changed the planet in radical ways since the introduction of the industrial society some 250 years ago. In the more developed parts of the world the early and obvious flaws of that industrialization has long since been addressed.

This is a good thing and it has since given many people a standard of life unprecedented in human history. But it has also fundamentally changed the way we live and think regarding ourselves, our needs and the environment. In doing so it has made it much more abstract for the contemporary person to see and comprehend the dangers that industrialization without carefull planning brings.

A figure often used to symbolise the industrial society is the linear arrow (Fig1.1). The creation of any given product in the industrial system can be traced in this simple picture. It all starts with the gathering of the necessary resources and then continues with transportation, manufacturing and distribution of the item or service. All this is fuelled, at least manly, by non-renewable resources. All along the way there are energy losses and waste materials. In USA today a typical product only contain 5 % of the materials it took to create it (McDounaugh et al 2006, p.28). After the product is used it will be thrown away, usually becoming landfill or being burned. In both scenarios the resources in the product are lost. According to some sources, more than 90 % of the materials extracted today in the USA become waste almost immediately (McDounaugh et al 2006, p.27). This linear way of thinking has simply become a part of our lifestyle; to consume without deeper thought about the consequences this result in.

As a response to this the majority of the global community has come to realize that in order to up hold the quality of life in our societies things have to change. The vision for the future has come to be a new system comparable with the circular arrow (Fig1.2). In this future, most commonly referred to as a sustainable future, the human population will once more become an integrated part of their environment and the processes that governs it.

To approach sustainability theory, the first thing to look at is the arguments to why this is a preferable vision for the future. Today the three issues perceived to be the most important arguments to why a sustainable future is needed are: climate change, population increase and resource depletion. These are in many ways closely connected but for clarity they will be discussed separately.

Climate change

In the last half of the 20th century the issue of climate change has risen to become one of the most debated questions regarding man kinds common future. In the early days of the debate the discussion was mainly

Fig 1.1 The linear arrow can be seen to represent the linear system of the Industrial Sociesty.

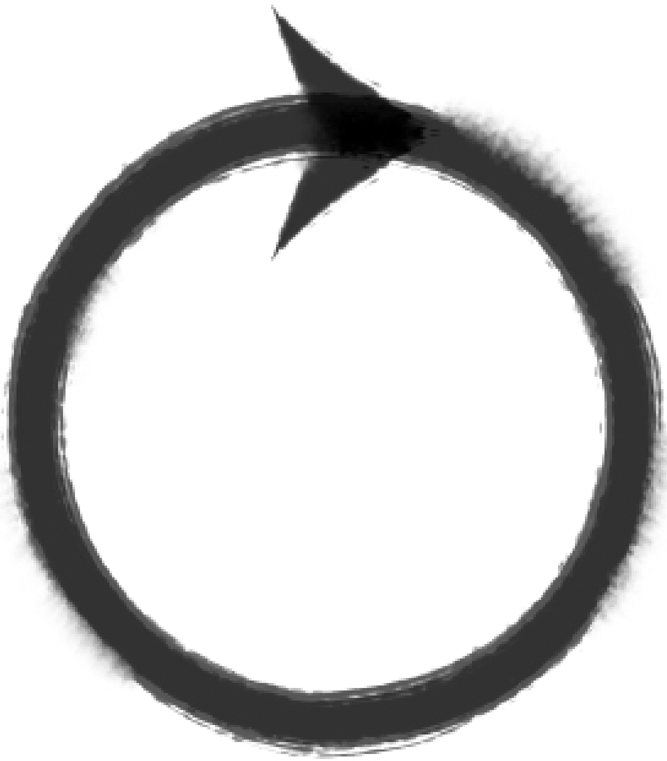


Fig 1.2 The circular system proposed in Sustainability theory.

to be held on whether the human population was responsible for this change or not. This theory has in later years come to be seen as mainly true.

With the emergence of this theory the need to further research the subject arose and in 1988 the *Intergovernmental Panel of Climate Change* or IPCC, was founded by the UN. Their mission is to provide objective information on climate change. Their findings have together with others done much to bring about the improved awareness of the issue.

In 2007 the IPCC together with former president candidate of USA, Albert Arnold (Al) Gore Jr., were rewarded with the Nobel Piece Prize for their work regarding global warming. The motivation was:

> [...] for their efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change.[1]

This thesis will not dive in to the complexities of this issue. Instead it will make the assumption that the reader has a basic understanding of the mechanisms of GHG (Green House Gasses), global warming and the theory that these are connected to human use of the non-renewable fossil fuels. The importance and urgency that this matter is given by the global community is vividly clear in this speech given by the chairman of the IPCC, Mr. Rajendra Pachauri, during the opening session of the UN *High Level Event on Climate Change* - New York on 24 September 2007:

> To start with let me say that we, the human race, have substantially altered the Earth's atmosphere. In 2005 the concentration of carbon dioxide exceeded the natural range that has existed over 650.000 years.[…] In the 20th century the increase in average temperature was 0.74 degrees centigrade; sea level increased by 17 cm and a large part of the Northern Hemisphere snow cover vanished. Particularly worrisome is the reduction in the mass balance of the glaciers and this has serious implications for the availability of water; something like 500 million people in South Asia and 250 million people in China are likely to be affected as a result.[2]

If the assumption is made that the theory of global warming as it stands is true, the numbers and thereby the impact of these changes, are going to be severe. For a planner or architect it is almost incomprehensible to imagine what this will mean for the future of our cities and developments. If some of the predictions made by the IPCC and othes are accurate it might even be necessary to move large populations due to conditions caused by the climate. This will put the contemporary infrastructure under enormous pressure and the need for good planning and the need for landscape architects and architects is probably going to increase.

Resource depletion

The way most of humanity think about and consume resources today can be represented by the linear arrow shown before. This can when viewed in a long term perspective, be defined as non-sustainable since the rescores are not brought back to the beginning of the arrow and the assumption is made that there are not an unlimited supply. This intense use and concentration of many resources threatens to create serious problems for the sustainability of our societies. Some of these are substances that are not commonly perceived as limited resources such as ordinary top soil and fresh water supplies.

Few people in the developed world are aware of that the issues of i.e. top soil loss are a cause for concern also for them. In developed parts of the world there is a growing conflict of space between the expanding cities and the surrounding landscape, often located on the best top soils. In the less developed areas the major danger is soil erosion due to short sighted agriculture methods based on i.e. scourging. These two and other factors, leads to a yearly loss of top soil in large quantities. And as described below it takes nature a long time to replace these losses.

> It can take approximately five hundred years for soil to build up an inch of its rich layers of micro organisms and nutrient flows, and right now we are losing five thousand times more than is being made.(McDonough et al 2002, p.96-97)

The second resource of fresh water supplies is according to the IPCC and others, a growing cause of concern in many parts of the world. And as the following text claims this is a fast growing problem:

[1] http://www.ipcc.ch
[2] http://www.ipcc.ch/graphics/speeches.htm

Demand for fresh water continues to grow in all parts of the world; consumption more than tripled between 1950 and 2000 (Postel 1993:22). Although vast reserves of fresh water lie beneath the earth's surface, much of it is too deep to economically recover (National Geographic 1993:24) and the fresh water in rivers, lakes, and wetlands accounts for less than 1 percent of the earth's water (McAllister, Hamilton, and Harvey 1997:210). While the availability of fresh water is fixed, the population demanding access to it is not. Currently, 20 percent of the world's population lacks direct access to a safe water supply (Dodds 2000:292) and 40 percent of those people live in water-stressed river basins. It is projected that by 2025 half of the world's population will occupy regions with water stress, 70 percent of which will be under severe stress (United Nations Development Programme 2001:103-110)."

(Murphy 2005, p.104)

The described issues regarding available top soil and fresh water are but two out of many resources that are used in a per definition, non-sustainable way. For the landscape architect or the architect these issues are likely to become an integrated part of the design problem in the future. With a broad range of knowledge and training in handling a wide range of problems in one process this makes these professions suitable to aid in solving the arising problems. It is also important to keep in mind that with a growing global market, it is likely that the future planner or designer will come into contact with resource depletion in one way or another.

Population increase

Since the introduction of the industrialized society many improvements to the quality of human life have been made. Combined these efforts have brought about a radical change in life expectancy. In 1900, global average lifespan was just 31years, and below 50 years in even the richest countries. In 2005, average lifespan reached 65.6 years; over 80 years in some countries[3]. This has resulted in an alarming growth rate of the global human population. In just the last half of the twentieth century the global population has doubled, from 3 bn people in 1960 to an estimated 6,7 bn people today (Murphy, 2005, p.108)[4]. The continuing increase in population is also predicted to continue for the foreseeable future. In many areas in an alarming rate, as in Egypt where one child born every 20 seconds (Cities Architecture and Society 2006).

The United States Census Bureau has made the following prediction (Fig. 1.3) which gives us a number of 9.4 bn by 2050. A number which is slightly more than the 9.1 bn people predicted by the UN 1996 for the same year[5]. Exactly how many people our societies can support is extremely difficult to calculate due to the large number of variables such as living standards, climate change etc. But that there at some point will have to be leveling out of the worlds population due to factors like food and water, seems like a logic conclusion. Some scenarios states that this will start as early as under 9 bn people while other calculations predicts it to be closer to 11 bn[6]. This shows the great uncertainty to any calculations connected to population growth and therefore these should be regarded as very approximate.

Fig 1.3 Calculations of human population increase based on numbers from the United States Census Bureau.

Another trend among this growing number of people is the accumulation in urban areas. It has been estimated that by 2050, 75 % of the global population will be located in cities. "Mostly in mega cities of several million people each and massively urbanized regions stretching across countries and continents (Cities Architecture and Society 2006)."

Regardless of the exact number that the global population will rise to, this means that there are going to be some daunting numbers for the new sustainable city planner and designer to handle. As an example London will have to plan for an additional 800,000 new inhabitants in the next 15 years (Cities Architecture and Society 2006).

[3] http://www.who.int/global_health_histories/seminars/presentation07.pdf
[4] http://www.census.gov/ipc/www/popclockworld.html
[5] http://www.census.gov/ipc/www/idb/worldpopinfo.html
[6] http://www.census.gov/ipc/www/idb/worldpopinfo.html

Conclusions

The change into a sustainable way of life seems to be a preferable option regarding the future, if the growing problems are considered. Out of the three issues discussed above the climate change is the most addressed one today. But as mentioned previously, these three are closely connected in many ways and are almost impossible to study separately. But seen side by side they highlight some interesting facts:

1. To counter the threat of global warming there has been a number of reductions to the emissions of the GHG. Combined with the statistics of our population growth the assumption can be made that there is a risk of having the reductions loosing their effect due to the increasing number of activities emitting GHG. This growth is predominantly connected to the rising standard of life in countries such as India and China.

2. If the global community are to effectively handle the abstract and long term effects of global warming, which most people can not feel or comprehend yet. It is important to have a stable situation regarding food, water and shelter. The massive population increase combined with a decrease in resources like the ones mentioned might create an unstable situation. This therefore poses a real threat to tackling of climate change.

3. The issue of the population increase combined with resource decrease regarding some basic resources, have the potential of causing severe problems. Some of these threats like famine and lack of fresh water, are in danger of affecting people much earlier than the long term effects of climate change such as rising sea levels. Still many of these problems can according to IPCC and others, be partly linked to changing .

PART ONE

Chapter 2: **AN EPISTOMOLOGY OF THE FAMOUS WORDS**

Chapter 2: **AN EPISTOMOLOGY OF THE FAMOUS WORDS**

When the basic arguments to why sustainability is a preferable vision regarding the future, are established. The questions of who created this idea and when, becomes relevant. This chapter aims to give a short answer to these questions.

The three pillars

When sustainability theory is discussed today it often comes down to what in this thesis will be referred to as the "three pillars" of ecological-, economical- and social sustainability. At first this definition seems to be sufficient and simple. But the fact is that this definition has taken some fifty years to define and take the shape that we know today. To understand how this complex expression came to be and why it is not as easily defined as it seems, there is a need to go back in history.

The first pillar

The history of sustainability theory has its roots in the 1960s. The impact of our modern industrial civilisations on the environment was at this time becoming ever more obvious to the public. At first the critique was mainly about local pollution but soon it had spread to the question of global environmental health. The impact of these questions had a limited impact on the politicians at first but at the end of the decade the issue had been taken up as a point on the political agenda. This could be regarded as the first attempts to bring about an ecological sustainability aspect on the political arena.

The second pillar

In 1970 the *Earth day* was introduced in the United States as an acknowledgment to the rising importance of the environmental questions. The discussions were mainly limited to the issue of growth or non-growth, conserving nature or exploit it for economic interests. But with the oil shortage crisis in 1973 the issue of resources limitations and the vulnerability of our societies became commonly known.

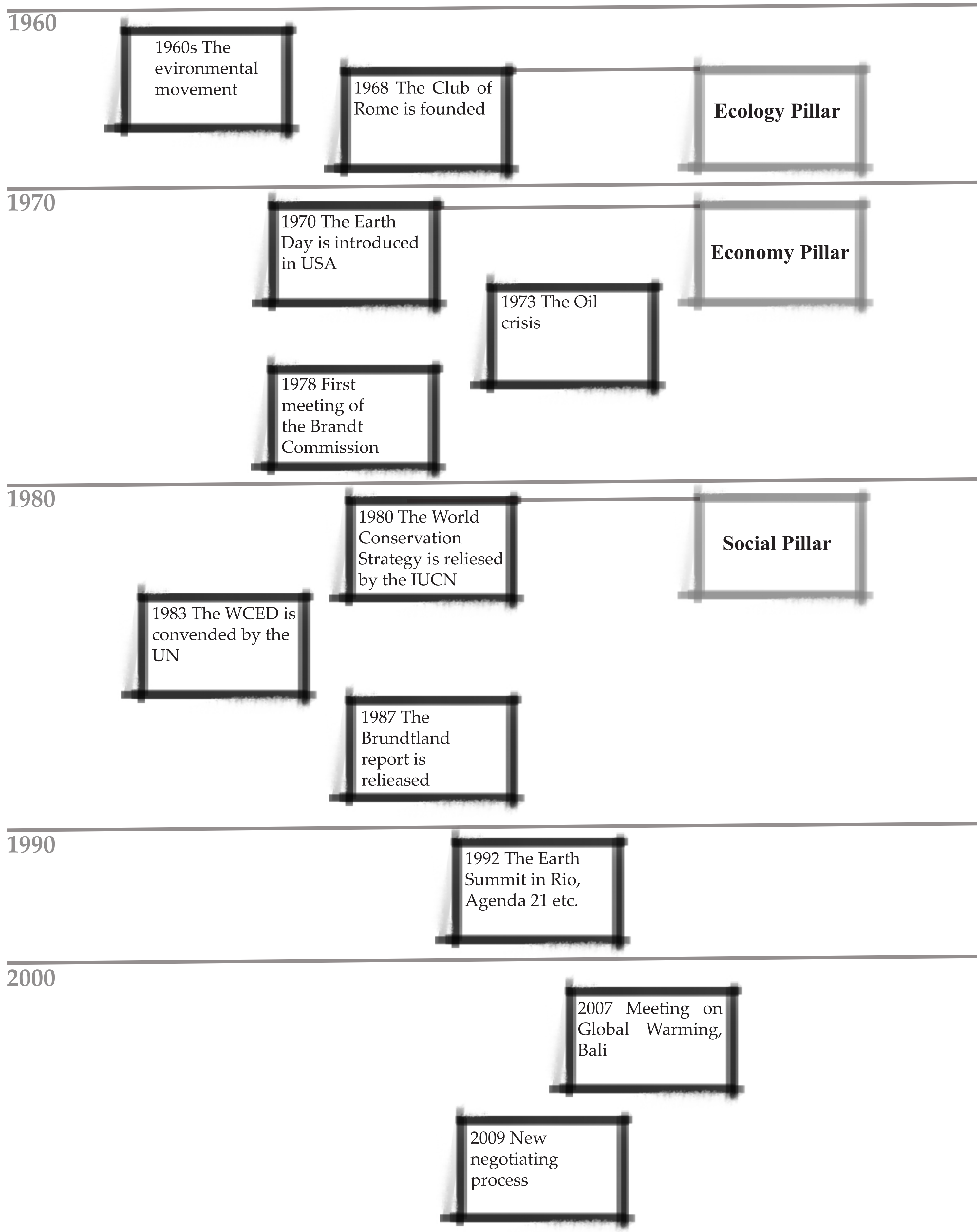
At this point in history the problems of limited availability of resources had already been foreseen by financial leaders and scholars around the globe. One such group called *The Club of Rome* was founded in April 1968 by Aurelio Peccei, an Italian industrialist, and Alexander King, a Scottish scientist. Their mission was and is, according to their web page, "to act as a global catalyst of change that is free of any political, ideological or business interest"[7]. In the year preceding the oil shortage they published a report called *Limits to Growth*. The report got a lot of international attention and helped to raise this new global issue. Among other things they commented "on the fact that global industrial activity was increasing exponentially, predicting drastic consequences if such growth were not altered,such as the irrevocable loss of non-renewable resources (Steele, 2005, p.165)."

This report and others can be regarded as the beginning of a global awareness to the fact that our industrial way of handling the environment and its resources could affect our future economies.

The third pillar

Ever since the first signs of the negative impact of the industrial societies on the environment there has been conservation groups formed to protect it. The oldest of these is according to their webpage[8], the *International Union for the Conservation of Nature* or IUCN . It was

[7] http://www.clubofrome.org/about/index.php


1960
1960s The evironmental movement
1968 The Club of Rome is founded
Ecology Pillar
1970
1970 The Earth Day is introduced in USA
Economy Pillar
1973 The Oil crisis
1978 First meeting of the Brandt Commission
1980
1980 The World Conservation Strategy is reliesed by the IUCN
Social Pillar
1983 The WCED is convended by the UN
1987 The Brundtland report is relieased
1990
1992 The Earth Summit in Rio, Agenda 21 etc.
2000
2007 Meeting on Global Warming, Bali
2009 New negotiating process

founded in 1948 as the world's first global environmental organization. This organisation was the first to use the word "sustainable" in context with the environment in 1980 in a publication entitled *World Conservation Strategy*, in which the word was connected to development (Steel 2005, p.166). The meaning of the report was to come to terms with the growth / no-growth debate that had raged all through the 70s. Below is a part of the text:

> Humanity's relationship with the biosphere… will continue to deteriorate until a new international order is achieved, a new environmental ethic is adopted, human populations stabilized, and sustainable modes of development become the rule rather than exception… For development to be sustainable it must take account of social and ecological factors, as well as economic ones; of the living and non-living resource base; and of the long-term as well as short-term advantages and disadvantages of alternative actions. (Purvis at al. 2004, p.4)

As the text shows the ecological and economical aspects had now been put together with the last social one as well. These are today the three "pillars" upon which we base the sustainability theory. The IUCN report did not gain much attention but another report realised the same year was more successful.

The concept grows

The *Brandt commission* was another independent commission on international development headed by the German Willy Brandt. Tthen chair of the *Social Democratic Party of the federal Republic of Germany*. They had their first meeting in 1978 and after ten meetings their conclusions were presented in *North – South: A Program for survival*, published in 1980. After the report several more meetings where held during a period of tree years when the commission traveled to several countries to assess its results. This resulted in addendum to their report in 1983.

This document raised many issues. But mainly it spoke of the problems regarding the industrialized northern hemisphere and the generally less developed southern hemisphere (Purvis et al 2006, p. 5-6). Some voices were raised criticizing the committee to have been too connected to the high-level financial institutions, and thereby not objective to the problems they looked at (Steel 2005, p.167). Still the commission raised awareness to the importance of "global negotiations" through the UN, dealing with the difficult questions of trade, development and environment in the developing world. It can be said that "the Commission began the process of reconciling economies with ecology (Steel 2005, p.167)".

A definition

1983 the UN had convened the *World Commission on Environment and Development* or WCED to address growing concern "about the accelerating deterioration of the human environment and natural resources and the consequences of that deterioration for economic and social development (UN resolution: 42/187. Process of preparation of the Environmental Perspective to the Year 2000 and Beyond)".[9] In 1987 they realised their report called *Our common future*, also known as the *Brundtland Report* after the president of the commission, Gro Harlem Brundtland, then prime minister of Norway. This document was viewed by many to bridge the two conflicting sides in the argument over growth or no growth. The most important lines in the report might be the definition of the sustainability concept or sustainable development, in a sentence that still is the most used one today:

> [Development that] meets the needs of the present without compromising the ability of future generations to meet their own needs…[10]

Mixing theory and politics

It is important to remember that this definition was made by the UN and therefore by default became a political definition due to the organization of this NGO (Non-governmental organization). The way the definition was written made it possible for the different factions of the negotiations to interpret the sentence according to their own agendas. Shifting the weight on the three pillars so to speak. The developing countries could argue their "need" to catch up with the already developed countries of the indus-

[8] http://cms.iucn.org/about/index.cfm
[9] http://www.un.org/documents/ga/res/42/ares42-187.htm
[10] http://daccessdds.un.org/doc/UNDOC/GEN/N87/184/67/IMG/N8718467.pdf?OpenElement

trialized north. It also contained the "need" for the industrialized world to deal with the environmental problems to secure a sustainable future for generations to come. This ability to interpret different meanings from the same lines of text isstill haunting the global negotiations today (Purvis et al 2004, p.6).

Plans of action

In 1992 an Earth Summit was held at Serrado Mar, near Rio de Janeiro, Brazil. This was an extension of the Brundtland Report. The summit was financed by WCED but organised by Maurice Strong. Strong had a long and career as a business man behind him and was also involved in the planning of the WCED meeting in Stockholm in 1972. According to Steele (2005, p.168), Strong's background as a businessman was relevant to the shaping of the outcome of Rio Summit. And as can be seen in the text below there are some parallels to be drawn regarding the green economy ideas like pollution rights, being realized today.

> Strong expressed his belief in a typically business like terms that it is necessary to 'put a price tag on the elements of nature' and that 'depreciation of natural resources has to be taken into account, literally, by nations all over the world. The loss of a country's natural resources must be subtracted from the GNP. When businesses have to pay for the loss of things, they have a powerful incentive not to pollute or over-consume'. "(Purvis et al. 2004)

The outcome of the Rio Summit was several agreements with their common base in the concept of sustainable development. Some of the more well known agreements were the *Framework Convention on Climate Change* (FCCC), the *Biodiversity Convention* and the *Agenda 21* document. It was also during this summit the "eco-efficiency" concept was put forward. This idea would have a big impact on the implementation of the Sustainability theory and will be further discussed in the next chapter. Though the summit did not reach the high goals that Strong had hoped for it helped to put some more substance into sustainability theory and helped to connect theoretical ideas to reality.

Agenda 21

Of the reports that came out of the Rio Summit the one named Agenda 21 can be regarded as the most commonly known. This document suggests a wide range of actions that are to be implemented globally, nationally and locally. Both by organizations of the UN, governments, and NGOs. The Agenda 21 document contains forty separate sections, 120 programme outlines and one thousand proposals. Due to its wide contents it is difficult to fully understand the scope of this document. But one can get a general idea of its goal from the introduction text:

> 1.1. Humanity stands at a defining moment in history. We are confronted with a perpetuation of disparities between and within nations, a worsening of poverty, hunger, ill health, and illiteracy and the continuing deterioration of the ecosystems on which we depend for our well-being. However, integration of environment and development concerns and greater attention to them will lead to the fulfilment of basic needs, improve living standards for all, better protected and managed ecosystems and safer, more prosperous future. No nation can achieve this on its own, but together we can in global partnership for sustainable development (Agenda 21, Preamble).[112]

In to the 20th century

After Rio there have been many more international gatherings, discussing topics ranging from women rights to social integration and economic imbalance. But the overshadowing topic today is Climate change.

During the last few years it has risen to be the major concern regarding the sustainable future. In 2007 a climate conference was hosted by the government of Indonesia on the Island of Bali. together more than 10,000 participants, including representatives of over 180 countries together with observers from intergovernmental and nongovernmental organizations and the media attended. The conference culminated in the adoption of the *Bali Road Map*, which consists of a number of forward-looking decisions that represent the various tracks that are essential to reaching a secure climate future. The Bali Road Map includes the *Bali Action Plan* which charts the course for a new negotiating process designed to tackle climate change, with the aim of completing this by 2009.

[11] http://www.un.org/esa/sustdev/documents/agenda21/english/agenda21toc.htm

Conclusions

It seems evident that sustainability theory is a huge mix of global political negotiations and theories regarding everything from climate change to social fairness. Regarding the fields of landscape architecture and architecture in relation to sustainability theory, it seems important to realize that it is an expression in constant change. This change is connected both to emerging scientific facts and contemporary political goals. This makes it difficult both to understand the theory and very difficult to implement directly in the working process of these professions.

Also; with this recent emphasis on the environmental issues, it makes it relevant to address the importance of the three pillars. Are all of them equal or should the emerging environmental facts regarding global warming etc. shift the focus in favor of the ecological pillar? And even if that would be the case, is it politically and socially plausible that humans on a global scale could put the environments needs in front of its own?

PART ONE

Chapter 3: ECO-EFFICIENCY ; THE “EFFECTIVE” WAY FORWARD

Chapter 3: ECO-EFFICIENCY; THE EFFECTIVE WAY FORWARD

As shown in chapter two sustainability theory is in constant change based on the contemporary situation. This means that the transformation process is still in action. How then is the wide range of projects being realized today, using the theory? This chapter aims to look at the general trends in the contemporary implementation.

Theory meets practise

At the Earth Summit 1992 in Rio de Janeiro, the "eco-efficiency" concept was made official. Even though this was the first time it was used in an official context, it was first proposed by the *World Business Council for Sustainable Development* or WBCSD, in a publication called *Changing Course* in preparation for the summit. Then, a group of 48 industrial sponsors including big names like Dow, DuPont and Chevron, the council had been asked to bring a "business perspective" to the summit. In the report one of the councils founders, Stephan Schmidheiney, stated that;

> Within a decade it is going to be next to impossible for a business to be competitive without also being 'eco-efficient' – adding more value to a good service while using fewer resources and releasing less pollution (McDonough et al. 2002, p.52).

It also stated that:

> Industries and industrial operations should be encouraged that [author's spelling] are more efficient in terms of resource use, that generate less pollution and waste , that are based on the use of renewable rather than non-renewable resources, and that minimize irreversible adverse impacts on human health and the environment (McDonough et al 2002, p.52).

Further is stressed that:

> […]eco-efficiency is not achieved by technological change alone. It is achieved only by profound changes in the goals and assumptions that drive cooperative activities, and change in the daily practices and tools used to reach them. This means a break with business-as-usual mentalities and conventional wisdom that sidelines environmental and human concerns (Changing Course: A Global Business Perspective on Development and the Environment, p.9).[12]

Today, the WBCSD has some 200 members drawn from more than 35 countries and 20 major industrial sectors, involving some 1,000 business leaders globally. The council also comprises a regional network of 55+ national and regional partner organizations – called *Business Councils for Sustainable Development* (BCSDs) – mostly located in developing countries.[13]

Still a major innovator in process of advocating eco-efficiency this council of business and leaders have been joined by many other NGOs and governmental agencies, together further strengthening the eco-efficiency concept. Looking at the official web page of WBCSD today the council's objectives are:

- Be a leading business advocate on sustainable development
- Participate in policy development to create the right framework conditions for business to make an effective contribution to sustainable human progress
- Develop and promote the business case for sustainable development
- Demonstrate the business contribution to sustainable development solutions and share leading edge practices among members
- Contribute to a sustainable future for developing nations and nations in transition

[12] http://books.google.com/books?hl=sv&lr=&id=BDYGdfiAGtoC&oi=fnd&pg=PR11&dq=Changing+Course:+A+Global+Business+Perspective+on+Development+and+the+Environment+&ots=vuO07p_KPc&sig=tlEJ7dhOV2d0NnHOwnVSjBffG_A

[13] http://www.wbcsd.org/templates/TemplateWBCSD2/layout.asp?type=p&MenuId=NDEx&doOpen=1&ClickMenu=LeftMenu

To achieve this, the critical aspects of Eco-efficiency are, according to the WBCSD:

- A reduction in the material intensity of goods or services
- A reduction in the energy intensity of goods or services
- Reduced dispersion of toxic materials
- Improved recyclability
- Maximum use of renewable resources
- Greater durability of products
- Increased service intensity of goods and services

(Hunter 2008, p.34)

Conclusions

If the current situation regarding the implementation of sustainability theory in our societies is reviewed there are a lot of similarities to the list above. The same can be argued regarding the new "green" or "sustainable" architecture.

This could be seen as a major success for the eco-efficiency advocators in the pursuit a sustainable future. But looking at the eco-efficiency concept it could be argued that it is an "effort to be less bad"[14] that still uses the same linear way of thinking that built up the industrial society, and therein lays the problem. If we are to evolve the current way of living and building into something that is truly sustainable it might not be enough with the "profound changes in the goals and assumptions"[12] advocated by the industry. Most probably there will have to be an even more profound change regarding the level of thinking. Or as Albert Einstein once said;

> "The world will not evolve past its current state of crisis by using the same thinking that created the situation."

[14] http://www.un.org/documents/ecosoc/cn17/1998/background/ecn171998-bp13.htm

PART ONE

Chapter 4: **WHY BEING LESS BAD IS NO GOOD**

Chapter 4: **WHY BEING LESS BAD IS NO GOOD**

According to the conclusions in previous chapter the contemporary trend is to "be less bad". If this is not a sufficient way of addressing the sustainability issue then are there any other alternatives?

The authors

In 1995 the American architect William McDonough and the german chemist Dr Michael Braungart started *McDonough Braungart Design Chemestry*. McDonough has a long history and interest in "green" architecture and is the founding principal of *William McDonough + Partners, Architecture and Community Design*. He has also served as dean of the School of Architecture at the University of Virginia. He has received several rewards for his work on the field of sustainable design. In 1996 he received the *Presidential Award for Sustainable Development*, the highest environmental award given by the United States. Michael Braungart is a chemist and founder of the *Environmental Protection Encouragemet Agency* (APEA) in Hamburg Germany. Prior to this he was the director of the Chemistry Section of Green Peace. He has received numerous awards for his accomplishments.

Cradle to Cradle

In 2002 they released their book *Cradle to Cradle, Remaking the way we make things*. In the book McDonough and Braungart point out the danger regarding the current effort "to be less bad". This according to the authors, actually creates a situation where "eco-efficiency only make the old, destructive system a bit less so (p.62)" and "effective destruction is harder to detect and thus harder to stop (p.65)". They further describe the contemporary society as a system where prosperity equals economic activity regardless of what that activity results in. As an example they show that "the 1991 Exxon Valdez oil spill actually increased Alaska's gross domestic product [because] so many people where trying to clean up the spill (P.36)". This shows that "the GDP [which is the common factor to measure prosperity] takes only one measure of progress into account: activity. Economic activity. But what sensible person would call the effects of an oil spill progress? (p.6)". The authors also argue that we have become trapped in an implementation of a "brute force principle" to sustain our current quality of life:

> The attempt to impose universal design solutions on an infinite number of local conditions and customs is one manifestation of this principle and its underlying assumption, that nature should be overwhelmed; so is the application of the chemical brute force and fossil fuel energy necessary to make such solutions "fit"(p.30).

This "one size-fits all" design-mentality (p. 28/141) and "brute force principle" is according to the authors two of the main reasons to the current linear society sytem that they label a "Cradle-to-grave system (p.93)".

Regarding Eco-efficiency the authors to Cradle to Cradle defines it as the rule of the four Rs (p.53): **Reduce, Reuse, Recycle** and **Regulate**. By applying the assumption "to be less bad is no good" on these rules the authors make some of the limitations of this approach visible.

The first R; **reductions**, is described as "a central tenet of eco-efficiency". But when the longer perspective is considered a reduction "does not halt depletion and destruction – it only slows them down, allowing them to take place in smaller increments over a longer period of time (p.54)."

The second R, **reuse**, is also a source of deception according to the book. To the bystander this might convey the picture that we are actually doing something and that it is good for the environment. "But in many cases these wastes – and any toxins and contaminants they contain – are simply being transferred to another place (p.55)."

Recycling is another common phrase today which according to the authors is more correctly described as downcycling. This since almost all recycled products today actually loose quality and materials every time they go through the recycling process. Sometimes the processes even increase contamination of the biosphere. I.e. "Electric-arc furnaces that recycle secondary steel for building materials are now a large source of dioxin emissions, an odd side effect for a supposedly environmental process (p.57)."

Regulations are the last piece of the eco-efficiency puzzle according to Cradle to Cradle. These are the efforts of the legislating parts of society to prohibit various actions and deeds that are seen as negative. In the field of environmental protection these regulations have often been the product of a conflict between environmentalists and the industry. Hence the industries have often been regarded as the "bad guys" that has to be restricted in an effort to save nature. As the authors point out, this is not a god way of making progress. First the regulation tool itself is a blunt one according to the authors. It often lacks the flexibility to work on all situations; it is a "one-size-fits-all" solution.

Secondly it creates a negative polarization of the different parties. A rule per definition means that there have to be one side that is right and one side that is wrong, a situation which is seldom true. In the book the stance that is taken is that: "We do not mean to lambaste those who are working with good intentions to create and enforce laws meant to protect the public good. In a world where designs are unintelligent and destructive, regulations can reduce immediate deleterious effects". But "ultimately a regulation is a signal of design failure (p.61)". This all results in a system that according to the authors aims to:

> • Release fewer pounds of toxic wastes into the air, soil, and water every year
> • Measure prosperity by less activity
> • Meet the stipulations of thousands of complex regulations to keep people and natural systems from being poisoned too quickly
> • Produce fewer materials that are so dangerous that they will require future generations to maintain constant vigilance while living in terror
> • Result in smaller amounts of valuable materials in holes all over the planet, where they can never be retrieved
> (McDounough et. al 2002, p.62)

To sum up McDonaough and Braungart describes the eco-efficiency as "an outwardly admirable, even noble, concept" but "not a strategy over the long term, because it does not reach deep enough (p.61)" They also state that "[…] to be less bad is to accept things as they are, to believe that poorly designed, dishonourable,destructive systems are the best humans can do. This is the ultimate failure of the "be less bad" approach: a failure of imagination (p.67)".

Eco-effectiveness

To remedy this situation McDonough and Braungart first stress the importance of diversity:

> "Ultimately, it is the agenda with which we approaches the making of things that must be truly diverse. To concentrate on any single criterion creates instability in the larger context, and represents what we call an "ism", an extreme position disconnected from the overall structure."
> (McDonaugh et. al., 2005, p.147)

Regarding these isms of the 20th century the stance is taken that even though many isms have had good intensions to begin with they still have within them the power of doing bad as described below:

> "But taken to extremes – reduced to isms – the stances they inspired can neglect factors crucial to long term success, such as social fairness, the diversity of human culture, the health of the environment. […] even ecological concern, stretched to an ism, can neglect social, cultural, and economic concerns to the detriment of the whole system."
> (McDonaugh et al 2005, p.149)

Secondly they argue that in order to get eco-efficiency past its current state of "being less bad" a new way of thinking about designing the sustainable society is needed. This lead to what they call eco-effectiveness, as an evolution of the eco-efficiency concept. In this effort to create a new industrial re-revolution they put down new design assignments and ask: Why "instead of fine-tuning the existing destructive framework [doesn't] people and industries set out to create the following:

• Buildings that, like trees, produce more energy than they consume and purify their own waste water
• Factories that produce effluents that are drinking water
• Products that, when their useful life is over, do not become useless waste but can be tossed onto the ground to decompose
• and become food for plants and animals and nutrients for soil; or alternatively, that can return to industrial cycles to supply high-quality raw materials for new products
• Billions, even trillions, of dollars' worth of materials accrued for human and natural purposes each year
• Transportation that improves the quality of life while delivering goods and services
• A world of abundance, not one of limits, pollution, and waste
(p.90-91).

To achieve this vision the authors claim that:

> If humans are truly going to prosper, we will have to learn to imitate nature's highly effective cradle to cradle system of nutrient flow and metabolism, in which the very concept of waste does not exist.
> To eliminate the concept of waste means to design things – products, packaging , and systems – from the very beginning on the understanding that waste does not exist (p.103-104).

This will according to the authors lead to a circular "cradle to cradle" system instead of the existing linear "cradle to grave" system. For inspiration and guidance to these design principles McDonough and Braungart turns to nature:

> Let's take a closer look at the cherry tree: As it grows, it seeks its own regenerative abundance. But this process is not single purpose. In fact, the trees growth sets in motion a number of positive effects. It provides food for animals, insects and micro organisms. It enriches the ecosystem, sequestering carbon, producing oxygen, cleaning air and water, and creating and stabilizing soil. Among its roots and branches and on its leaves, it harbours a diverse array of flora and fauna, all of which depend on it and on one another for the functions and flows that support life. And when the tree dies, it returns to the soil, releasing, as it decomposes, minerals that will fuel healthy new growth in the same place. Te tree is not an isolated entity cut of from the systems around it: It is inextricably and productively engaged with them. This is a key difference between the growth of industrial systems as they now stand and the growth of nature (p.78).

They also ask us to consider this:

> […] all the ants on the planet, taken together, have a biomass greater than that of humans. Ants have been incredibly industrious for million of years. Yet their productiveness nourishes plants, animals, and soil. Human industry have been in full swing for little over a century, yet it has brought about a decline in almost every ecosystem on the planet. Nature doesn't have a design problem. People do. (p.16)

Conclusions

In order to sum up eco-effectiveness it could be argued that it is a design approach that aims to: *think holistically before action is taken, respect diversity and design with principles inspired by nature's laws*.

But if landscape architects and architects are to use this approach in their designs for the 21st century, there is one important fact to take into consideration. In nature there is a set of natural rules that keeps the ecosystems more or less in balance. These rules have in many aspects been put out of action regarding mankind since the introduction of fossil fuels and other technological advancements.

Thus there is reason to question to what degree humanity stand a chance of once more become fully integrated parts of the environment. This presumed it is not willing to fundamentally change its' general lifestyle. With that said humanity still have to subdue to the fact that it is still a part of the natural systems and will not in the foreseeable future be able to disregard its' most fundamental rules. Disregarding these will inevitably lead to severe consequences or as Winston Churchill once said;

> "First we shape the landscape, and then it shapes us"

PART TWO

THEORY TO SITE

THEORY TO SITE

Introduction:

In part one chapter four McDonough and Braungart paints a vision where "the buildings produce more electricity than they use" and "factories produce effluents that are drinking water". "A world of abundance, not one of limits, pollution and waste". To realise this vision of sustainability they advocate design principles inspired by nature's laws and set up a series of design goals under the label of eco-effectiveness. As discussed in chapter two the sustainability concept is often regarded to contain the three aspects of ecological-, economical- and social sustainability. In this second part of the theses it is manly the ecological aspect that is of interest. The following question has been formulated:

Is it possible to realize the visions from Cradle to Cradle; Remaking the Way We Make Things, when the Eco-effetiveness concept is brought down to the physical reality on a contemporary urban site?
Also; which physical implementations do the Landscape architect and Architect have today and which are needed in the future, in order to realize this vision ofecological sustainability?

To be able to examine this there is need to establish a point of reference. In Cradle to Cradle the authors use the tree as an example of an ecologically sustainable organism and as a model of reference. Hence this thesis will use the same. But to only look at the tree will not provide a usable tool; rather it is the systems that shape the existence of the tree and its ecosystems that are of interest. In this thesis these systems or cycles have been simplified to:

- Energy
- Matter
- Water

In the comparisons that was made in this thesis the facts and views was mainly based on the following writers:

Folke Günther: M.Sc., has a background as field biologist and farmer, as well as his university career. He has worked eight years as a lecturer in Human Ecology at Lund University and was a Ph.D. student at Dept. of Systems Ecology, Stockholm University. The title of the thesis is *Ecological Adaptation of Human Settlements*.

One of the conclusions from his work is that ecological adaptation is a good way to attain sustainability, and that such an adaptation among other things involves a geographical and functional integration between settlements and agriculture for recycling of nutrients and diminishing industrial energy dependence.

Such integration can be attained also in urban sites by a progressive change of the urban borders to an undulating form penetrating the surrounding agricultural land, ruralisation.Today, he is the managing director of Holon Ecosystem Consultant.

John T. Lyle: During the late 1970's, John T. Lyle (1934-1998), a Cal Poly Pomona landscape architecture professor, challenged graduate students to envision a community in which daily activities were based on the value of living within the limits of available renewable resources without environmental degradation.

Influenced and inspired by emering design philosophies, several Cal Poly Pomona faculty members formed an interdisciplinary team to design an institute that would offer a holistic and cooperative model of community development witin the rigidly organized and hierarchical administrative structure of the university. Today it is known as *The John T. Lyle Center for Regenerative Studies.*

Alison G. Kwok: Ph.D., AIA, is an associate professor in the University of Oregon architecture program and a licensed architect. Prof. Kwok teaches design studios, environmental control systems, and green design elective courses.

She has taught in New York, California, Hawaii, Hong Kong, and Japan. She is co-author of the recently published *Green Studio Handbook* (2007) and *Mechanical and Electrical Equipment for Buildings* (10th ed. 2006) and was a key participant in the University of California Berkeley's Vital Signs Project.

Prof. Kwok was Principal Investigator for the Agents of Change curriculum project that addressed building performance through on-site case study development. She is a member of the USGBC's Formal Education Committee and has been a governing member of the Architectural Research Centers Consortium and the Society of Building Science Educators; is an active member of several technical committees for the American Society of Heating, Refrigerating and Air-Conditioning Engineers; and is active in the American Solar Energy Society.

Per G. Berg: Is a professor in sustainable development. He took his Ph.D. 1986 in microbiological ecology. When the Institute for future studies was formed in 1988 Berg became responsible for three studies in: *Eko-technique, Biology in city planning* and T*ransports for the future*.

Since then he has actively worked with questions regarding eco-building and planning. Since 1993 he is head of the research regarding City planning in a neighbourhood perspective. Since 1996 he is also connected to the *Baltic University Programme* at Uppsala university, a network of teachers and scientists in more than 90 cities in 14 countries around the Baltic sea.

Finaly; since ecological sustainability is closely connected to local conditions this makes it difficult to discuss it in a global perspective. In this thesis a generalized post industrial city as has been chosen as a reference for the man made development and this city has been put in a general tempered landscape. Thereby it should be acknowledged that if the geographical location or type of city would be changed, the discussions in part two might have looked different.

PART TWO

Chapter 5: **ENERGY; POWER WITH A DOWNSIDE**

Chapter 5: ENERGY; POWER WITH A DOWNSIDE

Cheap energy is in the contemporary urban situation, often taken for granted. But if the conclusions from Part one are correct this might be about to change. How does Eco-effectiveness intend to handle this issue?

The natural cycles

Almost all living things on earth are depending on the sun in order to survive. According to Lyle 1994 p.55 (Fig 5.1), this energy source sustains four main functions that are vital to biological life on earth. In order to understand the magnitude of energy that is provided by this source the following comparison could be made:

Each second the sun provides some 174 petawatts at the upper atmosphere (Smil 1991, p.240). To put this number into context it can be compared to Sweden's total annual need regarding energy for food production, which is estimated to 60 TWh (Günther 1993, p.126). In a very simplified calculation this results in the conclusion that this amount of energy could sustain the agricultural production of Sweden for some 2900 years.

These numbers can lead to the conclusion that the solar power is more than enough to sustain the ecosystems as well as our needs. The problem lies with efficiency.

> About 96 to 98 percent of the solar energy striking an average landscape is lost as unusable heat while the rest is fixed in biomass. When an animal eats the plant matter, roughly 10 times as much energy is dissipated as heat as is fixed in animal biomass. (Lyle1994, p. 55)

Not even the most efficient landscape is able to extract much of the energy provided by the sun:

> Marshes are the most efficient biomass converters; about 1.5 percent of the solar radiation striking an average marsh is fixed in plant matter, and a highly efficient marsh can fix twice that much. The most efficient temperate forest converts about the same amounts as an average marsh and grasslands fix between 0.13 and 1.2 percent. (Smil 1991 quoted by Lyle 1994, p. 54)

This has led to the consequence that the natural systems have evolved according to the principle of economic energy use. Or as Aristotle once wrote in his book Politics (Politics book 1, ch 2, quoted by Murphy 2005, p.92):

> "nature does nothing uselessly"

To sum up the ecosystems way of handling energy it seems that they:

- Use the power from the sun
- Are highly economic with the energy provided

The man made system

Where nature mainly has to depend on the rather inefficient extraction of solar energy, humans have come up with a number of alternative power sources. Through taming the forces of wind, water and fire during our early stages of civilization humanity moved on to the energy imbedded in fossil fuels and nuclear power during more resent times. A technological break through that according to the theory of climate change etc. are about to couse some devastating effects

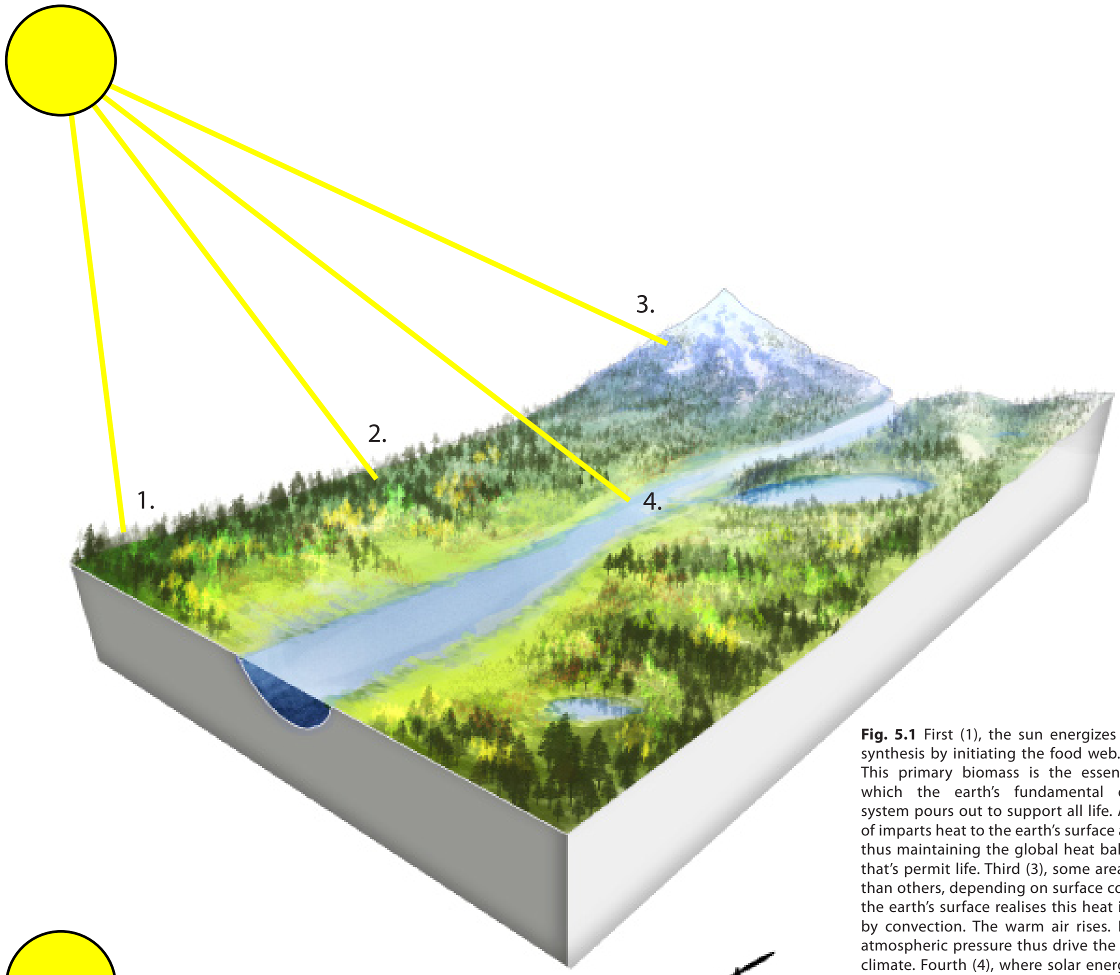


Fig. 5.1 First (1), the sun energizes life through photosynthesis by initiating the food web. Thus life is created. This primary biomass is the essential funnel through which the earth's fundamental energy distribution system pours out to support all life. A second (2) portion of imparts heat to the earth's surface and the atmosphere, thus maintaining the global heat balance within a range that's permit life. Third (3), some areas absorb more heat than others, depending on surface cover and declination; the earth's surface realises this heat into the atmosphere by convection. The warm air rises. Its temperature and atmospheric pressure thus drive the pattern of wind and climate. Fourth (4), where solar energy happens to strike the surfaces of lakes and seas, it evaporates water and thus energizes the hydrologic cycle. (Lyle1994, p. 55)

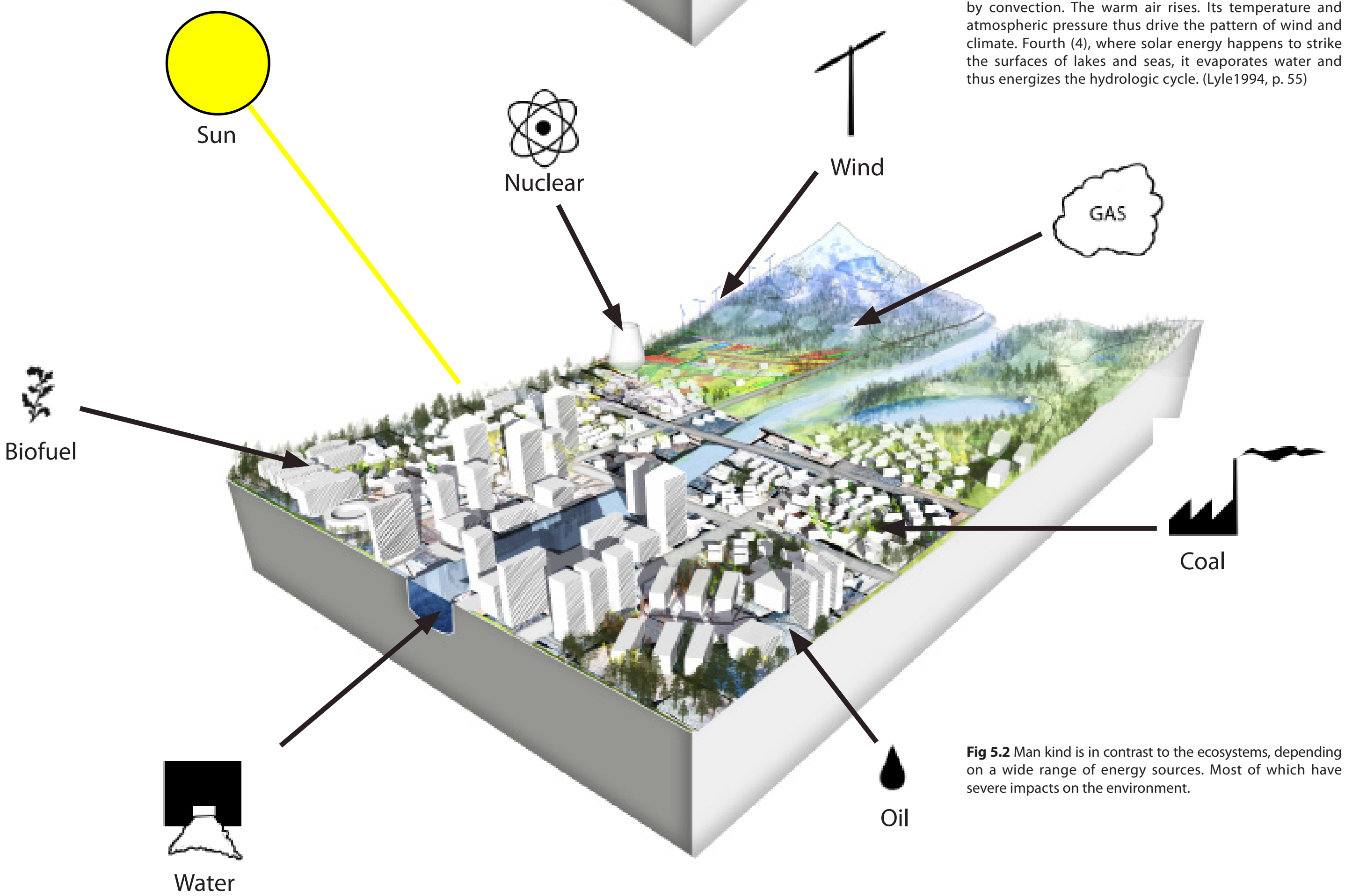


Fig 5.2 Man kind is in contrast to the ecosystems, depending on a wide range of energy sources. Most of which have severe impacts on the environment.

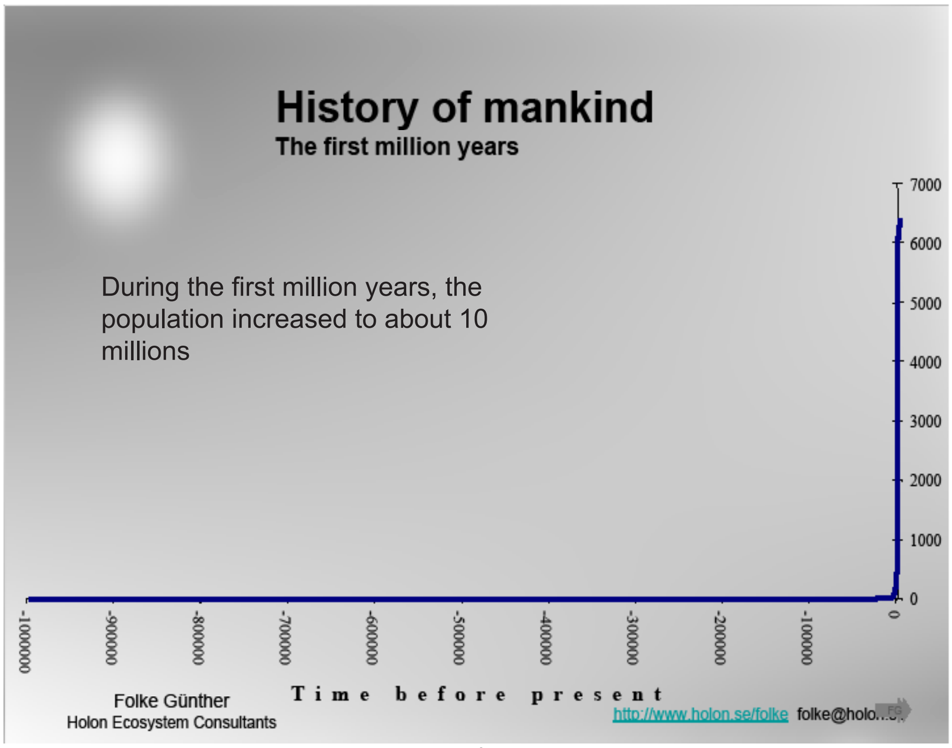


Fig 5.3 Diagram showing the human population incease during the first million years.

Human population

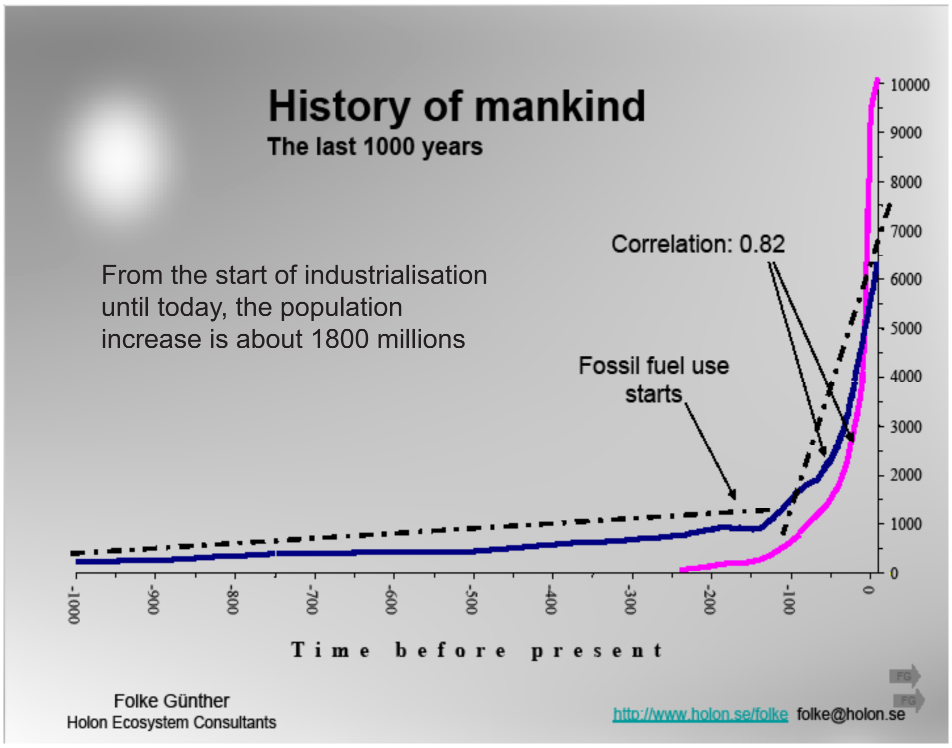


Fig 5.4 Diagram showing the human population incease during the industrial age in comparison to man kinds increased energy consumption.

Human population
Energy consumption.

regarding the environment. Most of these sources are today converted to the high-quality energy known as electricity that in turn upholds most of the urban systems (Fig. 5.2). But the fact is that during 99.99% of our existence man kind has been limited to the same solar power that nature still is (Berg et. al 1993, p.120).

It was not until the extraction of fossil fuels provided an apparently unlimited power source that the human species could truly expand outside the natural bonds that up until then had kept it back. This can be illustrated by comparing human population growth with its historic use of fossil fuels(Fig. 5.3-5.4). Based on these diagrams the conclusion seems to be that this use of "unnatural" energy has created a situation where the global human population today, is kept at a level that would probably be impossible without easy access to abundant energy.

Regarding the urban energy consumption there are numerous functions such as transportation of people and goods, lighting, heating etc. to be considered. In this chapter regarding energy the discussion will limit itself to a building in order to examine the implementation of the eco-effectiveness concept.

Today the energy that sustains the urban systems is in a global perspective, predominantly produced using non-renewable resources outside the city edges. It is then transported in the shape of electricity to the consumer. In Sweden around 5-7%[15] of this produced electricity is calculated to be lost already during this transportation. Further electricity is also commonly used to maintain tasks such as controlling heating and cooling in the contemporary building, tasks that can be solved in other ways according to Berg et al 2002, p.50.

In Fig. 5.5 (Kwok et al 2006, p.184) the average consumption of a contemp rary American non-residential building is illustrated. According to this diagram the heating and cooling of space stands for 35% of the energy used energy. If these tasks could be managed without or with reductions to energy consumption, as Berg et al claims, it could be argued that the contemporary building is using its energy in a wasteful way.

[15] http://www.abb.se/cawp/db0003db002698/07ca61aa118fba31c12572fe001ecf04.aspx

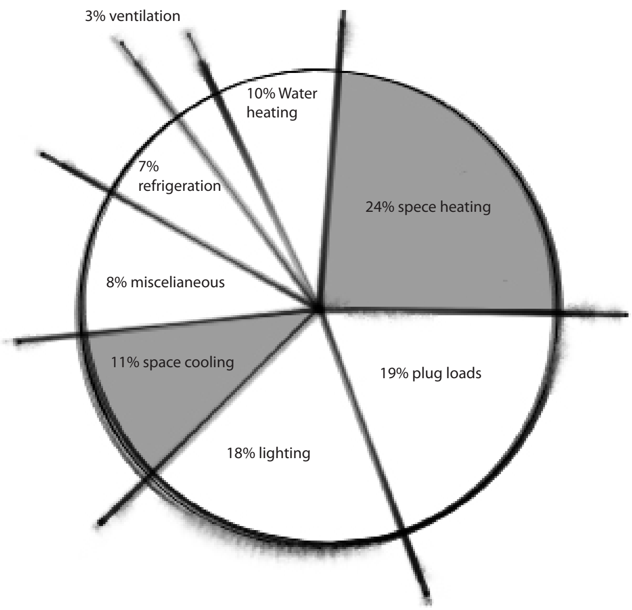


Fig 5.5 Contribution of different energy consuming factors in a non-residential buildning (Original picture: Kate Beckley, Kwok et al 2007, p.183)

To sum up the energy problems of the general urban building it seems that:

- It uses energy in an non-economic way
- It uses a large amount of non-renewable energy

The Cradle to Cradle vision

In order to examine the eco-effective approach regarding energy the design goal from chapter 4, page 38 (McDonough et al 2002, p.90) will be used. Combining the two conclusions mentioned above with the design goal, the goal can be further defined into:

- Design a building that, like a tree, produces more energy than it consumes. That uses no non-renewable energy sources and is economic with its produced energy

To achieve this, the landscape architect and architect have to; *think holistically before action is taken, respect diversity and design with principles inspired by nature's laws*.

First it seems logic to assume based on the holistic picture, that the alternative of avoiding the use of non-renewable energy sources is to prefer. Instead the designer should aim to implement a diverse set of renewable ones. Looking at nature for design inspiration the sun should be the preferred choice. Further these power producing sources should be located close to the building in order to avoid transportation losses.

Secondly it seems that if the designer aims to create a building that can produce more energy than it consumes there is a need to reduce energy consumption. According to Fig. 5.5 the heating and cooling of space stands for 35% of the energy used. If this could be address in other ways then with the use of electricity from non-renewable energy sources as Berg et al claims, it seems like a good beginning.

In nature the issue of climate control is solved in several ways. Single organisms use their mobility to avoid undesired climate conditions through i.e. migration. Assumed that this is not an alternative for the building there is need to look at more stationary solutions. The most common way that nature approaches the stationary climate control issue seems to be isolation, be it through the use of fur or building a nest underground. This is also a passive solution that does not require any activity and hence no energy.

Hence the following desired attributes regarding physical implementations can be found:

- Produce renewable energy, preferably by solar power on site
- Lower energy consumption by using passive energy saving design to address the heating and cooling problem

Physical Implementations

Harvesting sun energy: The science of extracting energy from the sun is labelled Photovoltaics. A photovoltaic cell provides direct current output. This output can de used directly, be stored or converted and be fed into an electrical grid (Kwok et. al 2007, p.197). Regarding the efficiency of this process that in nature was never more then roughly 3 %, humans have succeeded to get this number up to somewhere around 10-20%, the majority of the remaining radiation is like in nature, converted to heat (Kwok et. al 2007, p.198). Some sources even suggest that there have been experiments where the efficiency has been over 40 %.[16] Regardless of these improvements compared to nature, today "a whole roof of PVs may only be able to provide 20% of the electricity needs of a project (Kwok et. al 2007, p.13).

Based on this number it seems that as advocated by the authors in Cradle to Cradle (p.132) and others, the most plausible alternative is to use an increased range of diverse renewable power to aid the solar panels. Solar power is also highly dependent on local conditions and might not be a preferable choice on many locations. Other renewable sources such as wind, water and bio-fuels are not without their problems as well. I.e. as shown below (Fig. 5.6) the levels of energy bound in different compounds are generally higher n the non-renewable resources which mean that there have to be a larger amount of the new bio-fuels produced to attain the same effect. It also results in a conflict regarding agricultural land that is needed to feed a growing population. Combined with the issue of top soil loss discussed in chapter one the need for proper planning and design becomes evident.

Bio fules[17]

	Bound energy (MWh/m3)	Effective heat (MWh/tonnage)
Oil for incineration	10	11.7
Nature gas	10.8	14.4
Coal	6.1	7.6
Ethanol	5.9	7.5

	Land area in ha required to replace 1m2 of oil.
Wheat; ethanol	0.65
Rape; oil	0.90

Fig 5.6 Levels of energy bound in different compounds and examples of required area for production. Numbers from the Swedish Agricultural Ministry.

[16] http://www.renewableenergyworld.com/rea/news/story?id=46765
[17] http://www2.sjv.se/webdav/files/SJV/trycksaker/Pdf_rapporter/ra06_1.pdf

Isolation: In nature this has many forms. In this thesis the following list of contemporary physical implementations have been chosen to represent some of the urban alternatives:

- Green walls
- Green roofs
- Landscape orientation

Green walls: When looking at reducing the heating effect during warm summers these types of shading devices can be very efficient in comparison to standard built-in isolation due to the fact that "[...]shading stops the heat entering in the first place[...]" (Dunnet et al 2004, p.130). This shading effect can, according to Dunnet et al, reduce the temperature fluctuations with as much as 50% in the wall. A number that is closely related to the total area shaded rather than the thickness of the green wall (Köhler 1993, quoted by Dunnet et. al 2004, p.130). It has been calculated that "together with the insulation effect, temperature fluctuations at the wall surface can be reduced from between 10°c (14°F) and about 60°c (140°F) to between 5°c (41°F) and 30°c (86°F) (Peck et al. 1999 quoted by Dunnet et. al 2004 p.131)." According to the same book "a 5.5°c (10°F) reduction on the temperature immediately outside a building can reduce the amount of energy needed for air-conditioning by 50-70 per cent (Peck et al. 1999 quoted by Dunnet et. al 2004, p.130)." The reader has to keep in mind that these numbers refers to English conditions and climate.

Also during the cold moths of the year a green wall can help to reduce the cooling effect on a building. This requires that an evergreen climber has been used. The heat loss is caused by wind chill together with low temperatures. According to the book one-third of the general homes demand for heating during the winter is caused by these two factors. It is also states that; "Reducing wind chill by 75 per cent reduces heating demand by 25 per cent (Peck et al. 1999 quoted by Dunnet et al 2004, p. 131)."

Green roofs: Regarding isolation green roofs have the same advantages and energy savings as the green walls do. As Fig. 5.10-5.14 shows the implementation of such

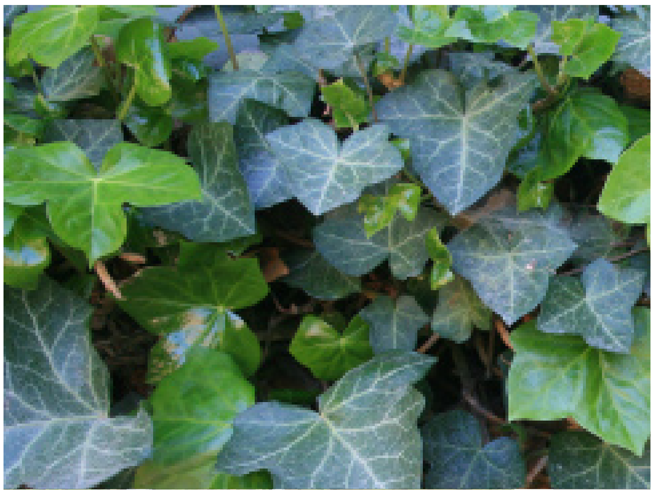


Fig. 5.7 German research results show Hedera helix with a thickness of 20-40 cm (8-16 in) is the most effective insulator (Dunnet et. al 2004, p.131).

Fig. 5.8-5.9 As these two examples show the implementation of green roofs today are available both in large and small scales. Top: proposal for Brightons new Fotball arena, Whitelaw Turkington Landscape architects, London. Bottom: Malmö Canoe Clucb

Fig 5.10 Extensive green roof and eating area on the 2005 Rhode Island School of Design Solar Decathlon House. (Picture: Jonathan Knowles, Kwok et al 2007, p. 50)

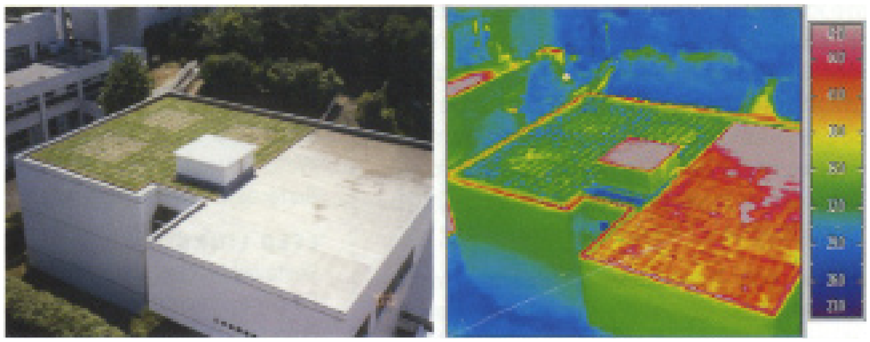


Fig 5.11 Experimental green roof on a building (left) at Yokohama National University, Yokohama, Japan. The left side of the roof has pallets of clover, the right side is a conventional exposed roof surface. Infrared thermography (right) shows the effect of the green roof on surface temperatures. (Picture: Ecotech laboratory, Kwok et al 2007, p. 50)

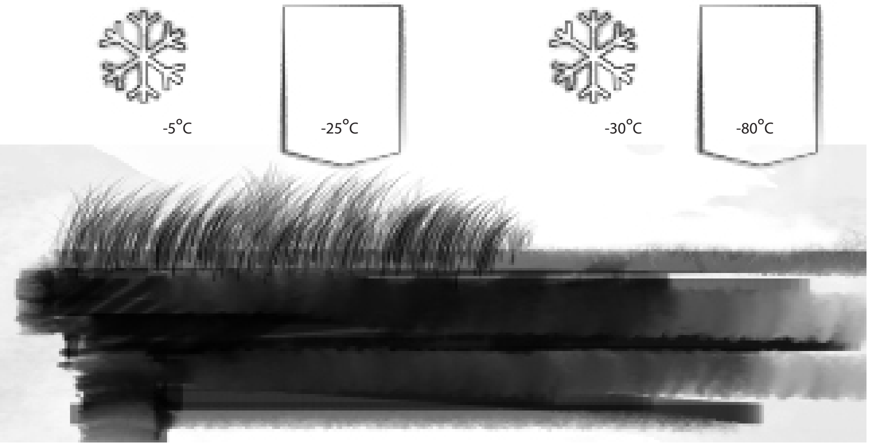


Fig. 5.15 A green roof can have significant impact on the difference inbetween max and min temperature on the roof structure. This will affect the lifespan of the construction. (Numbers from: Greener Roofs; extensive vegetations on roofs by Piga 1995, p.. 15)

Fig 5.12 Lecture hall located below an experimental green roof at Yokahoma National University. (Picture: Ecotech laboratory, Kwok et al 2007, p. 51)

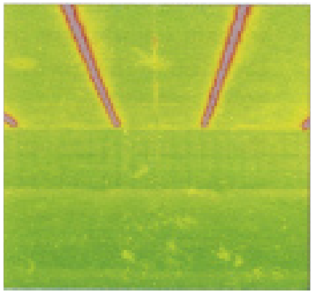


Fig 5.13 Thermograph taken at 3>00 PM in classroom below the green roof. Temperatures average 90 ° F [32 ° C]. (Picture: Ecotech laboratory, Kwok et al 2007, p. 51)

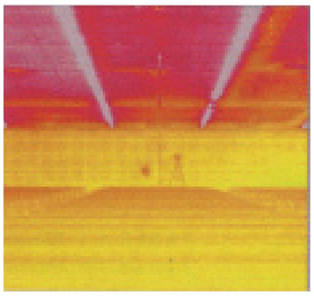


Fig 5.14 Thermograph taken at 3>00 PM in classroom without a green roof. Temperatures average 100 ° F [38 ° C] in the seating area and 108 ° F [42 ° C] at the ceiling. (Picture: Ecotech laboratory, Kwok et al 2007, p. 51)

a roof can have a significant impact on the roof temp-erature and thereby the indoor climate. The Green roof will also help to reduce the temperature fluctuations on the roof structure just as with the green walls. In Fig. 5.15 the changes between min and max temperatures are are shown in a green roof compared to a standard construction. As the numbers show the difference is significantly reduced.

Landscape orientation: The last passive approach we will look at in this thesis is the use of landscape orientation. Not strictly speaking a form of isolation or physical implementation, it is still a useful tool in the pursuit of addressing the climate control of a building. To simply orientate a building according to the conditions on site and with regards to the local climate conditions can have big impacts on the energy consumption. A simple design approach like this can result in the decision to maximise windows facing the predominant direction of the sun and to do the opposite in the other direction. To maximise the passive use of solar energy like this the use of thermal mass can be implemented (Fig. 5.16). To simply use other features in the landscape such as trees etc., can also help to minimize wind exposure and to maximise the passive use of the sun (Fig. 5.17).

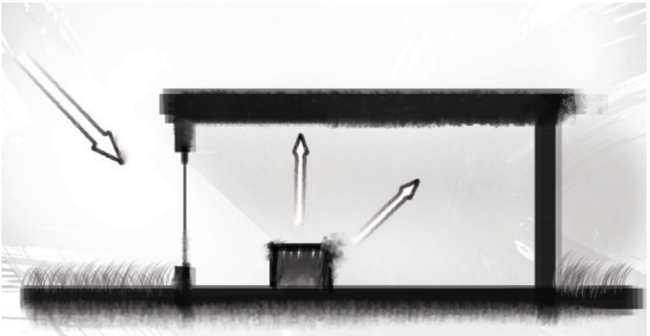


Fig. 5.16 To store the heat and reradiate it when solar radiation is no longer coming in requires a storage medium called "thermal mass". As in most other processes of energy and material flow, storage capacity is essential for operation and is often the limiting factor for effectiveness of the system (Lyle 1994, p.107).

Fig. 5.17 A tree in full leaf intercepts between 60 and 90% of the radiation that strikes it, depending on its canopy density. A decidious tree in the wintertime refelcts between 25 and 50%. Thus, clusters of trees spaced closely together can reduce amdient summer temperature in lage areas, helping with issues such as the Heat Island effect (Lyle 1994, p.102).

Conclusions

The numbers and details regarding energy presented by various authors are in many cases difficult to comprehend and verify. There is often great uncertainties and generalisations built in to the statements and facts. Still the overall picture of energy consumption is rather clear when it comes to human activities.

Regarding Cradle to Cradles eco-effectiveness concept and its goal to produce buildings that produces more energy than it consumes, it seems to be plausible. It will though, require that our societies cut down on the contemporary wastful ways of consuming energy. But looking at the western lifestyles and trends today in a bigger picture. Makes it difficult to believe that man kind in the near future can reduce its energy consumption to the levels that might be needed.

Rather it seems that there will be increasing need for energy in the global community. An increase that could be difficult to supply with the renewable sources only. All this assumed there are no new problem free power sources to be found. Still the landscape architect and architect can do much to help through the implementation of simple design-procedures such as described. Regarding the future needs for implementations there is much to be done for the scientist in order to make these implementations more effective.

To summarize abundant energy is the very foundation to the modern contemporary urban context. Providing man kind with the power it needs to reach our ambitious dreams. But it is power that comes with a downside.

- We need to reduce our consumption of energy in general and especially non-renew able energy
- We need to find new sources of energy and render the ones we have more effec tive
- Regarding the physical implementations there is a wide range that can be implemented but new and more effective ones will be needed

PART TWO

Chapter 6: **WATER, NATURES HIGWAY**

Chapter 6: **WATER; NATURES HIGHWAY**

Water is one of the fundamental factors that make the existence of life on this planet possible. Generally perceived as an abundant resource, it is often taken for granted. Contemporary predictions regarding climate change etc. are stating that this might be a chancing matter in the future future. How does the Cradle to Cradle vision intend to handle this?

The natural cycles

Looking from space roughly 70% of our planet is covered by water (Owen et. al 1990, p.122). Of these massive volumes of water only 25 % is fresh water and a large part of that is bound in the ice at the North- and South Pole of the globe. On a landscape level the availability of fresh water varies dramatically depending on geographical location. Still even in a water rich landscape like the one found in Sweden less than 0.8 % is what is referred to as ground water. (Boverket 1995 s.10). And of this 0.8% a large amount is deposited in deep locations in the earth crust that is hard to reach for the surface based ecosystems. This shows that the availability of fresh water reserves is not to be over estimated.

Together all this water is bound in the ever changing hydrologic cycle. Containing slow moving seas, lakes and brooks, as well fast flowing rivers and water falls this system is truly global and diverse in appearance. Still it can be deceivingly easy to describe as Fig. 6.1 shows. But the seemingly simple outline of the system is governed by a wide range of underlying complex systems that are easily altered (Lyle 1994, p.141). The hydrologic cycle also serves as natures main transport system. It has been estimated that rain generally "erodes a rocky surface at the rate of one-fourth to one-fiftieth of a millimeter a year[…] (Owen et al 1995, 9.82)". Given time this small eroding can, thanks to the scale of the system, result in the transportation of enormous amounts of matter. This is the way that many materials such as minerals, gets introduced into the ecosystems.

Water is also a vital part of the biological organism itself. "Each of the more than 10 million kinds of organisms on this planet, from the amoeba to the blue whale, must take water into its body to survive. In most species, including humans, 70 per cent of living biomass is composed of water (Owen et al 1995, 9.123)".

To summarize the ecosystems relationship to water they:

- Are depending on this complex moving system for supplying nutrients such as minerals etc.
- Are depending on water to build up biomass

The man made system

According to Lyle (1994, p.143) there are in general terms, four major interventions caused by man regarding the hydrologic cycle: Alteration of Water Chemistry, Watershed Degradation, Water Diversion and Crop production. Of these four the last three are directly depending on alterations to the pattern of flow and the first is more connected to the use of matter which will be further addressed the next chapter. In urban areas intervention in the flow of the hydrologic cycle can clearly be related to the industrial linear thinking. Through the implementation of technical drainage

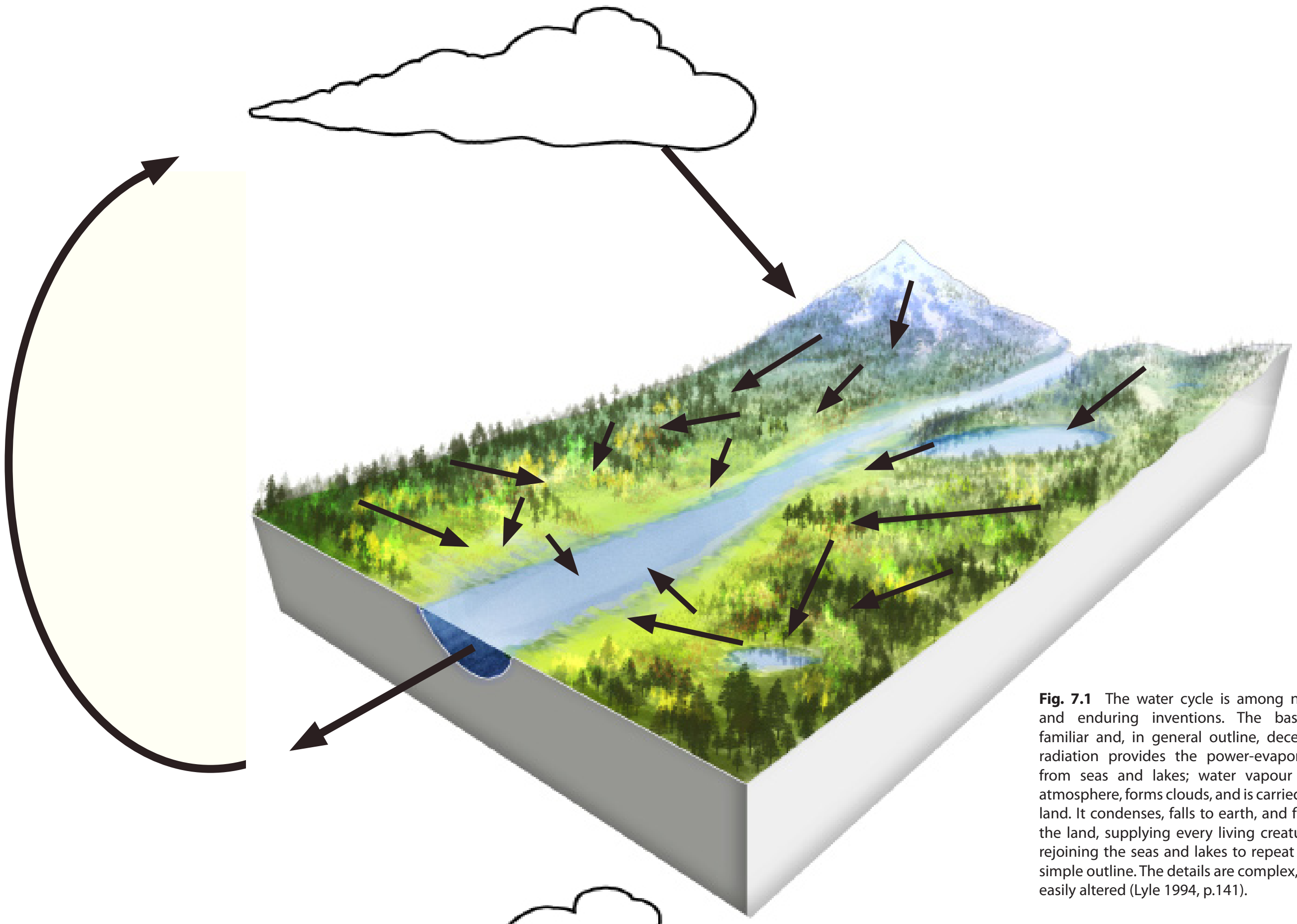


Fig. 7.1 The water cycle is among nature's more elegant and enduring inventions. The basic mechanisms are familiar and, in general outline, deceptively simple. Solar radiation provides the power-evaporating water, mostly from seas and lakes; water vapour then rises into the atmosphere, forms clouds, and is carried by the wind over the land. It condenses, falls to earth, and flows on and through the land, supplying every living creature before eventually rejoining the seas and lakes to repeat the cycle. That is the simple outline. The details are complex, always chancing and easily altered (Lyle 1994, p.141).

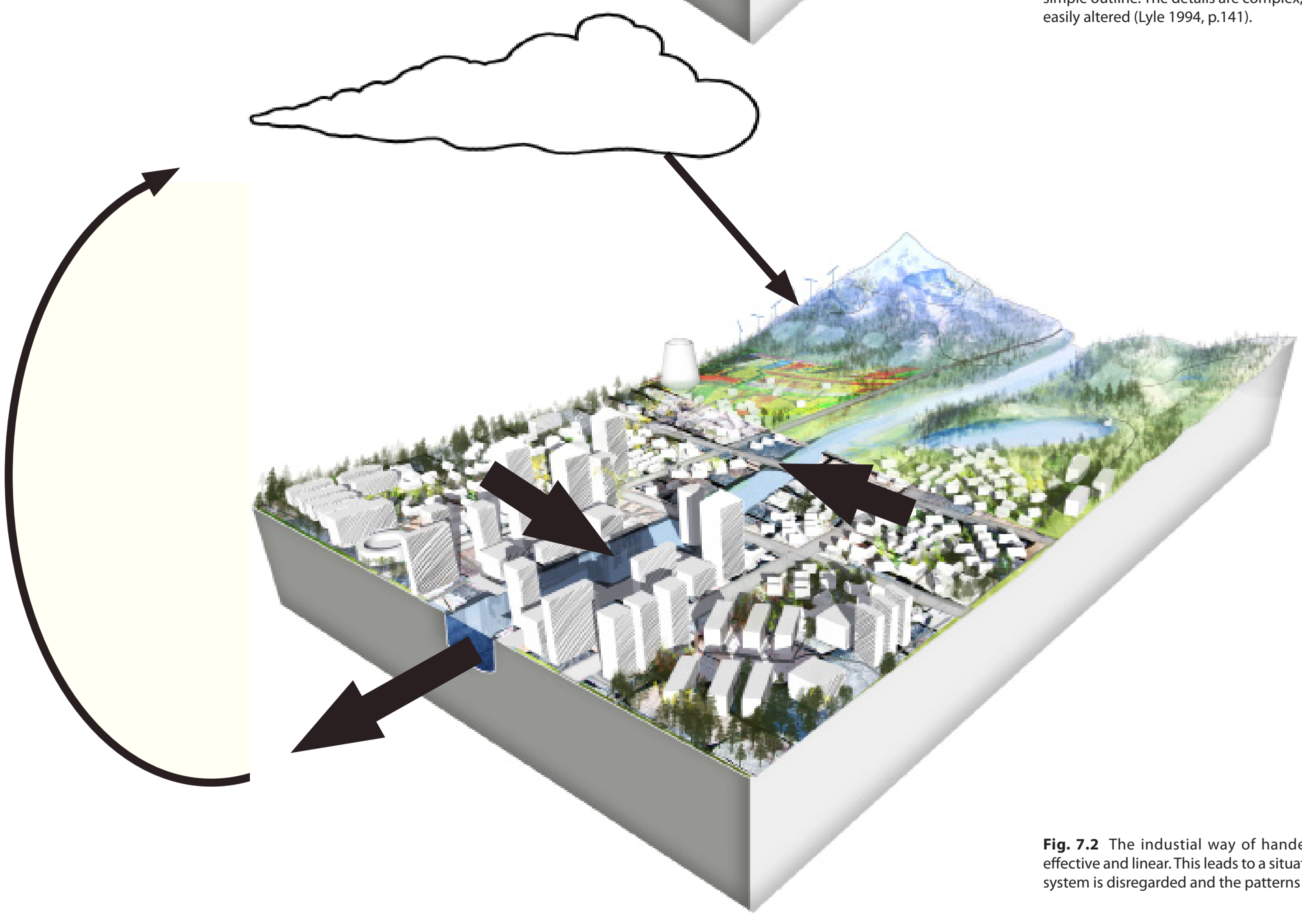


Fig. 7.2 The industial way of handeling runoff water is effective and linear. This leads to a situation where the bigger system is disregarded and the patterns of flow are altered.

systems and other simplifications to the flow patters, major changes are caused (Fig. 6.2. The alteration of flow is also connected to the problems regarding climate change as mentioned in chapter one. But exactly what the implications of this will be are hard to tell.

When urban developments took of in the beginning of the last century an increasing amount of land became hard paved or in general impervious. This resulted in increased amounts of runoff water. Today it is estimated that "around 75 per cent of rainfall on towns and cities is lost directly as surface runoff compared to around 5 per cent for a forested area (Sholtz-Barth 2001 quoted by Dunnet et al 2004, p. 43)".

Still the hard surfaces are relatively small compared to the soft permeable ones. It has been estimated that in Sweden it is only 0.5 percent of the annual precipitation that actually falls on hard paved surfaces (Lönngren 2001, s.13). And it should also be taken in to consideration that the amount of impervious surfaces "ranges from [I.e.] 10 percent for residential development to 71 to 95 percent for industrial and shopping centers (Ferguson 1998 quoted by Dunnet et al 2004, p. 43)." This brings a wide diversity to the urban situations and not all of them are negative regarding water flow.

The problem arises because the industrial way of handling this run off water is through the implementation of systems such as pipes and channels. And while "a concrete channel may move the water away and solve the flooding problem in that particular place, it fails o deal with the groundwater regime, with the wild life habitats of stream, wetland, and floodplain, with soil transport, with water supply – even with downstream flooding. […] Thus the solution to one problem often creates a number of others, some of them even more serious than the problem being solved. (Lyle 1994, p.147)". It also has serous consequences that hard surfaced urban developments together with agricultural areas are growing rapidly and are constantly simplifying the landscape. It has been estimated that of the over 60% of forests that once covered the planet, less than half remains largely due to human intervention (Lyle 1994, p.143). This seriously alters the flow of water and thereby changes a major factor governing the ecosystems.

To sum up the urban development regarding water flow, it seems that the problems are:

- It simplifies the natural flows due to the in dustrial "effective" treatment of runoff water
- Is contaminates bodies of water and land due to the hydrologic cycles' natural role as a transportation system

The Cradle to Cradle vision

Looking at the eco-effectiveness design goals regarding water from page 36 (McDonough et al 2002, p.90) the authors of Cradle to Cradle proposes to create:

- Buildings that, like trees, […] purify their own waste water
- Factories that produce effluents that are drinking water

To achieve this, the landscape architect and architect have to; *think holistically before action is taken, respect diversity and d sign with principles inspired by nature's laws.*

Both of these goals seem to be closely connected to the issue of how man kind handles matter today. But they fail to mention the need to address the issue of intervention to water flow, which according to Lyle causes a wide range of problems. In order to realize a sustainable future this is an important aspect and should be examined. Hence this chapter will mostly concern itself with the intervention to flow and leave the issue of matter to chapter seven.

Since the eco-effectiveness design proposals do not directly address the issue of flow the summation of the concept will be used. If the designer looks to nature the trend seems to be the implementation of a "complex moving system". This diverse cycle of slow- and fast flowing, connected and open parts make it possible for the water to infiltrate back into the ground or evaporate. It therefore seems like a sound design principle to copy this sort of system both in the urban and rural situation.

Hence the following desired attributes regarding physical implementations can be found:

- The ability to slow down and prolong the flow of water
- The ability to trap and collect matter

Physical Implementations

Local treatment of runoff water: To create a system like the one required the landscape architect and architect need a diverse set of physical implementations. Today these systems are referred to as "Local treament of runoff water"(Fig. 6.3). To implement a system like this demand that the designer must keep a few things in mind:

> A: First the flow of runoff water is uneven. For the main part of the year the runoff pipes are empty, to be filled to the limit during heavy rain.
> B: The transport of pollutants are also uneven. In the beginning of a down pour and especially after a period of drought, the runoff water rinses hard surfaces and big amounts of particle bound pollutants go with the water. At the end of a down pour or at the end of a rainy period the runoff water can instead be rather clean.
> C: The amount off and pollution content off runoff water can significantly vary between areas, depending on the amount of hard surfaces and the activity in the area.
> (Lönngren 2001, s.12, My translation)

This calls for a set of physical implementations that can deal with changing conditions and uneven flows. Bellow is a list of some contemporary solutions:

- Green Roofs
- Bioswales
- Detention ponds

Green Roofs: This is often the first entry point for the down pour in an urban area. Regarding water flow these physical implementations can play a significant role. According to Piga 1995, as much as 60 % of the yearly precipitation on a roof can be kept away from the traditional runoff system. These positive effects starts already at a 2 cm sedum roof on a gravel drainage layer (Söderblom 1992 quoted by Piga 1995, p.13).

Bioswales : After the roof the remaining run off can either be led to the traditional pipe system or to a bioswale. Urban- or bioswales are open channels designed to attenuate runoff water but not to hold it during an extended period of time. These channels can have a varied design such as grass-, dry-, or wet swales (Kwok et al 2007, p.255). All with the common feature that they are slowing the water down and allow it to evaporate and infiltrate. This opens opportunities for the designer to elaborate with a wide range of plants and design expressions depending on local conditions. After the water has passed a system of one or more bioswales there are further alternatives to process the runoff (Kwok et al 2007, p.255):

- Infiltration into the soil
- Flow into a bioretention area or detention pond
- Discharge to a stormwater sewer system
- Direct to receiving waterways

Retention Ponds: In the case of a dense urban situation the best way to treat the last stop for runoff water, if the infiltration and evaporation is insufficient, might be detention ponds. These physical implementations do require large surfaces and will have a major impact on the design of a site. Since the detention ponds are intended as final destinations until evaporation and infiltration can deal with the water, there are some implications to consider. Due to the transportation role of the water these final destinations will be the offloading point of remaining water carried pollutants. Hence the dust or detritus that will remain after evaporation or infiltration might have high levels of hazardous materials and will therefore have to be either detained or collected.

Further there is often the argument of the growth of algae and mosquitoes in water sheds like these. This is mostly the result of designs that are not carefully executed. Regarding algae good conditions for competing plants can reduce this risk. According to Lönngren 2001, p.50, roughly half of the water surface should be covered by competing vegetation in order to keep the algae at bay. And regarding he mosquito problem this can be countered by the introduction of spices that feeds on their larva.

Fig. 6.3 Principal sketch: Local treatment of runoff water

Conclusions

Regarding eco-effectiveness and water it seems like there is a good chance of addressing the issues in urban areas. It does however require that the landscape architect or architect design with the whole system in mind. To i.e. only implement a feature such as a detention pond will probably result in flooding. And since the hydrologic system is such a vast system both planners and designers have cooperate in order to make the systems work properly. This is a huge task but one where the architectural professions can do much good if they are allowed.

To summarize; water is natures high way and both its flow and content is easily altered by man. This require that it is treated with care.

- We need to make our water visible again and make our systems more diverse
- We need to think big and down- as well as upstream
- The physical implementations are available to address water flow in urban areas

PART TWO

Chapter 7: **WHY MATTER MATTERS**

Chapter 7: **WHY MATTER MATTERS**

Matter is an elusive concept that is hard to define. In this thesis it will refer to all the compounds that make up our physical reality here on earth. Largely thanks to cheap energy man kind has had a major impact regarding the flows and uses of these resources. How can eco-effectiveness help the designer in order to become better at handling these issues?

The natural cycles

The way life has evolved on our planet generally comes down to two factors; energy, as previously discussed, and the availability to a certain number of substances. One of these, water, was discussed in previous chapter. The others necessary for biological life are commonly referred to as nutrients. These can according to Günter 2008, be grouped as follows:

H O C N S P Na K Ca… and 64 others...

The first five nutrients in this list have gaseous phases and can therefore be transported by the air. This makes them easy to transport in nature and as a result these are generally easy to come by in an ecosystem.

The last three and the following 64 are without gaseous phases and must therefore be transported as solids or liquids. These nutrients are also more common in the earth crust than in the human body.

In between is the nutrient known as phosphorus. This nutrient is 10 times more common in the body than in the earth crust. This makes it a valuable nutrient for all organisms that uses it (Günther 2008). Since these nutrients are in shifting abundance and some, like Phosphorus (Fig. 7.1), are in limited supply this has lead to the consequence:

> […] that limited materials are used as efficient as possible and is more and more prevented from leaking out the closer the system gets to ecological maturity. Typical for this material efficiency is a transaction from linear material flows to cyclical and from simple cycles to complex [my translation] (Folke Günther, System ecology and city planning) (Berg et. al 1993, p.116).

To be as efficient as possible nature has adapted to these cycles in a number of ways. As an example in this thesis the cycle of phosphorus will serve as an example. Important to point out is that phosphorus as most nutrients, is closely connected to the movement and fluctuations of the hydrologic cycle previously discussed.

To sum up the ecosystems way of dealing with matter they:

- Uses the limited materials as efficient as possible
- Tries to catch them in cyclical and complex material flows

The man made system

In the man made systems the principles regarding flow of matter differs. These differences can be divided into two issues:

First; the contemporary societies crave many more materials than that of an average ecosystem. Man kinds technical advancements has created a need for hundreds

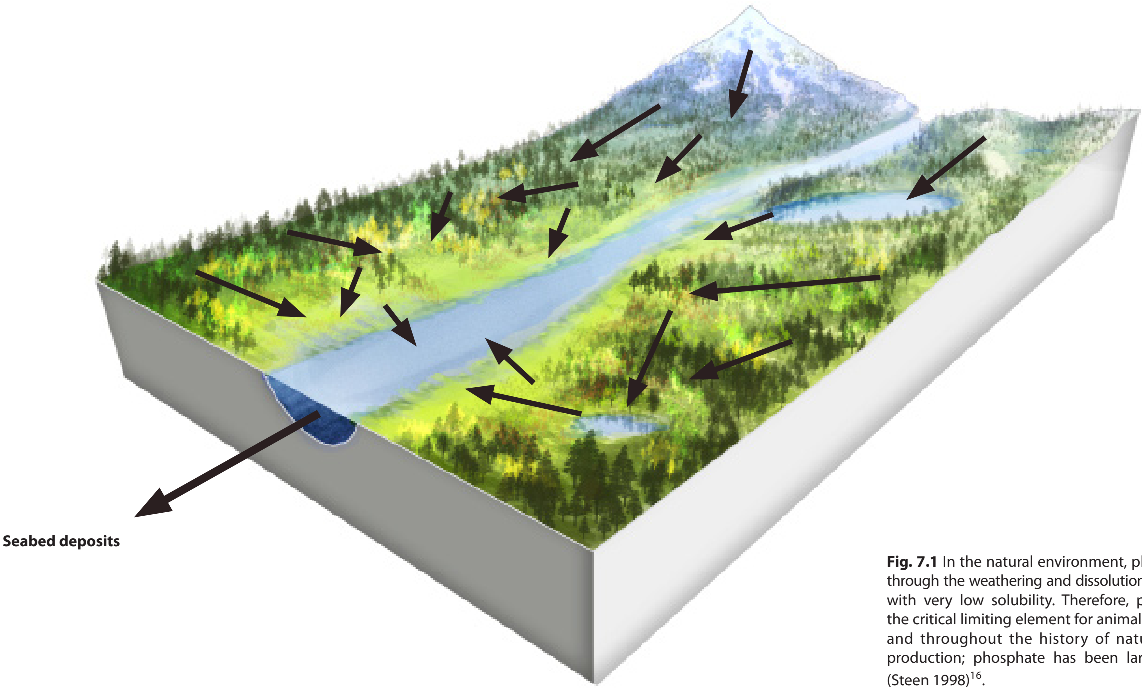


Fig. 7.1 In the natural environment, phosphorus is supplied through the weathering and dissolution of rocks and minerals with very low solubility. Therefore, phosphorus is usually the critical limiting element for animal and plant production and throughout the history of natural and agricultural production; phosphate has been largely in short supply (Steen 1998)[16].

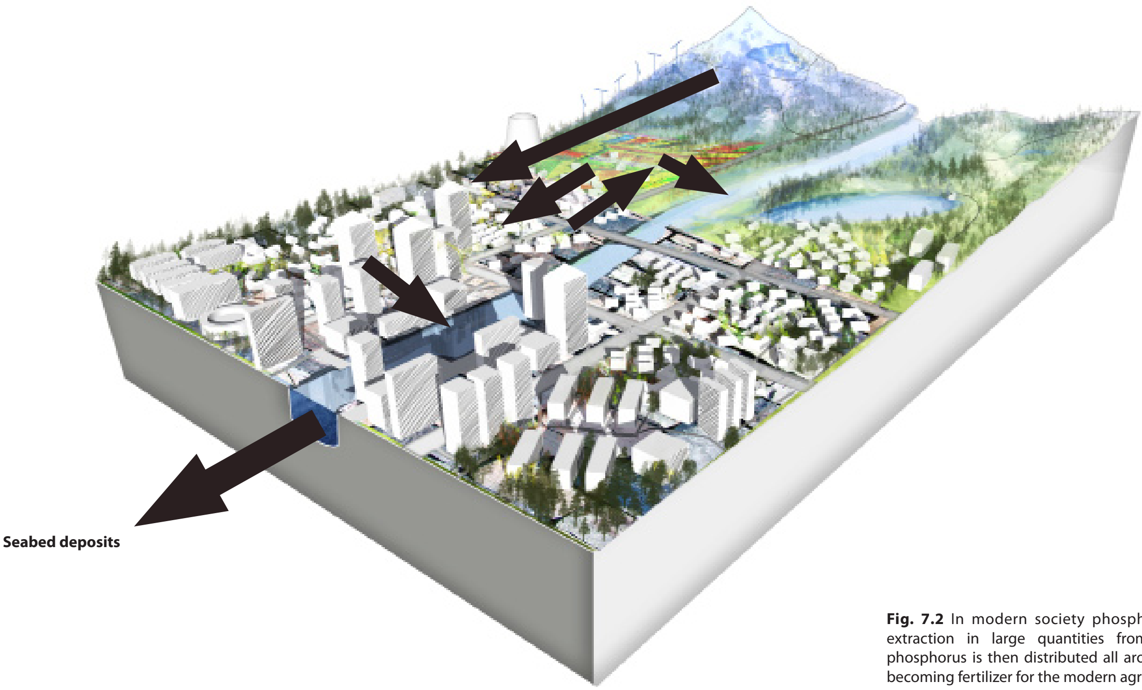


Fig. 7.2 In modern society phosphorus is supplied by extraction in large quantities from open mines. The phosphorus is then distributed all around the world, often becoming fertilizer for the modern agriculture.

of compounds that where never intended to be a part of the natural cycles. Secondly; largely due to the use of fossil fuels, humans have come to disregard the fundamental rules regarding the flow of matter that have evolved within and between the ecosystems.

This has resulted in a situation where:

> Every day a typical European city of 1 million inhabitants consumes 11,500 tonnes of fossil fuels, 320,000 tonnes of water and 2000 tonnes of food. The transformation of this material creates waste on a similar substantial scale: 25,000 tonnes of carbon dioxide, 300,000 tonnes of waste water and 1600 tonnes of solid waste (EEA, 1998; Stanners and Bordeau, 1995) (Quoted by Purvis et. al 2006, p.101).

In a sense human urban settlements have now come to a situation where they have become "disconnected" from the natural "cyclical and complex" material chains. Rather there is an ongoing accumulation and concentration of both natural and "un-natural" matter due to the one way flow. This concentration is in almost all cases, never designed to return the matter back to the natural cycles. Instead it ends up as what is commonly referred to as waste. This end product of our society is often incinerated or disposed of in landfills. And since this process is not designed with the aim of returning matter to nature there are consequences. One of these is referred to as the sink-effect or the HEAP-trap (Hampered Effluent Accumulation Trap, Günter 2008, Fig. 7.3).

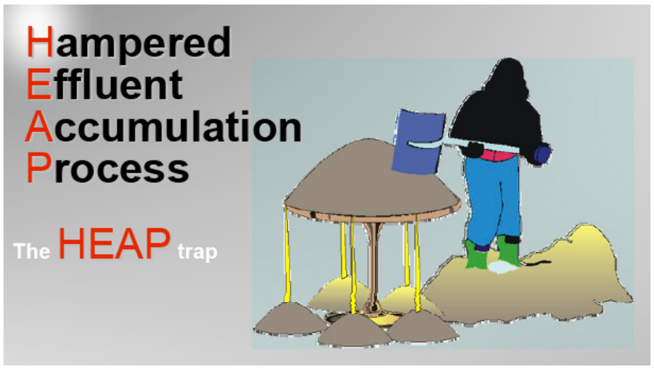


Fig. 7.3 The HEAP-trap can be described as a table upon which sand is pored. To begin with there is nothing to stop the pile growing but at one point the table will be filled and all sand added to the table will now fall off. In our urban areas the same principle can be used to describe the way matter is handled. Despite recycling systems and public cleansing plants, these can only handle a limited amount and the rest is "´falling over the edge of the table", leaking out into the surrounding ecosystems.

[18] http://www.nhm.ac.uk/research-curation/projects/phosphate-recovery/p&k217/steen.htm

This unintended leakage of concentrated matter is what has become commonly known as pollution. In some areas of the planet this phenomenon has reached serious levels like in the former Soviet union where:

> Scientists have deemed 16 per cent of the [land] unsafe to inhabit, due to industrial pollution and contamination so sever it has been termed "ecocide"(McDonough et. al 2002, p. 148).

The linear use of materials have also raised the question regarding the risk of resource depletion as mentioned in chapter one. This is an issue which is most difficult to calculate and the factors of the equations are very hard to define.

In the article *Phosphate Recovery, Phosphorus availability in the 21st century,* Management of a non-renewable resource[16] that first was published in the journal: *Phosphorus & Potassium, Issue No: 217 in September-October, 1998* the author Ingrid Steen, a Group Agronomist at Kemira Agro in Copenhagen, Denmark, examines the outlook for global phosphate rock suply and management of this non-renewable resource. She states that:

> High-grade phosphate ores, particularly those containing few contaminants, are being progressively depleted and production costs are increasing.

Her estimation is:

> By applying the phosphate consumption growth rates […], world fertilizer use would reach 60-70 million t/a of phosphates by 2050. It is concluded that global phosphate resources extend, for all intents and purposes, well into the future, but that depletion of current economically exploitable reserves can be estimated at somewhere from 60 to 130 years. In essence, using the median reserves estimates and under reasonable predictions, it appears that phosphate reserves would last for at least 100+ years (See Fig. 7.4).

According to Steen, this estimation suggests that the depletion threat regarding phosphorus, is not an immediate one. Still there are many factors to take in to account regarding the extraction of resources such as phosphorus, i.e. the technological advancements that could make extraction more efficient in the future. But in the definition of sustainable development made by the Brundtland commission: "[Development that] meets the needs of the present without compromising the ability of future generations to meet their own needs..." there is no mention of a time frame. This makes the issue of resource depletion relevant regardless of how long it will take until or if, man kind is affected.

Further as with most issues regarding declining resource availability, depletion does not happen over night. In the case of matter this process is closely connected to energy. As Fig. 7.5 shows the energy cost of extracting a resource, in this case copper, is raising exponentially when the availability is decreasing. If the assumption is made that there in the near future will be a decline in the availability of cheap energy and that there will be less new deposits of minerals etc. to be found. The conclusion to be drawn is that this could mean a raise in cost for extraction of matter and through that the products and processed that depends on them.

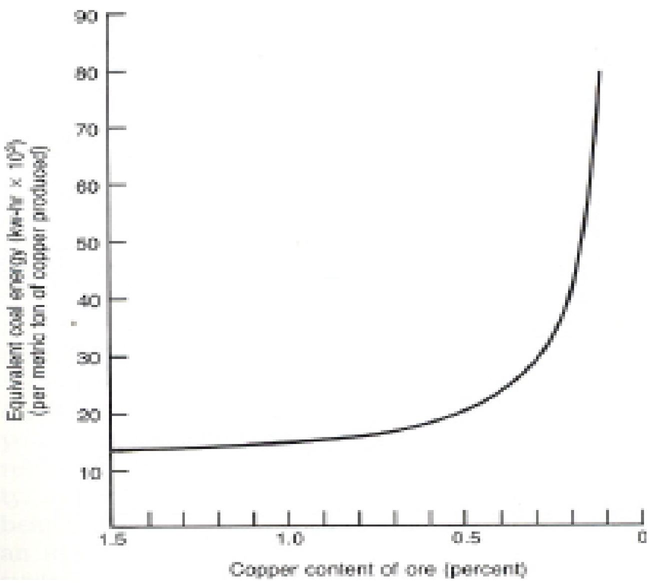


Fig.7.5 Graphical representation of the amount of energy needed to extract a mineral as the concentration of the ore decreases. Note that once the concentration falls to a critical level, energy consumption increases drastically (Owen et al 1990, p.447).

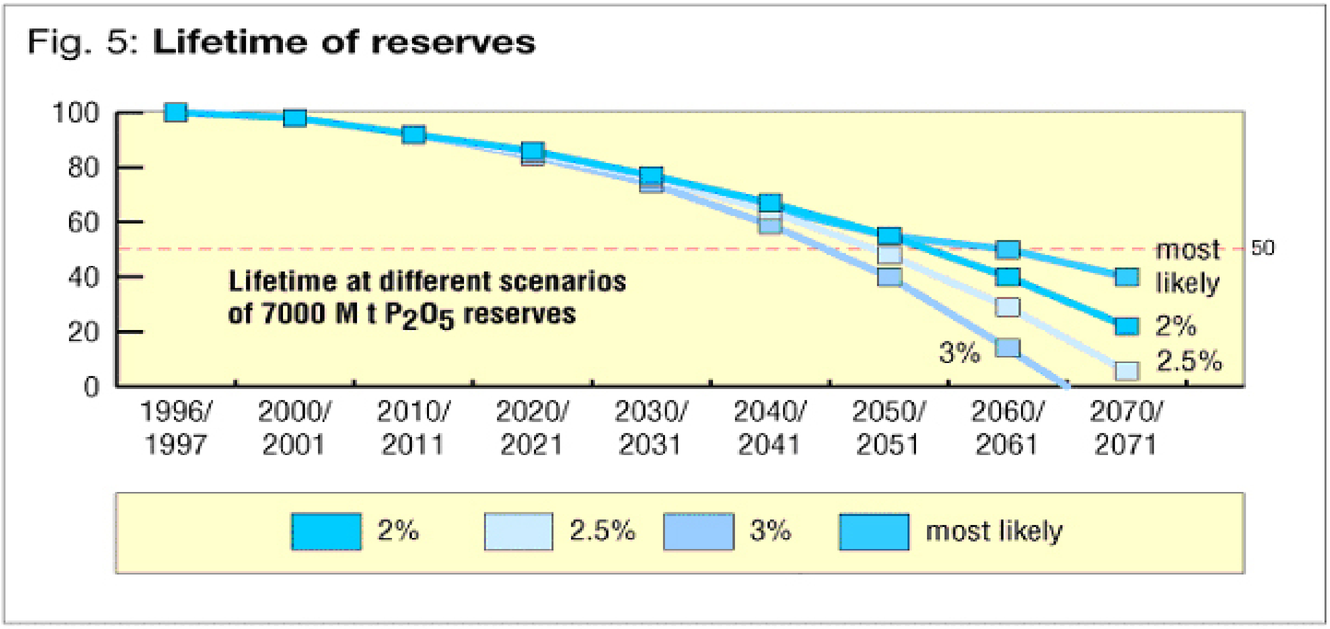


Fig. 7.4 Estimations regarding the future availability of Phosphorus. These estimations are very difficult to conduct and there are a number of factors that can change in the future succh as new and more effective technology etc. Diagram from: Phosphate Recovery, Phosphorus availability in the 21st century, Management of a non-renewable resource that first was published in the journal: Phosphorus & Potassium, Issue No: 217 in September-October, 1998, Ingrid Stee

To sum up the urban development regarding matter, it seems that the problems are:

- The modern society uses many materials that are not "natural" and can be regarded as more or less limited resources
- Thanks to cheap energy humans accumulate matter without sufficient systems to return it to the surrounding ecosystems

The Cradle to Cradle vision

Regarding matter Cradle to Cradle with its eco-effectiveness concept, sets out to create:

- Products that, when their useful life is over, do not become useless waste but can be tossed onto the ground to decompose and become food for plants and animals and nutrients for soil; or alternatively, that can return to indus-trial cycles to supply high-quality raw materials for new products
- Billions, even trillions, of dollars' worth of materials accrued for human and natural purposes each year

To achieve this, the designer has to; *think holistically before action is taken, respect diversity and design with principles inspired by nature's laws.*

Looking at the issues that were concluded regarding the urban system, both regarding matter and water. These design goals does not tell the designer much about the issue of reconnecting the matter back to the ecosystems. Hence there seems to be a need to add aother design goal to the list in order to examine the eco-effectiveness concept:

- Design a diverse system that with inspiration from nature, can reconnect matter from urban areas to the natural cycles

Regarding the first two design goals there are a few things to address. According to the authors the problem regarding our cradle-to-grave designs and the waste it produces, is not their quantity but rather "the nutrients – valuable "food" for both industry and nature – that are contaminated, wasted, or lost (McDonough 2002, p.98)". This loss is not only to be blamed on the inadequate systems of retrieval but also because of what the authors "jokingly refer to as "Frankenstein products" or (with apologies to Jane Jacobs) "monstrous hybrids" – mixtures of materials both technical and biological, neither of which can be salvaged after their current lives (McDonough 2002, p.99)". The first step to address this is according to the authors, that people need to realize that "there are no such things as waste (McDonough et. al 2002, p.92)".

As an example of this problem they use ordinary sewage sludge. Today this waste product is used as fertilizer "which is a well-intended attempt to make use of nutrients, but as currently processed it can contain harmful substances (like dioins, heavy metals, endocrine disrupters, and antibiotics) that are inappropriate for fertilizing crops (McDonough et al 2002, p. 56)". Even in "treated" sewage effluents there are still high levels of these compounds (McDonough 2002, p.101). This exemplifies that "unless materials are specifically designed to ultimately become safe food for nature, composting can present problems as well (McDonough et. al 2002, p. 56)".

The solution according to the Cradle to Cradle vision is to recognize that "there are two discrete metabolisms on the planet. The first is the biological metabolism, or the biosphere – the cycles of nature. The second is the technical metabolism, or the technosphere – the cycles of industry, including the harvesting of technical materials from natural places. With the right design, all of the products and materials manufactured by industry will safely feed these two metabolisms, providing nourishment for something new (McDonough et al 2002, p.104)".

Also; many of the products that today can be referred to as monstrous hybrids, could be designed in other ways. I.e. "most packaging (which makes up about 50 percent of the volume of the municipal solid waste stream) can be designed as biological nutrient …. (McDonough et al 2002, p.105)".

The second problem is to address the reconnecting of matter to the ecosystems. As mentioned the authors do not give much notion regarding their solution to this problem. Instead the designer have to think holistically before action is taken, respect diversity and design with principles inspired by nature's laws.

To begin with it can be established that most transport of matter in the contemporary society is depending on cheep non-renewable energy sources. According to chapter five this is something that is projected to change in the future. And as the example regarding the amounts of waste produced in a European city showed, the quantities to be transported are substantial. To create a cyclical or "re-connected" system based on cheap energy therefore seems unlikely.

In nature the transportation of matter is mostly done through the hydrologic cycle, a way of transporting matter that is fuelled by solar power. Using the assigned design principles regarding inspiration from nature's laws, this system seems like an important key factor to solve the problem.

Hence the following desired attributes regarding physical implementations can be found:

- Collect or "trap" biological and industrial matter in order to put them back into either the biological- or technical metabolism
- Apply natures own devices preferably the use of the hydrologic cycle, in order to re-connect the flow of matter with minimum demand of energy

Physical Implementations

To solve the problems discussed there is little chance of this if different professions and fields of knowledge do not cooperate. Regarding the design and production of non-monstrous hybrids the landscape architect and architect can only do their part in this process. This would i.e. be to put pressure on their suppliers to come up with new "sustainable" products. Though in this thesis it is the physical implementations on site that is of interest:

Living machines: The physical implementations available today in order to help collect- and reuse matter are with regards to their monumental task, quite modest. The systems that are available are often referred to as Green or Living Machines (Fig. 7.6). These are not one large machine but rather are a set of physical implementations that are combined into a system, with the aim of decomposing and collecting natural compounds in a way that is safe for the environment. Even if these green machines are a good step towards a more cyclical treatment of matter their efficiency is difficult to maintain due to the fact that they are based on living organisms that in turn are depending on a continuous source of "food". The abundance of monstrous hybrids also poses a threat with their "un-natural" compounds.

They also require:

- Space
- Ongoing care
- Accessibility
- More or less controlled temperatures
- Separation from the occupants due to health issues

(Kwok et. al 2007, p. 239-240)

It should be said that these technologies are still young and there are many improvements that the engineers can do. As well there is much to gain if they are to be implemented since our "waste" is rich in valuable nutrients like Phosphorus. This nutrient occurs naturally in sewage sludge and other organic wastes. In fact, in European sewage sludge, which is often land filled, phosphate occurs in higher concentrations than it does in some phosphate rock in China, where much of it is mined to devastating effect on local ecosystems (McDonough 2002, p.102). Still it comes back to the system as a whole and the monstrous hybrids in order to make these physical implementations truly usable.

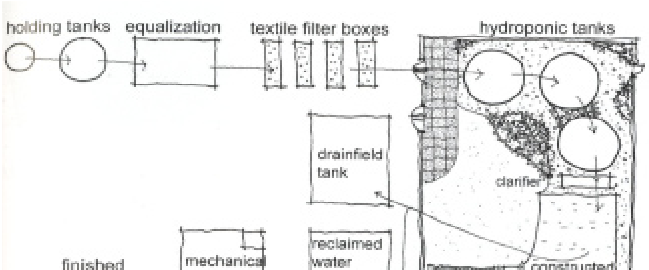


Fig. 7.6 Diagram showing the typical components and sequence of flows in a Living Machine (Kwok et al 2007, p.239).

Green roofs & Living walls: Regarding the trapping of water- or air born pollutants there is an ongoing discussion of how efficient greenery is. In this discussion promoting greenery as a solution, it is important to make a distinction of which vegetation is intended. This since most of the experiments refers to trees and larger vegetation (Dunnett et al, p50). And it:

> […]must be admitted that some extravagant claims are made about the ability of roofs to aid this process. There have been little direct experimental work to investigate the role of green roofs in this regard, and most claims are made by inference from the result of tests on other types of vegetation. The ability of extensive roofs with low growing sedum-based vegetation is probably rather small in this regard. It will also be necessary for a high density of green roofs to be present in an area rather than a few isolated individuals. "(Dunnett et al., 2004, p.50)

However there are some areas regarding pollutants carried in water, where the green roofs can be effective. As with heavy metals:

> Green roofs can play a major role in trapping [these], studies have shown that they can trap up to 95 per cent of cadmium, copper, and lead and 16 per cent of zinc (Peck et al. 1999). Lead , zink, and copper are used in roof construction themselves, and green roofs can help to limit the extent to which dissolved salts of these metals can contaminate water supplies (Dunnett et al., 2004, p.50).

Even so the problem of i.e. heavy metals still remains in this type of "traps", and require that efficient ways of collecting and recycling them is designed. One possible solution could be to bring in a second phase of vegetation where certain types of plants could be used as collectors. There have been tests done in USA where plants growing on contaminated ground have been known to extract enough levels of lead to be delivered directly back to the industry. The plants are burned and the lead reintegrated into the technical cycle. The plants used in this experiment was from the family of *Brassica* (Lönngren 2001, s.21)

Transporting matter: Regarding the creation of a transport system based on the hydrologic cycle there seems to be two scales to consider:

The transportation on a small scale is in a way inevitable due to factors like the HEAP-trap. Living machines, local treatment of run off water and other implementations together with municipal services such as collecting and reusing are a step on the way on this scale.

But since the global community is moving matter over vast distances both nationally and internationally,there is the larger scale to address as well. This redistribtion of matter is acute in a short time perspective, as long as the problem with biological- and technical metabolisms can be addressed. But on in longer time span the consequences are harder to foresee.

Still to keep on according to the eco-efficiency principle of "being less bad" is according to McDonough et al "a failure of imagination (McDonough et al 2002, p.67)".

Conclusions

The question whether the visions from Cradle to Cradle is feasible or not regarding matter seems to be difficult to answer in a yes or no statement. As in the discussion regarding energy, there are great simplifications and generalisations being made.

I.e. regarding the arguments put forward by Günther and Steen regarding the depletion of phosphorous shows that these issues are never simple. Simply looking at the problem from a pect can result in an alarming picture while another set of facts can put the assumptions into doubt.

Still the challenge seems to lie with the mixing of biological and technical nutrients as well as with the redistribution of these on a large scale.

To address monstrous hybrids is as been discussed, possible in some areas but there is still much to be done. And before that issue is addressed the "waste" from the urban areas both solid and water dissolved, are very difficult to handle.

Regarding the redistribution of both biological- and technical nutrients on a large scale there seems to be no implementations available. Unless large amounts of energy are to be used it seems like the accumulation of matter and the resulting leakage will continue for the foreseeable future.

To summarize; the contemporary treatment and consumption of matter is complex and problematic. And as quoted by Purvis et al:

> Recognition of the complexity of the economic, social and cultural systems underpinning urban metabolisms increases the challenge of effecting change. It does not, however, diminish the clarity of the central message that change in urban metabolisms, replacing linearity with a cyclical flow of materials through the city, is a vital element of progress towards sustainable development (Boyden et al, 1981; Di Castri et al, 1984; Girardet, 1992; Wolman, 1965). (Quoted by Purvis et al, 2006, p.102-103)

In short; Matter does matter.

- We need to reconnect our flows of matter to nature
- We need to learn how to design with a holistic approach, in order to do this we need to realise that there are biological and technical substances to consider
- The physical implementations available are not enough, there is a need for designing systems of recycling, this seems to demand energy or structural changes to our developments

PART THREE

VISIONS FOR A SUSTAINABLE FUTURE

VISIONS FOR A SUSTAINABLE FUTURE

Introduction:

One of the assignments of a landscape architect or an architect is to think forward. Hence it is a part of their job to create visions regarding this future.

In this last part of this thesis the conclusions from part one and two will be combined into three visions regarding a sustainable future.

THE LOW-TECH VISION

The first vision is a low-tech solution with influences from the visions of the "ruralization vision" (Folke Günther)(Berg et al 1994, p.147) where a "ruralization" of existing urban areas is implemented in order to achieve a sustainable society.

This vision is based on the assumptions that:

Energy:

Man kind does not gain any new power sources and fossil fuels decline towards depletion. This leads to the result that diverse number of renewable energy sources have to be used. This excludes sources such as nuclear power, oil, coal etc. Due to the in general, lower energy content of the renewable sources. There are major also major changes in the contemporary way of living and consuming energy.

Water:

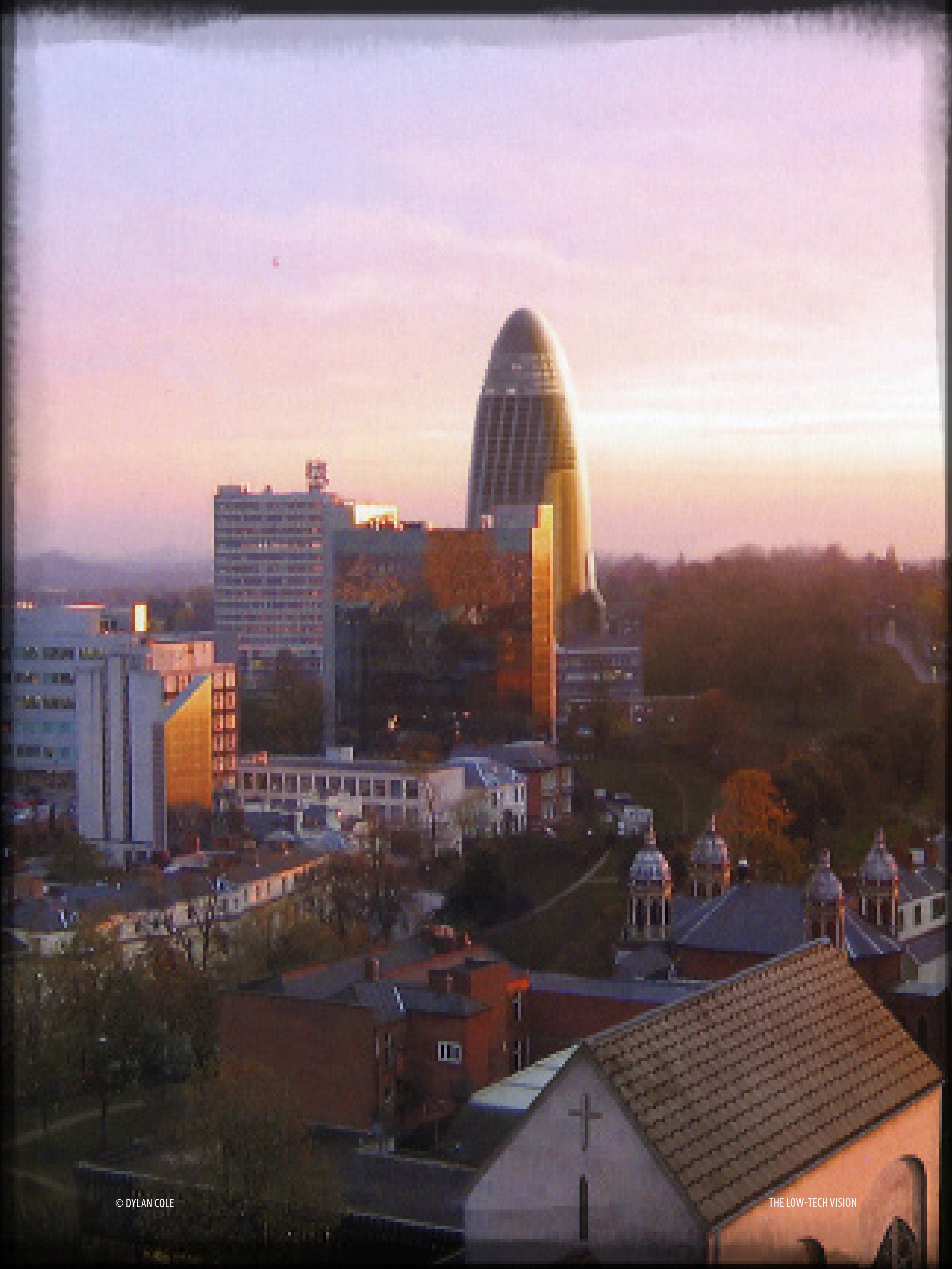
The matter of water flow is solved with the implementation of existing passive technology in combination with the ruralization.

Matter:

Since there is not enough energy to create and sustain an artificial cyclical system for redistribution of matter. The urban areas are hence forced to become ruralized in order to get closer to it sources such as food. Regarding pollution the biological nutrients can be directly redistributed to the local landscape. Technical nutrients separated and reused in all ways possible.

Conclusion:

This scenario will result in difficulties to sustain the current human population. This is due to the loss of cheap energy which will lead to a decline in the "efficiency" of agriculture. There will also be severe changes to the landscape since mode land is needed in order to sustain these smaller communities and the new small scale agriculture. With the loss of the industrial cities there is also a possible decline in large "global" economic activity and possibly in technological advancement.



THE HIGH-TECH VISION

The second vision is a high-tech solution where one or more new power sources are combined with drastic achievements in technology. The new technologies are most probable to emerge from the ongoing synergy effect regarding subjects such as; Bio-technology, Nano-technology, Energy technology and Computer science. This makes it possible to further expand and intensify the ongoing urban trend.

This vision is based on the assumptions that:

Energy:

Man kind gain one or more new power sources that can be perceived to be renewable or at least harmless. This leads to the result that the old and destructive power sources of the 20th century can abandoned. A whole new set of rules regarding the sustainable future is created.

Water:

The matter of water flow is solved either through to the implementation of passive systems like the local area treatment or by advanced technology.

Matter:

Since the energy to create an artificial cyclical transport system now is available this is implemented globally. Regarding pollution the biological and technical nutrients separated and redistributed with advanced technology.

Conclusion:

The feasibility of this vision is disputable. Comparing the time required to research and implement new technology and knowledge with the in some cases immediate needs, raises serious doubt to this vision. There are also political factors to take into account. In the contemporary world the control of advanced technology and energy stands for a large part of the conflicts. This is probably not something that is going to change in the near future.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THE MID-TECH VISION

THE MID-TECH VISION

The third vision is a mid-tech solution where no new power sources are found and the fossil fuels are abandoned. This requires the global community to change its consumption of both energy and matter. High-tech solutions are mixed with passive "natural" ones in order to reach the sustainability goal. This future could be regarded as the Cradle to Cradle future.

This vision is based on the assumptions that:

Energy:

No new energy sources are found and fossil fuels decline towards depletion. This leads to the result that man kind have to rely on a diverse number of renewable energy sources and implement drastic reductions in energy consumption. Existing nuclear power will also continue to be used. Technological improvements reduce the hazardous radiation of the waste.

Water:

The matter of water flow is solved with a series of physical implementations that imitates nature. The landscape surrounding the urban areas, are integrated into this diverse system in order to achieve the sustainability goal.

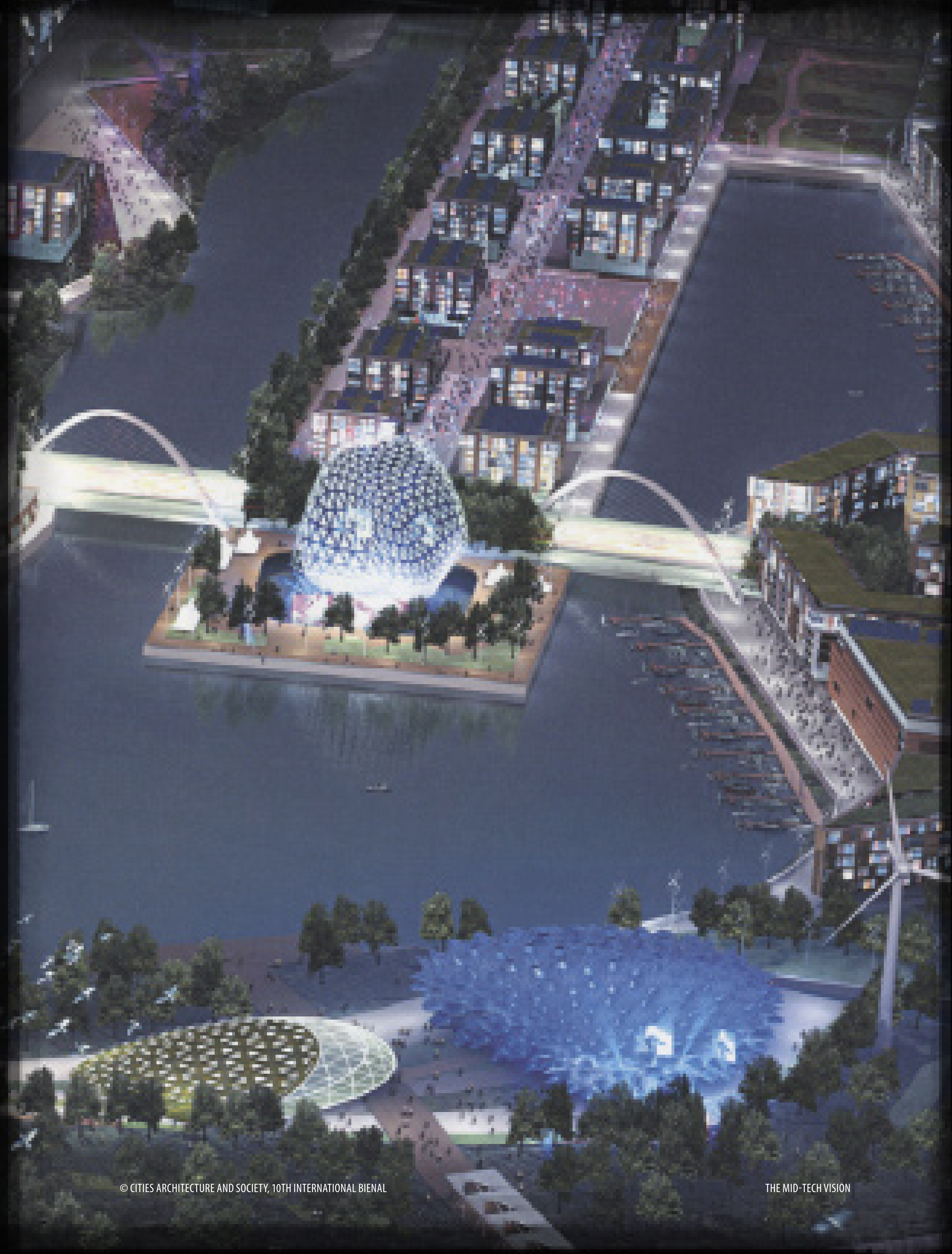
Matter:

Since there is not enough energy to create an artificial cyclical system for redistribution of matter to the ecosystems there is need to design some sort of system that can do this without massive energy costs. A shift from global trade towards local is probable. Regarding pollution and waste a whole new design thinking swings into action and products regarded as "monstrous hybrids" are phased out. Further more; effective systems are integrated into the urban fabric and society as a whole in order to control the flow of matter.

Conclusion:

Regarding the current state in the world this seems like the most plausible future if we are to create a sustainable way of life. It could even be argued that the first steps in this direction are already realised in the so called "eco-villages". But these are still isolated cases in the larger context of our societies and need to be further developed to function on a larger scale.

There are question marks regarding the plausibility of sustainability theory and there seems to be the an overwhelming risk of creating a system where the humans "only make the old, destructive system a bit less so (McDonough 2002, p.62)" as mentioned before. But if there is to be a change towards a sustainable future this seems to be the way. And in this process the landscape architect and architect has an important role to play, using all their imagination and creativity in order to help solving the problems.



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