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The Value of Co-creation with our Ecosystem: Industrial Ecology and Stakeholder Management

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EXECUTIVE SUMMARY

We are heading towards an Energy-Climate era where companies must build businesses able to respond to the constraints that Mother Earth has imposed. Mostly caused by human activities, environmental damages, from climate change to biodiversity decline and scarcity in natural resources, have damaged our natural environment. What is more, associated costs have risen along such destructive process. It is disrupting the business world and forcing companies to replace their outdated linear way of thinking with a systemic one, where shared existence and mutual benefits dominate. A systemic perspective provides a holistic view of the environmental challenges, and helps companies adapting and identifying the set of new opportunities, as well as understanding the dynamic interaction between the environment, the economy and the society. Given the urge to take up to those challenges, such collective impacts call for collective solutions.

In order to achieve a sustainable and 'healthy' ecosystem, and collectively lead to a sustainable business environment, every economic agent must play the role of co-creator within the business ecosystem. The latter refers to a complex and dynamic network, where the organizations and their members interact and cooperate to develop mutually beneficial relationships. Combined with the concept of business ecology, they comprise the interrelationships within the entire ecosystem, in accordance with the natural environment.

Such holistic and pro-active approach involves a review of the company's *raison d'être*. It should be made by interacting and cooperating with other organisms within and outside the company's business ecosystem — i.e. among the whole set of actors that may have direct or indirect impacts on its activities — so as to jointly develop innovative solutions, in accordance with the business and natural environments. Through the concept of industrial ecology, a mutual valorization of the resources, a collaboration and knowledge sharing between the distinctive agents of the ecosystem will lead to building a highly integrated and closed system. The waste produced by one company is indeed used as a new resource for another, or returned harmlessly to the ecosystem. It leads to some synergistic win-wins, therefore improving the economic and environmental performances of each of the economic agents.

Creating synergies between, building sustainable relationships with and setting up an effective management for stakeholders enables sustainable-driven companies to understand their evolving needs and relevant issues. It therefore allows them to identify new value creation opportunities. Finally, the role and commitments of business leaders are essential to ensure a shared vision and to communicate the purpose of such sustainability-driven actions within the ecosystem.

Those forward-thinking companies have all the tools at their disposal to lower long-term costs, and improve their productivity and reputation, while regenerating the environment, rather than harming it. It enables them also to 'outgreen' their competitors. They gain, indeed, greater competitive advantage through efficient initiatives, investments and innovations promoting long-term growth. More importantly, the related concepts and approaches illustrate that protecting the environment and generating positive profits are not antagonistic conceptions. *Are these efforts the end of the problem? Certainly not, they are only the very beginning of a possible and urgent solution.*

INTRODUCTION

The business world and the natural world are inextricably linked. Our economy and society depend on limited natural resources, which most of the companies have not taken into account for too long now. Moreover, sustainable development has caught ever-greater public attention and generated many debates, since numerous catastrophic events have occurred those past years, and the costs engendered by the degradation of the natural ecosystems have been rising. The subject has also been at the top of the legislative agendas of most governments, and frequently covered in the media, as it has become a growing concern to the human kind.

As a result, addressing sustainability has gained a strategic and growing interest, therefore central in today's agenda of top management. Fortunately through an effective sustainable development policy, business can take up to those challenges and create new business values and opportunities. As Kris Gopalakrishnan, chairman of *Business Action for Sustainable Development* stressed in the Rio+20 Outcome document, *"*business is a central player in green growth and sustainability".

Defined in the first chapter, as wide as it can be, sustainable development asks for a new form of management, based on new values, innovation and creativity, in accordance with each of the three pillars it encompasses, i.e. environmental, social and economic, in order to achieve a real change. As J. Dernbach, environmentalist and author of *Sustainable development and climate change law*, once said, "sustainable development is among the most important ideas to come out of the 20th century".

The first chapter of the present thesis will review the context in which companies are embedded, and the complex reason why we are heading to a new era where the natural environment is imposing constraints not only to the business world, but to our own ecosystem as well, all dependent on the health of the components of the natural ecosystem. The second chapter will dig into the heart of the thesis, i.e. *the demonstration that the value of co-creation within and outside the business ecosystems has become essential* in business strategies that address sustainability.

Related to the environmental challenges that companies are facing and the other key drivers previously developed, the second chapter will first define what is meant by *business ecosystem*, along with its closest analogies, and the concept of business ecology. Secondly the chapter will stress the importance for businesses to replace their outdated linear way of thinking with a systemic one, where shared existence and mutual benefits dominate.

A collective and systemic solution to addressing the challenges previously stressed will be presented in the third chapter by introducing *the concept of industrial ecology.* The concept, a plan of actions and additional tools will be developed in the chapter, along with the idea that the traditional industrial systems should fit into the industrial ecosystem. It will be demonstrated that a mutual valorization of the resources, a collaboration and knowledge sharing between the distinctive agents of the ecosystem, in accordance with the natural environment, lead to close the loop of the system and to some synergistic win-wins, therefore improving the economic and

environmental performances of each of the economic actors. The concept of functional economy will come along with such collective actions to build a system that encourages a sustainable use of resources and energy.

The fourth chapter will focus on how firms should *manage their stakeholders* when addressing the sustainable development. It will be demonstrated that, in the adoption of a systemic perspective and the achievement of synergistic solutions, fostering sustainable relationships and effective collaborations with their stakeholders will lead to sustainable businesses, and enable the identification of new value creation opportunities. More particularly, some key stakeholders-firm interactions will be synthetized, which will underline the major role of the stakeholders, i.e. co-producers in the value creation process, and the importance of the social pillar in the development of a sustainable policy.

It seems interesting to explain the *role of business leaders, and executives* in this approach of the value of co-creation within the entire business ecosystem. The fifth chapter will stress their roles and the importance of their commitments towards sustainability-driven actions. As achieving sustainability will require severe cultural and organizational changes (often hardly or slowly accepted) in the behaviors and mentality, the chapter will show how the executives who manage such forward-thinking companies can encourage their employees to individually engage themselves in sustainable development, which will indirectly lead to greater results, in terms of economic well-being, and/or improved environmental performances.

In order to illustrate and add some additional characteristics to what has been developed in the previous chapters, two cases will be presented in the sixth one: the analysis of closing loop initiatives of *CBR Cement*, one of the subsidiaries of HeidelbergCement Group in the Benelux — an international leader in building material markets —, and the initiatives of *Spadel Group* — the Benelux leader in the water and lemonade markets — towards the development of a sustainable development policy while interacting with and managing its stakeholders and their requirements.

In addition to the conclusions closing each chapter, a final *conclusion* will precede some suggestions of related topics that could be further investigated.

The chosen research method is a “conceptual analysis” where data’s and theories are gathered through literature research, including the latest books, articles, and videos. It led to the comparison and assessment of different interpretations and own reasoning’s, by breaking down sustainable development into different sets of ideas, concepts and tools, such as the business ecology, the business ecosystem, the industrial ecology, the functional ecosystem, the Life Cycle Assessment methodologies, and plenty of others. Furthermore, some interviews with the managers involved in the respective cases were conducted.

1 SUSTAINABILITY AND THE 'ENERGY-CLIMATE' ERA

We are heading towards an era that Thomas Friedman calls "the Energy-Climate Era", where our standards of living, our economy, and our political choices are going to be constrained if we do not find a better way to protect our natural world and make the biggest environmental issues disappear.

A definition of sustainable development and its three pillars will precede the introduction of the world we are living in. It helps understanding why we will focus presently on the dominant environmental pillars of sustainable development and describes the environmental issues that have the greatest impacts on the natural world. Those interconnected challenges can also be perceived from an economic, and social point of view. Afterwards, key drivers that have encouraged the companies to integrate sustainability into their strategic ambitions, in addition to the challenges previously developed will be identified. All together it will highlight how fundamental it is for a company to accept this 'green' revolution, in order to assure long-term growth as well as a competitive advantage over its competitors.

1.1 WHICH CONTEXT ARE WE IN?

"Mother Nature and the Market hit the wall because our normal became excessive and unsustainable".

Thomas Friedman, 2009

Thomas Friedman, author of the book *Hot, Flat, and Crowded*, considers that Americans turn out to be a "*Grasshopper Generation*". In other words, they are consuming "a staggering amount of our national wealth and natural world in a very short time, leaving the next generation a massive economic and ecological deficit"(2009:30). They are not devoted to the accomplishment of great national goals, such as putting someone on the moon, but instead to more private preoccupations and consumptions (Friedman T. L., 2009:30).

According to the author, benefiting from the information age and less and less regulated financial sector, many people are living beyond their means, without any sense of the risk involved, and of the consequences of their actions, both at the corporate and individual levels.

Besides, globalization and global markets have given the opportunity for more and more consumers and producers to respectively buy and sell their goods and services, and to collaborate with more and more people in more places for less money than ever before — what T. Friedman called '**living in a flat world**'.

The author insists that we also live in a '**crowded world'**. To illustrate, according to the UN Population Fund statistic (UNFPA, 1999), "the world population will grow from the current 6 billion to between 7.3 and 10.7 billion by 2050, with 8.9 billion considered the most likely, meaning world population may grow almost as much in the next 50 years as in the past 50". These exploding populations are leading to strong consequences: rapidly overwhelming infrastructures in megacities, and environmental challenges, such as deforestation, overfishing, water shortage, and air and water pollution, as further introduced (Friedman T. L., 2009:65).

As a result, the combination of both, flat and crowded worlds, i.e. "more and more people who are able to live a modern high energy and high resource consuming lifestyle", represents the most dangerous threat to the global environment in the long run (Friedman T. L., 2009:68).

What's more, according to the author, this resource-wasting development model of America will lead to higher negative consequences if countries such as China, India and the Arab world decide to adapt this strategy, even more if there is no strong improvement in sustainable energy and resource productivity; "The old way is not replicable on the China-India scale in a flat world, without irreparable harm to planet earth"(2009:101).

In order to avoid that Mother Nature imposes its own constraints, the development of freedom and free market has to be accompanied by a new, more sustainable approach of how we produce energy and treat the environment (Friedman T. L., 2009:101). According to the latter (2009:109), such a 'Code Green strategy for sustainable growth' should be placed next to the Declaration of the Independence, according to the latter, since "the earth cannot handle that many of the kind of Americans".

1.2 Sustainable Development And His Triple-Bottom Line Definitions

According to a study published in MIT Sloan Management Review (Berns et al., 2009), a series of interviews with leaders and executives with experience in sustainability led to the conclusion that while 40% of them defined sustainability simply as "maintaining business viability", 64% of experts relied on one of two widely accepted definitions: the so-called 'Brundtland Commission definition', or the 'triple bottom line definition', both of which include economic, environmental and social considerations (See Appendix 1 [*Executives defining sustainability*, p 92]).

In 1987, the World Commission on Environment and Development of United Nations, also known as the Brundtland Commission, introduced the concept of *sustainable development,* which has conducted to reviewing the international agenda and global attitude towards economic, social and environmental developments (Bärlund, 2004).

The Brundtland Commission's report defines sustainable development as (Bärlund, 2004):

> "Meeting the needs of the current generation without compromising the ability of future generations to meet their own needs".

The authors Andy Garner (2005) and Kay Bärlund(2004) highlight the following key principles in their definitions of sustainable development:

- ***The sustainable use of resources*** — The concept points out the importance of protecting the natural resources and the environment.
- ***Preserving ecological and human health*** — The concept also underlines that "economic and social well-being cannot be improved with measures that destroy the environment"(Bärlund, 2004)**.**
- ***The promotion of environmental equity, both intergenerational and intersocietal*** — Intergenerational solidarity is crucial: "all development has to take into account its impact on the opportunities for future generations"(Bärlund, 2004).

Despite some criticism over the vagueness of the definition and de facto dominance of the environmental pillar, the latter has been broad and operational enough to set meaningful actions, and increase awareness. Among other things, during a conference on Environment and Development in Rio de Janeiro in 1992, a plan of action, *Agenda 21*, has been introduced where world leaders committed to ensuring sustainable development in every area in which human activities impact on the environment, and on all levels of society.

More arguments have been made by the author, Thomas Friedman, who underlines that sustainability is not an euphemism for charity work or socialism. Sustainability is essential for companies to win (e.g. assure competitive advantage), and it is a driver for long-term vision. Sustainablity is both the end and the means (Friedman T. L., 2009:54):

- Sustainability is an *outcome* — Everyone wants our environment, economic and natural one, our companies and institutions, to be sustained.
- Sustainability is a *mean* — It refers to a set of standards and principles for companies and our ecosystem so that they will endure.

Finally sustainable development requires acting and thinking through the "**triple bottom line**". It refers to the three essential dimensions of sustainable development, economic prosperity, environmental efficiency and social justice. Such model, developed by John Eklington (1995), is also commonly known as the three Ps' model.

Shorthly defined,

- **Profit :** is the real economic value created by the organization.
- **Planet** : refers to sustainable environmental efficiency and practices.
- **People** : refers to the significant values of the physical and social environments (e.g. labor condition).

Therefore, in order to be sustainable, according to Mullerat & Brennan (2005: 300), it is required that firms develop "sustainable definitions for their relations to *human beings* (CSR, relationship to employees, suppliers, customers, local communities, and other stakeholders), to the *external environment* (including biodiversity, and animal welfare) and to the global *economy* (including the economy of the community)".

1.3 De Facto Dominant Environmental Pillar

"Sustainable development (…) provides a framework for humans to live and prosper in harmony with nature rather than at nature'expense. Everything we care about — a growing economy, human well-being and security —is compromised, undermined or lessened by environmental degradation".

J. C. Dernback, 2009

Nowadays companies, whether big or small, cannot afford to ignore the environmental challenges they are facing. In this section, it will be demonstrated that 'business as usual' is no longer a viable option. A good way to start is by presenting the three waves of changes in corporate

practices related to the environment. Subsequently, the environmental issues that have had the greatest impacts on the global environment and indirectly on firms' business models and individuals' standard of livings will be presented. Finally, such challenges will be moved into a new set of opportunities, including a need for new technologies, products and services, as well as opening of new markets.

1.3.1 Environmental Issues Within Business Management

From 1940s on, the authors Hoffman and Bansal (2011: 5-8) identified three periods of change in corporate practices related to the environment. They can be described as the three "waves" of environmental management, as shown in Figure 1.

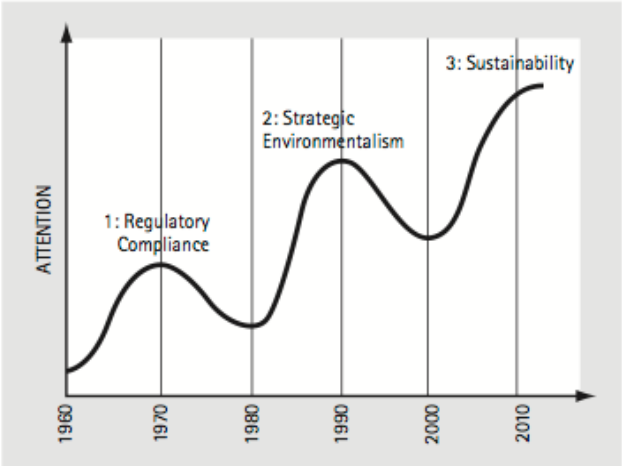

Figure 1: The three waves of Corporate Environmentalism 1960-2010 (Hoffman & Bansal, 2011)

Wave 1: Corporate environmentalism as regulatory compliance

It occurred in the late 1960s and early 1970s, and began with the acknowledgment that environmental issues were a problem that required regulatory controls, and a growing awareness of environmental issues in politics and the media.

The medias started to introduce the public to issues such as population growth, air, and water pollution, pesticide use and the need for regulatory agencies. The latter became the arbiter of environmental rules and norms. During this first wave, government regulations were perceived as constraints on companies' economic activities, and therefore as legal requirements.

Wave 2: Corporate environmentalism as strategic management

It occurred in the late 1980s and early 1990s, following the catastrophic events, and related deeper growing concerns, such as the accident at the Chernobyl nuclear reactor in Ukraine releasing a radioactive cloud over Europe (1986), or the publication of the Brundtland Commission report (1987). Industries began acting proactively on environmental issues, and protection, incorporating it in their business strategies.

Those events and the increased attention to environmental issues that followed pushed the companies to give more organizational power to their environmental departments, and to

integrate environmental considerations into their line operations, both in process and product decisions.

Wave 3: Corporate environmentalism as sustainability

A growing focus on the merger of environmental and social issues with the global economy appeared in the first decade of the twenty-first century. It was the result of series of events and issues that have conducted to an expansion of the scope of corporate environmentalism aiming at including the approach of sustainable development and each of its pillars. As a result, what Tost and Wade-Benzoni (2011:176) refered as ***environmental sustainability*** implies:

> "A status that an organization achieves when it functions such that the environmental benefits (e.g. natural resources) that will be passed on to future generations are not decreased, the environmental burdens (e.g. toxic waste) to future others are not increased, and the capacity of individual stakeholders to reach their potential is progressively enhanced".

In order to reach this status, it is essential that organizations take a *long-term perspective* on their decision making processes and their activities to protect and promote the interests and needs of future generations.

1.3.2 The Main Environmental Issues

Environmental issues are evolving over time and becoming a growing concern for companies. In order to have an idea of what are environmental issues we are talking about, the main interconnected ones — i.e. those that generate the greatest impacts on the natural environment— are presented thereafter.

It is important to note that there are plenty of issues, which will not be developed here subsequently. The chosen ones are those highlighted in the main references; that is the books of Esty and Winston (2009), and Thomas Friedman (2009).

Climate Change

> *"Climate change is happening now and is not some distant future threat. The world is warming because of human activities and this is resulting in far-reaching and potentially irreversible impacts on our Earth, atmosphere and oceans".*
>
> *WMO Secretary-General Michel Jarraud (Romm, 2012).*

The problem goes far beyond rising temperatures, it also includes rising sea levels, changes in rainfall patterns. It results in more severe droughts floods, hurricanes and other windstorms, which generate new pathways for disease (Esty & Winston, 2009:35).

Climate change is largely caused by greenhouse gas emissions, mainly *Carbon Dioxide* (CO_2)[1], and *Methane*, generated by "natural gas leaks and off-gassing from rice paddies and flatulent cows" .

While those two sources are natural phenomena, human activity contributes significantly to the release of those gases into the atmosphere (Packard and Reinhardt, 2000:36). Greenhouse gas emissions account indeed for 70 percent of the problem and emerge from three sectors: transportation, residential and commercial, and manufacturing (Esty & Winston, 2009:35).

Climate change has raised high concerns about its consequences on our planet. Among other things, it leads to:

- **Hotter temperatures:** Through the idea of 'Hot world', T. Friedman (2009:68) pointed out that our planet is experiencing a warming trend — over and above normal variations, and mainly due to human activities, associated with large-scale manufacture (See Appendix 3: [*The temperature trends*, p 94]).

According to scientists from NASA's Goddart Institute for Space Studies, "more energy is being absorbed from the sun than is emitted back to space, throwing the earth's energy out of balance and warming the globe". Among other frequent temperature spikes, the 2003 heat wave in Europe killed 26 000 people and some scientists expect that half the summers in Europe could be that hot by 2040.

The 2009 MIT's Joint Program on Science and Policy of Global Change highlighted that "if we stick with business as usual, in terms of carbon dioxide emissions, average surface temperatures on earth by 2100 will hit levels far beyond anything humans have ever experienced" (Friedman T. L., 2009:24).

- **Rising sea level:** It is acknowledged that ice is melting all over the world. What people do not know is that the potential result of some of this melting, specifically in Greenland and Antarctica, is a significant rise in sea level, which could imply large portion of countries to flood and coastlines to withdraw well into coastal communities worldwide (Esty & Winston, 2009:37-38).

According to the findings of the World Meteorological Organization Reports (Romm, 2012), the ongoing sea ice decline in the Arctic was one of the most prominent features of the changing state of the climate during the decade.

Scientists and experts, such as Al Gore, all agree that climate change is changing considerably faster and in a disruptive manner than ever expected by climatologists (Friedman T. L., 2009:169-170). According to Minik Throleif Rosing, a top geologist, most people will feel climate change through the form of higher water bills, because of fierce drought in some areas, or higher energy bills, because of the true cost of banning fossil fuel, but also through the form of higher insurance and mortgage rates, because of violent unpredictable weather.

[1] See Appendix 2 [*Global emissions of carbon Dioxide from Fossil Fuels (1900-2004),* p 93]

As a result, industries that rely on transportation — airlines, and logistics companies — and those that rely on petroleum and feed stocks — chemical and plastic manufacturers — should already start reconsidering their material and energy uses, as well as strategies. However, controlling emissions to lessen climate change will not only require actions from businesses but also from every individual, since rising temperatures and more unpredictable weather could affect a broad range of industries as well as livelihoods (Esty & Winston, 2009:39).

It is also important to note that because it does not matter where it is emitted, it means that one country cannot act alone in order to solve the problem. Global cooperation and joint action are essential (de Woot, 2005:194).

ENERGY

"Every one needs energy and energy production, no matter what the method, can damage the environment".

Esty D. and Winston A., 2009: 40

Human-produced energy mainly comes from burning fossil fuels — non-renewable energy sources (coal, oil and gas)—, which cause pollution and contribute to the accumulation of greenhouse gases into the atmosphere.

Industrialized countries consume most of the amount of energy and natural resources. The issue is even more critical given that the demand for energy is globally rising. As a result, the price of fossil fuel combustions (for electricity) will likely remain high for the foreseeable future, even more in fast–growth areas of the developing worlds, such as India and China (Esty & Winston, 2009:40-41).

In the recent years, this problematic has been seen as an incentive for innovation in the energy market. Renewable energy sources, such as wind, solar, geothermal, bio-based fuels, and tidal power have been capturing large market shares. Global wind power capacity has been growing at over 30 percent per year, and solar power at over 60 percent per year (Esty & Winston, 2009:42).

WATER SCARCITY

In addition to be a critical input for agriculture and many industrial process, water is the essence of life. However, according to the estimations of The United Nation Millennium Ecosystem Assessment, "as many as two billion people live with water scarcity" (Esty & Winston, 2009:43-44).

Given that the Earth is a closed system, freshwater supply is therefore fixed. However, demand for water keeps on increasing mainly due to rising population and an increase in irrigated crops (Esty & Winston, 2009:44). The international Water Management Institute (IWMI) expects that in the next 20 years consumption of water will increase by 50% (de Woot, 2005:75).

As a result, we are using more than what the Earth has to offer, leading nature's underground supplies, called aquifers, to draw down. The likely risks would be that hundreds of cities will face severe shortages and that there will be not enough water to supply households and agriculture, in particular in dry and overcrowded regions of the world.

Even though governments and communities are establishing several policies in order to protect the quality of drinking water supplies, our water are intensively threatened by industrial, and agricultural runoff — agriculture sector consume about 70 percent of the water we use —, and contamination from sources as diverse as mining operations, and constructions sites (Esty & Winston, 2009:44).

In addition, the excessive use of water in human activities threatens the whole ecosystem, as it is fully dependent on water (de Woot, 2005:75). As a matter of fact, nature also needs water in order to support plants and animals, which in return support human beings, leading to a real conflict between human demands and ecological needs.

Finally, aware of the scrutiny of their water use and fearing to face political attacks, public backlash, intensified regulation or even legal restriction, water intensive companies are actively working in managing the problem (Esty & Winston, 2009:46). For instance, *General Electric* has built a multibillion-dollar water infrastructure business, positioning itself to "solve the world's most pressing water reuse, industrial, irrigation, municipal, and drinking water needs". As *Unilever*'s environmental report recognizes, "working with consumers to foster the responsible use of water is clearly in our long term interest (…) because without clean water many of our branded products would be unusable".

BIODIVERSITY DECLINE

"Biodiversity loss could also destabilize the systemic and vital carrying capacity of our planet —as much as Climate Change".

Thomas Friedman, 2009

Since the 1992 Earth Summit in Rio de Janeiro, there has been a global consensus that we need to redefine our relationship with our natural world. Indeed, we should be conscious that the earth's changing climate, our pattern of resource consumption and our increasing population growth are together threatening the web of biodiversity that not only sustain all species, but also our own (Friedman T. L., 2009:79).

In such view, the UN's Millennium Ecosystem Assessment supported a specific scientific hypothesis: "the extinction rate is now as much as 1 000 times higher than the average rate over Earth's history"(Esty & Winston, 2009: 47). The report also underlined that "the main problem is the pattern of human development, which tends to destroy natural habitat".

Moreover, biodiversity extinction is also caused by toxic chemicals, pollution and therefore climate change. An other key factor contributing to the decline of biodiversity is the habitat of loss, mostly due to the population growth occupying more land, and the rise in standards of living, as well as increasing land conservation for crops and "slash-and-burn agriculture" in the developed world (Esty & Winston, 2009:48).

Many companies are facing pressure due to their contribution to this critical environmental issue. Particularly, communities and governments are the toughest in their demands to take heed of potential ecosystem damages, for instance when the location of a production facility is to be determined.

CHEMICAL, TOXICS AND HEAVY METALS

Being exposed to chemicals like dioxin, or heavy metals such as mercury can create severe public health risks. That is why strong chemical control laws have been voted in the United States and Europe. For instance, the European Union's REACH (Registration, Evaluation, and Authorization of Chemicals) directives mandates that "manufactures must prove the safety of every new and old chemical"(Esty & Winston, 2009:50). It requires producers to register every chemical they use and measure the potential risk to public health; the idea being that they should not introduce new materials, products, or technologies if associated risks are unknown.

New concerns are becoming significant sources of legal exposure. A common example is endocrine disruptors. Such chemical —used in everything from insecticides to detergents to plastics — may change hormones levels of animals and people and therefore impact on the reproduction growth and immune function (Esty & Winston, 2009:50).

Metal is also part of the increasing concerns in case of human exposure. As a result, governments are now applying strict regulatory rigor to mercury, cadmium and other heavy metals. Measures were justified as, according to some studies, "prenatal mercury exposure increases the risk of reduced brain function and developmental problems in 630 000 children each year (…)"(Esty & Winston, 2009:51).

As a result, companies should pay special attention to what they produce and how they produce it. The case of Sony is particularly significant in this instance. In 2001, a few weeks before Christmas, 1.3 million boxes of Playstatation were blocked by the Dutch government because legally unacceptable amount of the toxic element cadmium had been found in the cables of the game controls. This environmental problem costed Sony over $130 million.

WASTE MANAGEMENT

Even though our generation has started understanding that we generate too much waste and need to recycle them, the situation remains dramatic. Today, the United States recycle about 20 percent of glass, 40 percent of paper, 50 percent of aluminum and 60 percent of steel while some is doing better, such as Sweden, which recycles 90 percent of its glass and aluminum (Esty & Winston, 2009:54).

What's more, the disposal of toxic wastes from factories, offices and households is still a challenge. In particular the smaller the waste (in volume), the more difficult it is to manage, contrary to solid waste — i.e. the everyday materials from homes and offices.

According to Esty and Winston (2009:55), today's emerging problem is so-called "e-wastes", i.e. our outdated electronics equipment. Indeed, every old computer has "about four pounds of toxic materials including a who's who of the worst offender — flame retardants, lead, cadmium, and mercury". Waste Electrical and Electronic Equipment Directive of the European Commission (WEEE) demands that all manufacturers from a wide range of indutries, from electronics to appliances, pay for proper disposal or recycling of their products. Such pieces of legislation encourage companies to rethink their value chain. They foster the discovery of 'real' production

costs, so that companies that do design products with the end of life in mind (Esty & Winston, 2009:73).

Moreover, China's contribution to e-waste is making the problem even worse: "China now produces more than 1 millions tons of e-waste each year"[2], in addition to the already existing 5 million television sets, 4 millions fridges, 5 million washing machines, 10 millions mobile phones and 5 million personal computers (Choi J., in Friedman T. L., 2009:106). "Most e-waste in China comes from overseas, but the amount of domestic e-waste is on the rise", according to the latter.

Finally, inspired by the current famous business guide, "Reduce, Re-use, Recycle", laws and severe penalties have been introduced. In particular, in Europe, the "extended producer responsibility" laws are forcing industries "to design out some elements or take their products back and handle disposal themselves"(Esty & Winston, 2009: 56). For instance, Nokia and Exxon have tackled the problem and gone ahead of regulation through its "take-back" programs[3].

To conclude, managing wastes through recycling will be a great deal for our society, businesses and industries. In particular, it will help reducing the companies' contribution to the above-mentioned environmental issues. For instance, more aluminum recycling means lower greenhouse gas emmision, less toxic runoff (from mining), and reduces land use and biodiversity problems. In short, "recycling in the aluminum industry greatly reduces the burden on air, land, and water–a win-win situation for everyone"(Esty & Winston, 2009: 56). However, as chapter 3 will show, a more efficient preventive approach would be for companies to design products and processes that can be integrally recycled from the beginning.

Ozone Layer Depletion

From 1980s, a hole in the planet's protective ozone layer opened up over Antarctica, due to emissions of Chlorofluorocarbons (CFCs) — a set of chemicals, which spread everywhere. Similarly to climate change, no country can therefore address the problem on its own (Esty & Winston, 2009:57). In addition to being global, the issue is critical, as a thinned ozone layer makes the world a more dangerous place. Among others, it reduces agricultural productivity, leads to higher risk of skin cancer, and other health problems.

Amendments and treaties, such as the 1987's Montreal Protocol, fostering the elimination of the production of CFCs, have contributed to substantial progress on this issue. While many businesses had to find substitutes to use in the production of aerosols, solvents and others, CFCs does not seem to be the only chemicals harming the ozone layer (Esty & Winston, 2009:57).

Oceans And Fisheries

Over three-quarters of the world's fisheries are overexploited and beyond the point of sustainability.

Esty D. and Winston A., 2009:57

[2] Jamie Choi, a toxics campaigner with Greenpeace China, in Friedman T. L., 2009:106
[3] More on this in chapter 3 (3.9: *The Functional Economy*, p 44)

In other words, we are catching more fish than life cycles allow. Ocean habitats are also threatened, given that about 20 percent of the world's coral reefs are dead, and more are dangerously degraded (Esty & Winston, 2009:57). This issue may not directly affect business. However, for those who depend heavily on fishing recreation and tourism, the effect of declining fisheries may be severe. What's more, for the many ones who eat fish — a great source of protein — regularly, the effect of fish depletion is immediate.

DEFORESTATION

According to Esty and Winston (2009:59), the problem is mainly due to how trees are cut, since "clear-cutting scars the landscape and leads to sole erosion and water pollution". Even with reforestation, million of acres of forest are disappearing every year. Since 1990, the net result is the destruction of forest equal to Texas, California, and New York combined, or in European dimensions, an area larger than Spain and France combined (Esty & Winston, 2009:59). Businesses that use wood, paper, or cardboard packaging are partly responsible for it.

Moreover, what most of the people do not realize is that deforestation, such as in Indonesia or Brazil, is responsible for more CO_2 emissions than all the world's cars, planes, ships, trucks and train combined. It accounts indeed for more than 20 percent of all global emissions (Friedman T. L., 2009:71).

1.3.3 HOW ENVIRONMENTAL ISSUES MOVE FROM CHALLENGES TO A SERIES OF GREAT OPPORTUNITIES?

"A series of great opportunities disguised as insoluble problems."

John Grader — Founder of Common Cause, 2009

Those challenges occurring in the Energy-Climate Era are not just about facing a set of new dangers. It is also about seizing a *set of new opportunities* — an obligation for the sake of our natural ecosystem, but an opportunity for companies, nations, institutions and others to renew and regenerate themselves (Friedman T. L., 2009:462-463).

Indeed such environmental issues have moved to new large business opportunities including new technologies products and services, as well as new market openings and businesses, such as Bio, renewable energy, certified sustainability products, and plenty of others which have led to new products and new businesses (Esty & Winston, 2009:39, and Vaxelaire, 2011).

Regulations on the restrictions of chemicals use or heavy metal have also led forward-thinking companies to capture new markets; taking on a large opportunity to respond to the growing demand for healthy alternatives in everything from food to cosmetics (Esty & Winston, 2009:53). For instance, Whole Foods, leader in the organic and natural food market, is one of the fastest growing supermarkets today with more than 310 stores in North America and the United Kingdom (Whole Foods Official Website, 2012).

Therefore, as Reinhart (1999:43) underlines in his paper titled *Bringing the environment down to earth,* "companies should make environmental investments for the same reasons they make other investments: because they expect them to deliver positive returns or to reduce risks".

1.4 Social And Environmental Changes

The problem is that human beings hardly accept and appreciate changes without an even bigger crisis than the one that can overcome their resistance.

However, the challenges mentioned above require deep and long lasting changes in every aspect of our life, and society. As a result, the response must come now; later cannot be considered. Damages will be greater and the source harder to identify. "This is no longer just an environmental issue", argues Paul Gilding, an Australian leading environmental expert. "How we respond now will decide the future of human civilization. We are the people we have been waiting for. There is no one else. There is no other time. It is us and it is now"(Friedman T. L., 2009: 27).

Moreover, societal challenges, such as inequality and poverty, are increasingly dependent on environmental ones. For instance, one could think of the relocation of the most polluting activities in developing countries, (e.g. heavy manufactured), or growing "environmental refugees" — millions of desperate people migrating to overcrowded cities as it has become more and more difficult for them to live off their lands due to deforestation, flood, or droughts. In addition to those examples, the traditional, village-based way of living of most developing countries' populations — accounted for up to 3 billion people; mainly Africans, Indians, and Chinese —, which are dependent on, and meet their basic needs directly from nature, is also an example of the inextricably link between the social and environment pillars (Hart S. L., 2007:103-106).

Finally, as it will be further developed in chapter 4, the 'social' pillar of sustainable development, related to the relationships between firms and their stakeholders, is also essential to bring real changes, and minimize the firms'impacts on our natural environment.

1.5 Economic And Environmental Interests

> *"We cannot allow the goods produced or consumed to be made or used in ways that harm the environment on the scale that we have been. This way of growing standards of living is simple unsustainable – economically unsustainable and ecologically unsustainable."*
>
> *Thomas Friedman, 2009: 6*

As underlined in the book *Hot, Flat, and Crowded* of T. Friedman, the Great Recession that began in 2008 was "the moment that the Market and Mother Nature got together and said to the world's major economies, starting with the United States and China: "This cannot continue. Enough is enough"".

There was a time where companies assumed they could profit personally in the short term, without wondering about the long-term effects of their actions. However, according to Carl Pope,

executive director of the Sierra Club, "this is the first time in human history that economic growth has become the prerogative of most people on the planet"(Friedman T. L., 2009: 97).

Indeed, according to Jagdish Bhagwati (in Friedman T. L., 2009:19), Columbia University economist, most banks moved from their original purpose — to fund innovation and to finance the process of improving people lives by replacing the old technologies by new ones— to get involve in exotic and incomprehensible financial innovations that ended up destroying creation. T. Friedman's vision of the current financial sector demonstrates how it disrupts our system, and our planet:

> "So more and more money flowed into a less and less regulated financial system, and the banks took greater and greater risks with it — not just on subprimes but on all kinds of instruments — in more and more places using more and more exotics intruments and greater and greater leverage, making transactions that fewer and fewer people understood and were less and less transparent"(Friedman T. L., 2009:13).

In conclusion, a market is financially sustainable when it goes from short-term thinking that can damage economy, companies and jobs, to innovation and investments that promote long-term growth of aggregates (Friedman T. L., 2009:52).

1.6 Key Drivers Of Corporate Sustainable Development

MIT Sloan Business School conducted a survey with leaders and executives, in which all agreed that the biggest drivers of corporate sustainability investments — the forces that are having the greatest impacts on companies— are [4]:

Government legislation: It seems that more than 64% of the respondents argued that this issue has had a significant impact on how their organization was approaching sustainability. However, many of the interviewees also cited instances in which companies played role in shaping the regulatory framework too rather than simply reacting to it.

Consumer concern, **or consumption pattern*:*** 58% of the survey respondents are acknowledgeable of the significant impact that the consumer concerns can have on their companies. Today's consumers want products or services that are more responsible, and ideally at the same price. According to several studies, products have to satisfy three criteria's (Vaxelaire, 2011):

- Good for the consumers' health, or harmless in their use.
- Harmless to the environment.
- Responsible in the manufacture.

[4] See Chapter 4 (4.4): *The value of Managing Stakeholders* (p 54), for more details on each of the drivers, and Appendix 4 [*Key drivers of corporate sustainability investment*, p 95]

Employee interest: 56% of survey respondents selected employee interest also as an issue having a significant impact. In terms of recruitment, retention and engagement, such employee-related issues are among the major benefits of addressing sustainability.

Even though they are aware that it is a reality that the business world must confront, the interviewees also underlined that drivers, such as ***climate change,*** and other ***ecological forces***, are more pressing. Indeed the reality of our ***resource-constrained world***, and other ***environmental issues***, as cited above, should be the primary drivers for a sustainability investment.

While some survey respondents pointed out that company's brand and reputation represent the principal benefits of addressing sustainability, most leaders emphasized a broader panel of rewards in value creation, in particular the potential of sustainability to deliver new sources of competitive advantage (See Appendix 5 [*The main benefits of actions in addressing sustainability issues*, p 95]).

We live in a very dynamic world where these trends and forces will continue to evolve, and pressure companies to go "green". Indeed, this revolution, which industries and business can no longer ignore, highlights the importance of bringing sustainable considerations into their core business strategy. Esty and Winston (2009:8) call it the new "Green Wave", which presents an "unprecendented challenge to business as usual".

1.7 Firms And The Green Revolution

> *"It takes twenty years to build a reputation and five minutes to ruin it. If you think about that, you'll do things differently".*
>
> *Warren Buffet (Esty and Winston, 2009:14)*

We should change our perspective. Green is different from what we thought in the past. According to Thomas Friedman (2009:213), "green is the way you grow, build, design, manufacture, work, and live (….). Green becomes the smartest, most efficient, lowest cost-way — when all the true costs are included — to live, build, work, and play". After having demonstrated that green not only refers to a strategy for reducing environmental impacts, but also to 'outgreen' the competitors and deliver competitive advantage, it will be highlighted that the term 'green' will enter and be widely accepted in the near futur in our vocabulary.

1.7.1 'Outgreening' Its Competitors

It is important to note that green is not simply a strategy for tackling the environmental issues and producing cleaner power, and achieving energy efficiency. Companies adopting this approach can also 'outgreen' their competitors, through efficient initiatives and innovation, and will deliver together greater competitive advantage (Friedman T. L., 2009:378).

As a matter of fact, in our transparent and resource-constrained world, the old strategies of success, as T. Friedman defined them — outmining, outdrilling, outconsuming, outperforming, outspending —, are no longer viable, neither do they offer sustainable competitive advantages

(Friedman T. L., 2009:380-382). For instance, General Electric (GE) 's strategy is an example that was driven by those two mindsets. GE has had the ability to "get its business units to examine the growing demand for greener products, invests in Research Development to create such products, and then leverage that innovation with appropriate marketing to commercialize them" (Seidman, 2008).

Through carbon taxes, gasoline taxes, regulation and public opinion, or naturally through a dramatic change of the weather, the market and the Mother Nature are increasingly imposing the true cost of how companies use energy and natural resources (Friedman T. L., 2009:380). However, sustainability-driven organizations will likely benefit from higher revenues, lower operational costs, and even lower lending rates from banks that see reduced risks in companies with careful environmental management systems (Esty & Winston, 2009:12). Therefore, according to T. Friedman (2009:380), the greenest, cleanest and most efficient companies, but also other institutions, families, countries and manufactures, will succeed the most and the longest.

As an example of cost money savings, in the late 1990s, British Petroleum's (BP) CEO, Lord John Brown, committed the company to reduce its greenhouse gases emissions. After three years, BP has discovered numerous ways to cut emissions, improved efficiency and saved money. The initial investment amounted to $20 millions, but saved the company over $650 million over the first few years and, as of 2007, more than $2 billion (Esty & Winston, 2009:2). A clear link between actions that are good for the environment and the firm is obvious, but will not be more accuretely developed here.

1.7.2 THE TERM 'GREEN' IN THE FUTURE

In the future, there will be no such thing as the term 'green' (green companies, green building, green car). According to T. Friedman (2009:351), it will simply be a norm because the ecosystems of prices, the natural ecosystem, regulations, and standards will impose it. "The term 'green' will go the way of the term 'civil rights'", emphasized energy expert David Edwards[5]. However, critics argue that the term 'green' has too often, and in too many ways become "a license to feel good without doing good, to raise awareness without actually changing our behavior"(2009:458)— commonly referred as 'greenwashing'.

1.8 CONCLUSION

As Esty and Winston (2009) mentionned it, "a few, like climate change and water concerns, will be major problems for all of society. Nearly every company, large and small, will be forced to adress them". In such "hot, flat and crowded" world, and in the Energy-Climate we are heading to, where our Biosphere is imposing constraints on the society as whole, no one — neither markets nor industries or companies — are indeed prepared for what the future holds vis-à-vis the environment. And this is mainly because those challenges are mostly evolving, unpredictable and hard to quantify, creating both risks and opportunities. Still it is not an excuse for inaction. It

[5] In Friedman T. L., 2009:351

should translate into a growing awareness how we, individually and collectively, globally impact on the environment. Besides, it should eventually bring on collective solutions.

Both an end and a mean, *sustainable development* is defined as a policy of change encouraging all the actors — businesses, governments and individuals — to change the way they think and work. The most performing companies are those for which profit is an outcome rather than an end. As a result, it forces companies to adopt an approach of progress towards 'a better world', in term of environmental, economic and social performances.

The crisis that we are facing, rather economic or environmental also translates the urge to adopt a new way of thinking: short-term profit can not longer be part of the companies'objectives. It is the reason why Esty and Winston 'should' not refer to the green revolution, which presents an unprecedent challenge for the business of today, as a "green wave". A wave can be interpreted as something temporary that comes and goes. However the sustainable development promotes *a long-term perspective* in term of growth and performance, be it economically, environmentally and socially.

The three waves of corporate practices related to the environment revealed that it took a long time before regulation on environmental protection and companies' actions towards the environmental challenges were perceived as a *need* rather than a constraint. Still human beings hardly accept changes. However, it is important to realize how our current development model is accelerating the deterioration of our planet, without forgetting its implication to human health.

As a result, as T. Friedman said it, "*Later is Over".* Later was a luxury for our previous generation. Today the term 'later' should be removed from our dictionary: climate change, pollution, oceans getting overfished and polluted, forests and coral reefs getting destroyed, et cetera do not only have impacts on the global natural environment, but also on people who live off them. We can not longer ignore what is happening within our ecosystems and externalize the effects of our standards of living on the earth's climate and biodiversity. Education also plays an important role in adopting sustainable development in our standard of living. If defining as a necessity rather than a choice from an early age, the impact will be greater and more efficient over the long-term.

Smart companies, i.e. those that best meet and find solutions to those challenges, are developping tools and new concepts to be prepared to the rapidly evolving world, and are transforming those challenges into opportunities. Companies that calculate the risks and opportunities effectively will be able to make wise investments, and decisions that allow them to survive the coming "storms". In the following sections, new approaches, such as 'Industrial Ecology', are developed and entirely disrupt business as usual.

As it is going to be demonstrated hereafter, adopting a systemic approach that would marry all environmental issues and interactions with all the actors of the system is essential to our future: "this biodiversity issue is not about saving nature — it is equally about saving humanity", as emphasized by T. Friedman (2009: 192).

2 THE TERMS 'ECO' AND 'SYSTEMIC' IN A BUSINESS CONTEXT

The goal of this chapter is to introduce the concept of Business ecosystem. First of all, it is interesting to define what biological ecosystems and its closest analogies are for that the idea of business ecosystem is inspired by each of them. While business ecosystem refers to the network of complex relationships between the organization and its members, business ecology is even broader: it is the study of the reciprocal relationships between a business and its organisms, *and* the natural environment. After introducing a definition of the latter, in order to adopt a sustainable development policy as developed above and ensure mutually beneficial relationships within the entire business ecosystem, it will be demonstrated that breaking the outdated linear way of thinking to adopt a systems thinking is a feasible and efficient solution in the complex, diversified and evolving world which companies are embedded in.

2.1 DIFFERENT ECOSYSTEM ANALOGIES

The concept of 'Business Ecosystem' has existed for over ten years, and many authors, such as James Moore, have attempted to give a precise definition, but new attributes were added along the years. However, they have all agreed that 'business ecosystem' is a highly descriptive expression for the complex business environment which companies are embedded in.

The approach is first introduced by examining the functioning of the biological ecosystem, which is essential to understand the concept of 'eco' in a business context. Secondly, additional analogies to the conception of biological ecosystem will be reviewed, including industrial ecosystems — which will be more developed in the next chapter — economy as an ecosystem and finally social ecosystem.

2.1.1 BIOLOGICAL ECOSYSTEM

The word 'eco' comes from ancient Greek, and means 'house', i.e. where we live. It refers to "the survival of all living things and the intertwined relationships between those living things and their environment"(Xinghui, 2011). Those living things — the soil, water, air, and all species of animals and plants — are indirectly connected to maintain each other's existence and development. As a matter of fact, John De Guzman (2010) defines Nature as "different biological systems, which are integrated into one livable, intricate, and interdependent cycle".

Moreover, according to D. Chiras (2001)[6], "the study of those living organisms and the web of relationships that binds all of us together in nature" are called **ecology**. One of the most important concepts in the study of ecology is an **ecosystem**, which can be defined as "a chemical, physical, and biological system that encompasses the entire surface of the planet"[7]. Finally, according to the World Resources Institute (2000)[8] and Xinghui (2011), ecosystems refer to

[6] In De Guzman , 2010
[7] Ibid
[8] In Peltoniemi & Vuori, 2004:11

evolving and integrated networks, that are "dynamic, constantly remaking themselves, reacting to natural disturbances and to the competition among and between species".

2.1.2 INDUSTRIAL ECOSYSTEM

According to Peltoniemi and Vuori (2004:11), an industrial ecosystem is an "analogue of biological ecosystem, where all material is recycled infinitely and efficiently". However such ideal is hardly reached in any of the current industrial operations. As a result, a change of behaviors of both manufacturers and consumers is fundamental to maintain our standard of living without devastating the environment. This change would consist in "different parties cooperating by using each other's waste material and waste energy flows as resources" (Korhonen J. (2001)[9]).

More on industrial ecosystem is to be found in the following chapter throught the introduction of industrial ecology concept.

2.1.3 ECONOMY AS AN ECOSYSTEM

In his book, *Preface to Bionomics: Economy as Ecosystem (*1990), Michael Rothschild emphasized that "a capitalist economy can best be comprehended as a living ecosystem". He considers that some key phenomena that are also central in a business context can be observed in the nature, referring to "competition, specialization, cooperation, exploitation, learning, growth, and several others" [10]. Thereafter, several analogies between economic and biological phenomena were drawn by the author (Rothschild 1990: 213, in Peltoniemi & Vuori, 2004):

> "Every organism is defined by the information in its genes, but a living thing also is defined by its relationships to its prey, competitors, and predators. In the same way, an organization is defined by its technology and by its associations with its suppliers, competitors, and customers. From a bionomic perspective, organisms and organizations are nodes in networks of relationships. As time passes and evolution proceeds, some nodes are wiped out and new ones crop up, triggering adjustments that ripple across each network".

As a result, in Rothschild's analogy, firms are defined as biological organisms and industries as species. "Like the organisms and species that make up the global ecosystem, the world's firms and industries have spontaneously coevolved to form a vast living ecosystem."[11]

2.1.4 SOCIAL ECOSYSTEM

According to the author Mitleton-Kelly (2003:23)[12], the cornerstones of social ecosystem are the interdependence among the entities, and the phenomena of co-evolution within a social ecosystem.

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[9] In Peltoniemi & Vuori, 2004

[10] For more details and information on the analogy according to Michael Rothschild (1990), please refer to his book: *Preface to Bionomics: Economy as Ecosystem.* New York : Henry Holt and Company.

[11] In Peltoniemi & Vuori, 2004

Each actor of the ecosystem both influences and is influenced by his social ecosystem which consists of firm, and economic, cultural and legal institutions, as well as consumers and suppliers (Mitleton-Kelly, 2003:30). The latter argues (2003:31) that "functioning like a social ecosystem is a critical success factor for any organization".

2.2 INTRODUCTION OF THE 'BUSINESS ECOSYSTEM' APPROACH

The American strategist James F. Moore, the instigator of biological metaphors of organizational behaviors, defined 'business ecosystem' as the networks of positive sum relationships between all the actors of the ecosystem that should be "analyzed from a higher conceptual level rather than from the viewpoint of individual organizations" (Moore, Business Ecosystem, 2005). Indeed the author believes that in a business ecosystem "irrespective of an organization's individual strength, all actors are connected and share the success or failure of the network as a whole".

In 1993, James Moore's business ecosystem works by:

- "An **economic community** supported by a foundation of interacting organizations and individuals—the organisms of the business world.
- The economic community produces goods and services, which are of value to customers, who are themselves members of the ecosystem.
- The members of the organization include those who are:
  - Customers
  - Suppliers
  - Lead producers
  - Competitors
  - Other stakeholders
- Over the time, the members of the organizations will **coevolve their capabilities and roles**, and tend to align themselves with the directions set by one or more central companies. Those companies holding leadership — "the keystone species"— roles may change over time, but the function of ecosystem leader is valued by the community because it enables members to move toward **shared visions** to align their investments and find mutually supportive roles".

Therefore, James F. Moore underlined here that such **pro-active** attitude will enable companies to develop mutually beneficial relationships with all the members of the organization, which he refers to nature as the idea of « symbiotic ».

While, in the first definition, J.F. Moore highlights the interactions and the function of ecosystem leader to promote a shared vision within a business ecosystem, the author's definition was somewhat different in 1998. Business ecosystem became an:

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[12] For more details and information on the analogy according to Mitleton-Kelly, E. (2003), please refer to his book : *Complex Systems and Evolutionary Perspectives on Organizations: The Application of Complexity Theory to Organizations*. Amsterdam: Pergamon.

> "An extended system of mutually supportive organizations; communities of customers, suppliers, lead producers, and other stakeholders, financing, trade associations, standard bodies, labor unions, governmental and quasi governmental institutions, and other interested parties. These communities come together in a partially intentional, highly self-organizing, and even somewhat accidental manner".

In this reviewed definition, the author emphasized on a decentralized decision-making process and **self-organization**, leading to the idea that a business ecosystem is a *process*, where goals and controls are not set by external or internal leaders, but by spontaneous events and due to local interactions (Mitleton-Kelly, 2004, in Peltoniemi & Vuori, 2004).

Other definitions of a business ecosystem have been developed by experts, such as the authors Iansiti and Levien (2004). In short[13], according to the latters, the features of a business ecosystem include **interconnectedness** and **cooperation** between the entities of the ecosystem. In effect, they underlined the powerful analogy between a biological ecosystem and a business ecosystem in order to understand a business network. Like business networks, biological ecosystems are characterized "by a large number of loosely interconnected participants who depend on each other for their mutual effectiveness and survival"[14].

Moreover, the authors Power and Jerjian (2001) stated in their book *Ecosystem: Living the 12 Principles of Networked Business "*you can not manage a business on its own, but you have to manage an entire ecosystem". Therefore they are against a linear way of thinking, and also promote the advantage of cooperation and interconnectedness — one way to see it would be that due to interconnectedness, changes in the landscape of one company cause changes in the landscape of other members of the business ecosystem — in their approach of **complex** business ecosystem (Power and Jerjian, 2001, in Peltoniemi & Vuori, 2004).

2.3 Introduction To the 'Business Ecology' Approach

There exists a distinction between 'business ecosystem' and 'business ecology'. According to some academics, such as Amy K. Townsend (2006) and Joseph M. Abe (2008), business ecosystem is a first approach that is used as a biological metaphor to describe the increasing complexity of relationships among all the actors of a business while business ecology has a **stronger underlying relationship between business and the natural environment**.

According to Amy K. Townsend (2006), business ecology is "the study of the reciprocal relationship between business and organisms, and their environments". The goal of business ecology is to create sustainable business process as well as new and sustainable opportunities, through "the complete ecological synchronization and integration of a business with the sites that it inhabits, uses, and affects".

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[13] For more details and information on Iansiti & Levien 's business ecosystem (2004), *The Keystone Advantage: What the New Dynamics of Business Ecosystems Mean for Strategy, Innovation, and Sustainability*. Harvard Business School Press, or the paper of Peltoniemi & Vuori (2004)

[14] In Peltoniemi & Vuori, 2004

In a few words, sites refer to three categories, which a business should integrate intentionally and carefully [15]:

- Easily identified, *primary sites* are those that a company inhabits through its facilities (e.g. specific location of corporate headquarters).
- Just as easily identified, *secondary sites* refer to the places that businesses use for their resources (e.g. a forest from which the firm extracts some of the materials it needs in production).
- Far more difficult to identify, *tertiary sites* are those locations that are affected by businesses (e.g. global climate, or ozone layers).

A. Townsend emphasizes that the core of business ecology is that "the company acts as a **co-creator** with the other organisms in its sites on multiple levels of spatio-temporal scale to enhance the site's health in the short-term and long-term, thereby increasing its evolutionary opportunities". As a result, companies should fully integrate their activities according to those sites in order to create mutually beneficial relationships with the whole ecosystem and therefore regenerate the natural environment, rather than harm it (Townsend, 2006).

As a result, defined as "the new field for sustainable organizational management and design" by Joseph M. Abe et al. (2008), such approach implies a fundamental shift in the way that companies run their business to ensure long-term growth. In addition to encouraging vital relationships with the global environment, it leads to some cultural and organizational changes in order to align the development of the organization to its core purpose and values (Townsend, 2006, and Abe, 1998). According to Yorque et al. (2002) [16], this represents a "paradigm shift", which stresses how essential it is for companies to adapt and respond to evolving conditions and environments.

To conclude, as we have seen in the last chapter, concerns for the endangered natural environment are rising and spreading to the business. Though, as previously emphasized in section 1.3.3 (p 13), creating new models that would maximize the relationship between business and natural environment will help companies gain new market shares, and benefit from new sources of profit, controlled thus by companies.

2.4 Breaking The Linear Model To Adopt A Systemic Function

Many issues that companies face are most of the time described by a combination of three aspects: the triple bottom lines of economy, society, and environment. Indeed as it has been underlined in the previous chapter, while environmental damages may have negative impacts on economic benefits, they may also generate some benefits. Furthermore, they may also intensify societal inequality and poverty in some regions in the world while social activities may bring new business opportunities (Xinghui, 2011, and Hart S. L., 2007).

[15] For more detail, please refer to his book : *Green Business: A Five-Part Model for Creating an Environmentally Responsible* (2006)
[16] In Townsend, 2006

Therefore given that it is difficult to clearly divide the three parts, business should adapt a systemic way of thinking. A systems thinking is the most effective and feasible solution in our today's system that is complex, rapidly evolving, diversified, where companies and industries are highly sensitive to the natural environment and companies confronted with multiple stakeholders, as well as non-linear and integrated decision-making challenges (Xinghui, 2011). Moreover it will help managers adapt, see the wide range of choices and new opportunities, and identify the source of problems (Meadows, 2008).

As a result, considering what we highlighted in the previous chapter, it will get more and more unavoidable for a company to evolve from the outdated value chain — divided and linear way of thinking — to the concept of value network of a whole complex business ecosystem — an interconnected and co-evolved system where the change of the landscape of one actor causes the change of the others' landscape.

2.4.1 THINKING IN SYSTEM: TOWARDS A SYSTEMIC WORLD

> *"The place to start is with the whole. All parts of the whole —and their relationships to one another — evolve from this".*
>
> *Stephen G. Haines (1998)*

As the author of *Systems Thinking and Learning*, Stephen G. Haines, wrote, "we find ourselves in a small world of enormous complexity, a new world that demands we see it from a new perspective — a systems perspective — with a mindset attuned to processes, patterns, and relationships".

GENERAL SYSTEMS THEORY

Developed from the study of biology in the 1920s, General Systems Theory emphasizes "the value of viewing as a whole, of gaining a perspective on the entire "entity" before examining its parts"(Haines, 1998:v). The basic of General Systems Theory is that, in our work on any problem, the whole should be our primary consideration, and the parts secondary, which is quite different from our familiar reductionist, and analytic ways of thinking. Moreover, the theory underlines that "no part can be affected without affecting all other parts".

DEFINING SYSTEMS AND SYSTEMS THINKING

It is essential to firstly define 'system' and 'systems thinking' as most people use systems thinking to cover a whole range of meaning, without even knowing what system means (Haines, 1998:vi):

- *System*—"A set of components that work together for the overall objective of the whole".
- *Systems thinking*—"A worldview and way of thinking whereby we see the entity or unit first as a whole, with its fit and relationship to its environment as primary concerns".

In a systemic way of thinking, according to D.H. Meadows (2008), "all are essential. All interact. All have their roles". However, he also emphasized that the least obvious part of the system, its function or its purpose (for a nonhuman system or for a human one, respectively), such as ensuring its own preservation, is often the most crucial determinant.

FROM 'CAUSE-AND-EFFECT' TO 'MULTIPLE CAUSES AND MULTIPLES EFFECTS' CONCEPTS

An analytic way of thinking inhibits companies and individuals to provide long-term, permanent solutions. According to Haines (1998:10), such a linear approach is "to solve problem only one issue at a time, other issues must wait their turn, and this alone can cause problems". It does not take into consideration the environment, other systems, and it focuses on the concept of 'cause-and-effect' —one cause for every one effect.

On the other hand, the world of system consists in considering multiple causes tied to multiple effects in an open and evolving environment. Therefore, according to the latter (1998:12), the concept of systems thinking is that "all systems are circular entities" and is integral to "the input-transformation-output-feedback model" that forms the framework for systems thinking[17].

SYSTEMS THINKING MINDSET

The models of the systems thinking mindset are based on natural laws[18], i.e. on the principles of interrelationship, and interdependence found in all living systems. In order to develop this mindset, three fundamental principles of living systems defined by S. G. Haines (1998:2-4) are to be taken into consideration:

- *The principle of Openness* — "An open system accepts inputs from its environment, acts on the input to create outputs, and releases the output to its environment" (in contrast with a closed system). It gives awareness of the interactions with the environment, and those are crucial in order to manage change, make decisions and solve problems within systems.
- *The principles of Interrelationship and Interdependence* — "When one component of a system changes, it affects many other systems components, and may even alter the entire system". Similarly, when a system itself changes, it has a direct effect on the other systems in its environment because "there are points of relationship and interdependence that extend through and across systems and link them in various ways".

The author gives the example of the ecosystem of salt marsh, for which its inhabitants — birds, insects, grasses, and algae — depend on the conditions of the marsh, but the conditions also depend on them. Similar scenarios can be seen among and between businesses, communities, and even nations. Therefore, companies must detect patterns of relationship and interdependence between systems, looking for "leverage points"— i.e. areas of influence that, "if acted upon, can lead to lasting beneficial changes throughout those systems".

To summarize, the rules of systems, according to T. Friedman (2009:225) include:

- *The first rule of systems:* everything is interconnected. Meadows (2008) believes indeed, "changing relationships usually changes system behavior".

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[17] Appendix 6 [*The Systems Thinking* Approach, p 96] schematizes this model.

[18] Please refer to the book, *Systems Thinking and Learning,* for additional details on 'the Laws of Natural Systems: Standard Systems Dynamics' by S. G. Haines (1998: 16)

- *The second rule*: optimizing the system, rather than optimizing individual components. According to F. P Rose, a systems theorist, and a board member of the Natural Resources Defense Council, "optimizing individual components can only lead to incremental change; optimizing the system can lead to a transformational ecology"[19].

An interesting example of a new system creating a whole new function that is greater than the sum of its parts is the Toyota Prius hybrid. Toyota went indeed from a problem fix (how to make a car get better gas mileage) to a transformational innovation (how to make a car that produces energy and consumes less of it). Therefore, as T. Friedman (2009:226) underlines it, "Once you start working systemically, the benefits are endless — as are the opportunities".

SYSTEMS THINKING AND THE CONCEPTS OF BUSINESS ECOLOGY AND ECOSYSTEM

The idea of optimizing the whole system is supported by the importance of building strong relationships and interactions within the whole (economic) community, and with natural environments. What is more, it is also supported by the phenomena of co-evolution and co-creation with other organisms, which suggests that, the complementary concepts of business ecology and business ecosystem are the applications of systemic theories.

2.5 CONCLUSION

It appears that economy as an ecosystem and social ecosystem are the closest analogies to business ecosystem: there is a remarkable similarity between basic mechanisms of economic and biological phenomena, and the interdependence between the entities of the ecosystem. As a result, similarly to a biological ecosystem where all living things are indirectly connected to maintain each other's existence and development, business ecosystem refers to a dynamic network that binds all the members of the organization and itself together. It leads to an interconnected, and cooperative system to develop and maintain mutually beneficial relationships. In effect, the concept of business ecosystem insists on performing an overall analysis of the entire ecosystem and the interconnectedness between all its members rather than focusing on the viewpoint of the individual organizations (taken separately).

The concept of business ecology underlines the relationship between business and the natural environment to create new sustainable opportunities. It drives the company to play the role of co-creator with other organisms embedded in the business ecosystem. In this view, it will enable them to reach a healthy and sustainable business ecosystem.

It follows that, in a sustainable development policy, both concepts should be complementary. It should foster the interconnectedness that exists between the businesses, the members of the organization *and* the natural environment. Both concepts could work together to create new and sustainable opportunities, such as the commitment to ecological efficiency rather than harm the natural environment. In his article, *The leap: From value chain to business ecosystem*, Shi Xinghui

[19] In Friedman T. L., 2009: 225

(2011) suggested that the core essence of a 'green' company lies in "building socially and environmentally-friendly networks" while they focus on the futur and stress the present.

Furthermore, in the Energy-Climate era, companies must change their way of thinking. The previous concepts derived from a systematic way of thinking, which focuses on the analysis of the whole, rather than its parts and encourages a shared existence and mutual benefit. It leads to leave behind the outdated and traditional business logic of a linear and divided thinking, and of one cause-one effect to move to the logic of multiple causes tied to multiple effects, to generate long-term and permanent solutions.

The problem often encountered in such a systemic perspective is to ensure a well-defined purpose within the whole system. It is the reason why it will be further highlighted how important it is the role of business leader in order to move to a shared vision within a business ecosystem. Finally the business leaders will have to educate all the actors of the ecosystems about systems thinking and help them understanding how all of these activities are interdependent and affect each other.

Those three interconnected approaches enable the introduction of the concept of industrial ecology — also known as circular economy —, which leads firms to adopt a sustainable way of using natural resources and emphasizes on the interrelationship between and within the natural and industrial systems.

3 INDUSTRIAL ECOLOGY AS A COLLECTIVE SOLUTION

"The traditional model of industrial activity should be transformed in a more integrated model: an industrial ecosystem".

R. Frosch & N. Gallopoulos, General Motors Laboratories, 1989

As shown before, companies have assumed for too long now that Mother Earth has infinite resources and an infinite capacity to absorb waste. They have conducted their business based on false assumptions and a state of 'ecological overshoot', as defined by Giles Hutchins, Global Director of Sustainability Solutions at Atos Consulting, has been reached: we have been using the natural resources of our planet faster than nature can regenerate them.

G. Hutchins adds that "more than 90% of all natural resources that go into the production of durable goods are wasted by the point of sale". According to the latter, "innovating through sustainable products and services while reducing resource and energy-intensive production methods" is the real challenge and "this requires optimization alongside innovation and transformation". As a result, many companies become increasingly aware of those challenges and hence the opportunity to take those up.

Through *the approach of the industrial ecology*, many forward-thinking companies have adopted a systemic and more interconnected way of thinking, and have focused on a sustainable way of using their resources. The waste of one part of the industry is either used as an input for another, or returned harmlessly to the ecosystem, for instance as a nutrient (like a compost). Briefly, the author A. Garner (1995) defines industrial ecology as "the study of the physical, and biological interactions and interrelationships both within and between industrial and ecological systems".

The following section aims at understanding what is meant by industrial ecology, and how such systemic analysis could be collectively adopted by firms in order to minimize their resource consumption, maximize their energy efficiency, and therefore reduce their environmental footprint. Tools and a map of actions are suggested, as well as a complementary approach, following the principles of functional economy.

An actual case on industrial ecology and strategies to *close the loop* is analysed in chapter 6.

First of all, it is important to point out that the term 'industrial ecology' is not to be understood in the narrow sense of the word 'industrial', since it refers to all the human activities within the industrial system, i.e. the economic system, which undergoes a continuous evolution — from agriculture to tourism, the Internet, and services, all are part of the industrial activities (Erkman, 2004).

3.1 INDUSTRIAL ECOLOGY AND SUSTAINABLE DEVELOPMENT

As A. Garner emphasized it in his article *Industrial ecology: Introduction* (1995), the main goal of industrial ecology is the promotion of the sustainable development at the local, regional and global levels for all the different kinds of industrial processes, and activities. It is a global approach that includes every aspects of sustainable development: from environmental to economical

points of view, as well as social and territorial aspects (Garner A, 1995, and Korhonen et al., 2001).

Referring to the key principles of sustainable development developed in chapter 1, industrial ecology should "promote the **sustainable use of renewable resources and minimal use of nonrenewable ones**"(Garner, 1995), leading industrial activities to be sustainable. At the same time, the objective of the ideal industrial ecosystem is to keep waste as low and harmless as possible.

The second key principle is **the preservation of the ecological and human health**, since the latter is dependent on the health of the other components of the ecosystem. Industrial ecology should therefore protect the whole structure and function of the ecosystem, rather than degrade them. Neither should industrial activities cause catastrophic disruptions to the ecosystems, or it would jeopardize the planet's life support system.

Finally, the primary challenge of sustainable development is the achievement of **intergenerational and intersocietal equity**:

- The ability of future generations to meet their needs is endangered by the scarcity of natural resources and the deterioration of ecological health, due to the development of objectives based on short-term achievements.
- A large imbalance between developing and developed countries in their use of the resources leads to large intersocietal inequities. Developed countries indeed use a disproportionate amount of resources in comparison with developing countries.

Suren Erkman adds in his book *Vers l'Ecologie Industrielle* (2004:181) that industrial ecology is part of the **social responsibility** of companies. Industrial ecology implies thus a responsible use of the resources, while respecting the natural ecosystem and human health. The life-cycle process of the resources (from the initial extraction until the end of their life) underlines the responsibility of all economic agents, producers and consumers.

3.2 Defining Industrial Ecology

The concept of industrial ecosystem was introduced in 1989 by Robert Frosch and Nicholas Gallopoulos, two senior executives from General Motors, in their article, *Strategies for Manufacturing*. It led to the development of the term 'industrial ecology'. They argued that industrial activities coud be made more "environmentally-benign" if natural systems were perceived and used as potential models for the organization of industry. Later the field has been extended by authors such as A. Garner (1995), and S. Erkman (1997 & 2004).

There is no single definition of industrial ecology and the term carries multiple meaning. The next sections will study the differents aspects of industrial ecology, from a conceptual term to an operational strategy and a collaborative approach following, among others, the works of A. Garner, G. Hutchins and S. Erkman.

3.3 A Conceptual term

Industrial Ecology is a broad and conceptual framework to develop a systemic view of the industrial systems, in symbiosis with the natural ecosystems. It implies the expertise of different fields and a fundamental change in the production process, based on the functioning of the natural ecosystems.

3.3.1 Systemic Thinking

"The goal of industrial ecology is to reduce the overall, collective environmental impacts caused by the totality of elements within the industrial system."

Andy Garner (1995)

A systemic view of the correlation between human activities and ecological systems is fundamental to industrial ecology. It enables manufacturers to develop products in a sustainable way, as well as managers to avoid partial understandings and develop managerial and policy solutions, and processes that reduce the environmental challenges (Lifset & Boons, 2011:311).

Among others things, G. Hutchins (2012) emphasizes that companies must redesign and rethink their products and production lines, and this "from the upstream design and input sourcing to downstream product use and end of life disposal". In such 'cradle-to grave' framework, life-cycle assessment methodologies (see 3.7) have developed familiar tools for the valuation and reduction of companies' environmental impacts in all their activities from resource extractions to waste disposal.

Moreover a systems perspective is essential to raise awareness of the multiplicity of environmental concerns (Lifset & Boons , 2011:311). Rather than just examining greenhouse gas emission, or waste generation, such analysis can tackle the whole range of environmental impacts — from climate change and energy consumption to ozone depletion, et cetera.

3.3.2 Multidisciplinary Approach

In order to contribute to the development of industrial ecology and the resolution of complex environmental problems caused by industrial activities, expertise from a variety of fields — law, economics, business, public health, natural resources, ecology, engineering — is required (Garner, 1995). Collaboration and knowledge sharing between the different parts of the business ecosystems is indeed the only way for companies to answer the challenges of industrial ecology.

Changes in public policy, law and individual behavior along with, as Giles Hutchins mentioned it, innovation, the design and implementation of appropriate technologies as well as transformations are necessary for firms to deal with their environmental impacts.

3.3.3 Analogies To Natural Ecosystems

The ideal industrial ecosystems of R. Frosch and N. Gallopoulos(1989) would work as an analogy to their biological counterparts, which are perceived as highly efficient in using and re-using their own resources. The metaphor between industrial and natural ecosystems explains the term industrial *ecology*, and is fundamental to the model.

In such ideal industrial ecosystem, the waste produced by one company could be used as a new resource for another. No waste would leave the industrial system or negatively impact natural systems (Frosch and al., in Garner, 1995). The goal is indeed to reach a full "eco-industrial dynamic equilibrium" where industrial and natural processes are balanced and coexist in symbiosis without degrading each other (De Guzman, 2010n and Erkman, 2004).

3.3.4 Open (Linear) Versus Closed (Circular) Loop Systems

To reach such objectives, a change in the industrial system must occur— **from the linear logic** of the system, in which raw materials are used, and products, by-products and wastes are produced and dissipated into the environment, to a **cyclical system** in which the wastes are reused as energy, or raw materials for another product or process (Garner, 1995).

Braden Allengly described this change as the evolution from a Type I to a Type III system[20] (Garner, 1995, and Erkman, 2004):

Type I System:

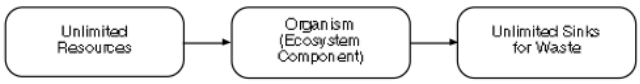


Figure 2: Type I System (Source: Braden, 1992)

This corresponds to what Suren Erkman calls the *juvenile ecosystems*, a linear and irreversible process in which materials and energy flows enter one part of the system and then leave either as a product, or by-products/wastes. Because by-products and wastes are not recycled or only at a very low rate, this system demands a high and constant amount of raw materials. As the supply of materials and energy is not finite, this system is unsustainable. An example of such system would be the traditional plastic model described in the Appendix 7 (p 97).

Type II System:

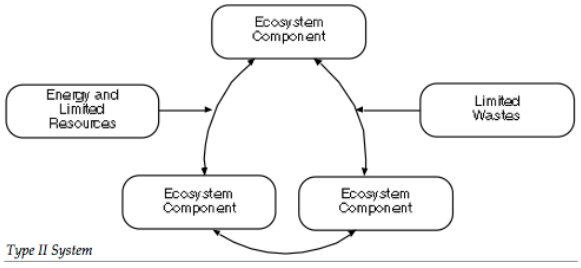


Figure 3: Type II System (Source: Braden, 1992)

This scheme characterizes the current industrial system; some wastes are recycled or re-used within the system while others still leave it. This 'semi-cyclical' system resulted from the

[20] Source: Braden R. Allenby (March 1992), *Industrial Ecology: The Materials Scientist in an Environmentally Constrained World*, MRS Bulletin 17, no. 3: 46–51.

rarefication of some resources (in particular, renewable resources, such as water and soils), from diverse pollution and from legal or economic factors (for instance, the recycling of precious metals).

Type III System:

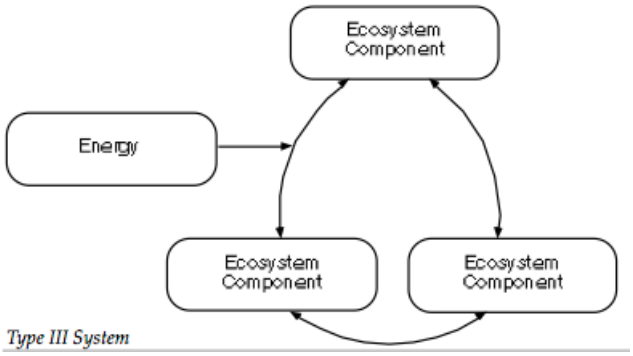


Figure 4: Type III System (Source: Braden, 1992)

This type represents a highly integrated, closed system and the dynamic equilibrium of ecological systems, where energy and wastes are constantly recycled and re-used by other organisms and processes within the system itself. Only solar energy comes from the outside.

A low proportion of material and energy flows and a high rate of recycled materials correspond to what S. Erkman calls *mature ecosystems*. A Type III system is sustainable. This is what industrial ecology seeks to achieve. An industrial ecosystem should indeed learn from the natural ecosystem, which has developed systems made of complex interactions and symbioses in order to minimize the material and energy flows.

In Appendix 7 is Mike Biddle's new sustainable business model, which deals with plastic. He succeeds to close the loop by using the waste from plastic products as inputs for the plastic industries (from pages 97 to 99).

3.4 An Operational Strategy

This concept of industrial ecology can be coupled with an operational strategy. As a result, it is not only a conceptual framework, but also an approach *of action* (S. Erkman, 2004). The ideal would be to reach the mature ecosystem for the industrial system described above and illustrated in Figure 5 (p 34), that is, a system that could be self-sustainable and well integrated in the whole economic activities of the system.

3.4.1 A Study Of Material And Energy Flows Within The Industrial System

The primary step is to understand how the ecosystem works — the flow of material and energy that enter and leave the system. This basic methodology is called 'material flow analysis' or 'industrial metabolism', following, among others, the works of Garner, 1995, S. Erkman, 2004, and Schalchli, 2009.

The goal of the study of industrial metabolism is to quantify and identify the flows, the transformations and the dissipations of energy and materials in the industrial system —how much

material and energy are entering or leaving the system. But it also aims at understanding how to transform the system such that it becomes sustainable. It aims at minimizing the environmental impacts and optimizing the resource efficiency of material and energy use within the industrial system.

Therefore, it can be applied to identify firms' negative impacts on natural ecosystems — "how those flows intersect, interact, and affect natural systems" (Garner, 1995)— as well as opportunities of development and cooperation between all the economic agents. It will help companies close their loop.

3.4.2 The Map For Action

Optimizing the use of resources, and interacting with our natural ecosystem suggests reorganizing our system of production. Suren Erkman suggested **a map of action**, which takes into consideration all that it has been previously developed, through 4 strategies of action, developed in his book *Vers une écologie industrielle* (1998):

Circularizing the economy — Build networks of resource use and waste in the industrial ecosystems, with the aim that the waste of one company becomes the resource of another company or another economic agent (for instance through eco-industrial parks (See 3.5.2, p 35)).

Minimizing the losses — Design new products and services that minimize the current huge material losses in the industrial systems, which pollute and waste materials. (See chapter 3.7 *Innovative tools to support Industrial Ecology*, from page 36).

Dematerializing the economy — Minimize the total material and energy flows while assuring equivalent services to their customers. There is a huge potential of innovation. One of the great opportunities here is adopting the approach of functional economy, following the principles of minimizing the conception of material economy (See chapter 3.9: *The Functional Economy*, from page 42).

Decarbonizing the economy — Decouple industrial activities from fossil carbon, which represents the source of many problems. The use of hydrocarbons should be less harmful (e.g. by recovering carbon dioxide from combustion) and promote the transitions to an energy use that is less rich in fossil carbon (e.g. promote renewable energy, and energy savings).

3.5 A Cooperative Approach

Industrial ecology implies to work at a systemic level (all region, or all sectors of economies) for efficient use of resources, and to encourage synergies between traditionally separate industries; what it is called "Eco-Industrial Synergies". Moreover, physical proximity between the infrastructures and the economic agents will help optimize those exchanges of energy and materials in order to move from synergies to "industrial symbiosis", or commonly referred to as "Eco-industrial parks".

3.5.1 ECO-INDUSTRIAL SYNERGIES

The concept of industrial ecology highlights the engagement of traditionally separate industries in a collective approach, and the creation of networks at a scale of a territory, sector, urban area or a zone of activities, in order to recover the industrial flows, pool the different business services together, et cetera. (Schalchli, 2009). As a result, it aims at realizing what S. Erkman (2004) refers to as "**Eco-industrial Synergies"**.

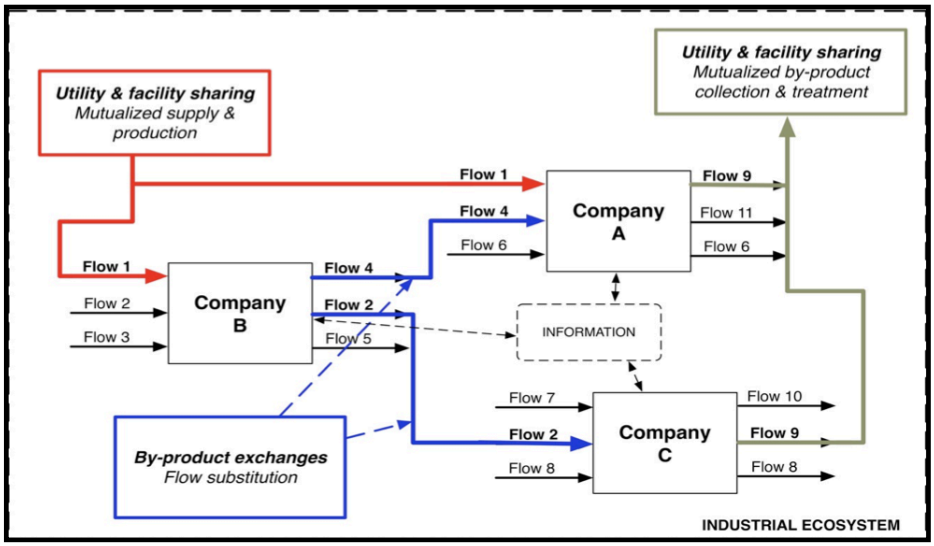


Figure 5: Industrial Ecosystem (Cyril Adoue, in Erkman,2004)

As illustrated in Figure 5, the eco-industrial synergies involve physical exchanges of materials, energy and by-products as well as an exchange of information between different companies. To summarize, it can includes (Association Orée, 2009):

- *The optimization and the exchange of industrial flows* (e.g. process waters, waste and by-products, et cetera)
- *The pooling of services to different companies* (e.g. collective management of waste, re-use of rain water, transport, mail distribution, et cetera).
- *The sharing of equipment* (e.g. boiler, vapor production, unit of waste treatment for the effluents, et cetera) *or resources* (e.g. jobs)
- *The creation of new activities* (e.g. development of new products or services from newly identified resources).

The expert Paul Schalchli from Orée Association (2009) and Marian Chertow (2007), an American pioneer in the era of Industrial symbiosis, underlines that when such collaboration between different companies and the development of such synergies are offered by relative geographic proximity, it should refer to "**Industrial symbiosis**"[21], a sub-field of industrial ecology.

[21] More: Chertow, 2008, in http://www.eoearth.org/article/Industrial_symbiosis (Retrieved May 05, 2012)

3.5.2 INDUSTRIAL SYMBIOSIS: ECO-INDUSTRIAL PARKS

In order to realize such exchanges in terms of materials, energy and waste, and encourage such synergies, the **physical proximity** of the infrastructures and economic agents is a fundamental condition (Chertow, 2008).

As illustrated in Figure 5, the idea is to build a network where companies collaborate in order to reduce and optimize the use of by-products and waste, recover their value and achieve economies of scale in their production processes (Tudor and al., in De Guzman, 2010, and Erkman, 2004). It enables companies to build an industrial ecosystem of their own where each one of them can use the waste of the other for economic benefits and environmental purposes (Andrews (1999), in De Guzman, 2010). This creation of network will look like the natural ecosystems by recycling other organisms' waste as food.

The idea of eco-industrial parks distinguishes itself from the traditional exchange programs of waste, for that it is a systematic utilization of all resources in a given region, rather than a simple waste recycling system(Erkman, 2004:35).

Before any activity takes place, the eco-industrial parks must be setup, planned, and agreed to by the companies. It is a evolutionnary process, since more and more companies can integrate the use of the park along the process. In establishing eco-industrial parks, companies should (De Guzman , 2010):

- "Obtain the *approval of the local authorities* where the park is going to be located.
- Create *the entire set of industrial facilities* under the form of plants and warehouses.
- Monitor and adapt closely their activities until they attain the *interdependency level* of an eco-industrial park.
- Collect the *wastes* of companies that are closely linked to each others in terms of inputs and outputs"

According to Suren Erkman (2004), favourable technical and economic conditions are not enough for the maintainance and emergence of eco-industrial networks. An incentive context that incorporates legal, social, political, organizational and managerial points of view is fundamental as well. Therefore from a simple land where infrastructure was built to welcome a group of companies, the park becomes a system integrating principles that promote mutual valorisation of resource of each company in its conception, planification, and management model.

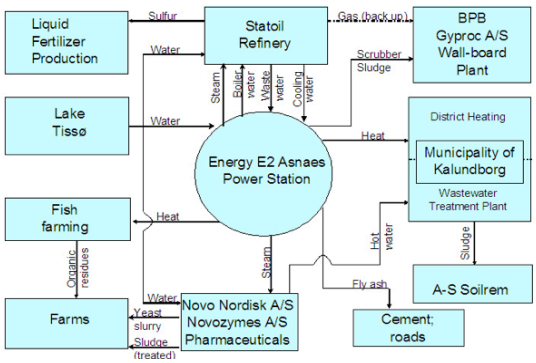


Figure 6: The Industrial Symbiosis at Kalundbug, Denmark (Source: Chertow, 2008)

As illustrated in Figure 6, a model of industrial symbiosis was first launched in the 1980s in Denmark. The Kalundborg eco-industrial park has created a highly intergrated industrial system in which there are currently 20 exchanges between the symbiosis participants, including a power plant, an oil refinery, a pharmaceutical plant, and a plasterboard factory (Chertow, 2008). Over 30 years, and a total investment estimated at €84 million, it has resulted in large waste and resources treatment savings, amounted to about €15 million per year (Association Orée, 2009)[22].

This processus has spread to the United States, Japan, China, England and has started to develop across Europe.

3.6 A Potential Umbrella of Individual Strategies For Environmental Impact Reduction

There exist multiple strategies that are used by individuals, firms or governments to reduce their environmental impacts. For instance, *pollution prevention* strategy suggests to "use materials, processes or practices that reduce or eliminate the creation of pollutants at the source" (U.S. EPA, Garner, 1995) and refers to specific actions undertaken by individual firms, rather than collective ones of the industrial system (Garner, 1995).

Others strategies such as waste minimization, source reduction, global reporting initiatives, et cetera, which are not developed here (but definitions can nevertheless be found in Appendix 8 [*Definitions of Sustainable Development Strategies for environmental impact reduction*, p 99]) are all approaches that are taken by **individual firms** to reduce their environmental footprint.

While those strategies are thus individual actions, according to A. Garner (1995), ***industrial ecology*** offers "an organizing umbrella that can relate the individual activities to the industrial system as a whole". Indeed, it has been demonstrated that this systemic approach refers to the activities of all entities within the industrial system, or "a collective reduction of environmental impacts".

3.7 Innovative Tools To Support Industrial Ecology

Recycling is the foundation of any policy aimed at closing material flows. However, one main negative fact on recycling is that it is an activity that is highly polluting. It consumes indeed a lot of energy and especially dissolves various substances into the environment. For instance, in the case of plastics, colorants and additives are dissipated during the process of recycling (Erkman, 2004:102).

Therefore a preventive approach would focus on minimizing not only pollution from manufacturing processes, but it would also be for companies to prioritize the process and product design as being from the beginning integrally recycled, and minimize all environmental impacts associated with the integral life-cycle of a product. Tools have been developed to support this

[22] See the article, *Industrial Symbiosis*, by Chertow M. (2008) to obtain additional details on the Kalundborg eco-industrial park.

approach, part of the concept of industrial ecology: Life Cycle Assessment methodologies, and Life Cycle Design (LCD) and Design For Environment (DfE).

3.7.1 Life Cycle Assessment (LCA)

Life cycle assessment (LCA), also commonly referred to as 'life-cycle analysis' and 'cradle-to-grave analysis', is a method of evaluating the environmental consequences of a product or process "from cradle to grave" — from raw material extraction through materials processing, to manufacture, distribution, use, repair and maintenance, and disposal or recycling at the end of its useful life of the product (Garner, 1995). It is an important and useful tool for the study of 'industrial metabolism' developed previously, and assessing environmental burdens as well as finding ways to minimize harm. Furthermore, it ensures product transparency and authenticity towards their stakeholders.

Definition of Life cycle assessment (LCA)

The Society for Environmental Toxicology & Chemistry (SETAC) defines LCA as:

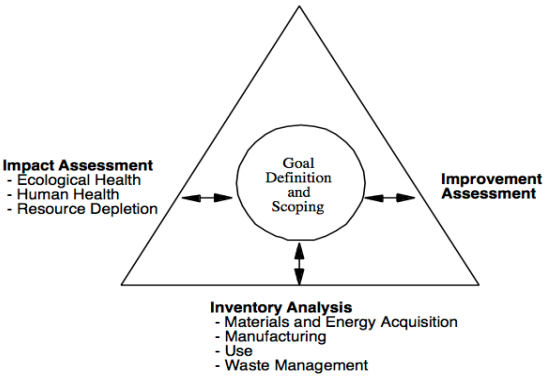
> "A process used to evaluate the environmental burdens associated with a product, process or activity"[23]

The U.S. EPA adds that an LCA is:

> "A tool to evaluate the environmental consequences of a product or activity holistically, across its entire life"[24]

Components of an LCA methodology

From Garner's article, 3 distinct components of the LCA methodology are defined by SETAC and the U.S. EPA as the following:



- ***Inventory Analysis*** — Identification and quantification of energy and resource use, and environmental releases to air, water, and land
- ***Impact analysis*** — Technical qualitative and quantitative characterization and assessment of the consequences on the environment
- ***Improvement analysis*** — Evaluation and implementation of opportunities to reduce environmental burden

Figure 7: Technical Framework for LCA (Garner, 1995)

[23] See Society of Environmental Toxicology and Chemistry (1993), Guidelines *for Life- Cycle Assessment: A "Code of Practice".* Pensacola, Florida: SETAC.

[24] See The U.S. Environmental Protection Agency (EPA). (Feb 1993). *Project Summary Life-Cycle Assessment: Inventory Guidelines and Principles*. Springfield

First of all, as previously mentioned, a LCA methodology focuses on the complete **product life cycle system** — "process of managing the entire lifecycle of a product from its conception, through design and manufacture, to service and disposal" to measure the environmental impact at every phase (Global Leaders in PLM Consulting, 2012).

In brief, the methodology is conducted in 3 phases (Garner 1995, and Esty & Winston, 2009:170).

- *The Life Cycle inventory analysis* is first developed to build a process flow diagram in which material as well as energy inputs and outputs for the product system are identified and quantified, as illustrated in Appendix 9 [*Process Flow Diagram*, p 100].
- Once the environmental burdens have been identified in the first stage, the *impact analysis* assesses and characterizes those impacts, which allows determining the severity of the impacts and ranking them.
- The *improvement analysis* stage responds to the results of the inventory and/or impact assessment by designing strategies to reduce identified environmental impacts.

To summarize, a LCA provides information and responds to questions such as (Esty & Winston, 2009:171):

- "Which step in the process uses the most water or produces the most air pollution?
- Can we re-use or recycle any by-products from manufacturing?
- Can we recycle the whole product?
- Which steps in the chain create environmental impacts that would concern different stakeholders?
- Where is waste and inefficiency?"

EXAMPLE OF AN LCA

A real example would be the one of *Procter and Gamble*, which has used life cycle assessment methodologies to guide environmental improvements for several of its products and packaging (Garner, 1995 and P&G official website, 2005). One of the case studies of the company on hard surface cleaners conducted to identify their potential impact on public health and on the environment. It enabled them to realize that "heating water for use with the product resulted in a significant percentage of total energy use and air emissions related to cleaning".

Based on this information, opportunities for reducing impacts were identified, such as "designing cold-water and no-rinse formulas, and educating consumers to use cold water". It enabled them to lower their energy requirements and their use of some chemicals, as well as their impacts on human toxicity and climate change. The use of cold water instead of hot water also enables consumers to reduce their energy bills. As a result, companies that understand the life cycle of their products also drive revenues, by finding ways to make customers' lives better (Esty & Winston, 2009:172).

For more details on the LCA applications, methodologies, difficulties and limitations, many textbooks and articles introduce principles and guidelines of Life Cycle Assessment. Among others, **ISO 14040:2006** describes the principles and framework for LCA.

3.7.2 Life Cycle Design (LCD) And Design For Environment (DfE)

According to A. Garner (1995), 'Life Cycle Design' (LCD), 'Design for Environment' (DfE) and other similar initiatives based on product life cycle have been developed to "systematically incorporate environmental concerns that need to be more effectively addressed in the **design process** to reduce the environmental impacts associated with a product over its life cycle".

Definitions of Life Cycle Design (LCD) and Design for Environment (DfE),

A. Garner defines and distinguishes Life Cycle Design and Design for the Environment as the following:

Life Cycle Design — "Systems oriented approach for designing more ecologically and economically sustainable product systems. It integrates environmental requirements into each design stage, so total impacts caused by the product system can be reduced".

Design for Environment — "Another design strategy that can be used to design products with reduced environmental burden".

Both have similar goals but evolve from different sources. As shown in Appendix 10 (p 100), while the former seeks to minimize the environmental impacts of each product system component —product, process, distribution, and management — and integrate the internal and external factors of the life cycle design management, the latter focuses on the design of the product and the process.

Components of an LCD

LCD methodology is the most commonly used as it covers more components of the product system. Thereafter is a brief explanation of the LCD methodology. For more details, refer to the paperwork on the *Industrial Ecology: Introduction* of Garner A. and the Appendix 11 for the Framework of *'Life Cycle Design* (p 101).

The framework follows distinct stages:

The Needs Analysis — The project's scope and purpose are first defined as well as the customer needs and market demand are identified. The effects of the product that could have on the environment are also examined during this phase. Finally, a comparative analysis with competitors can identify opportunities to improve environmental performance, i.e. compare a company's products and activities with another company.

Design Requirement — The project needs are used to formulate design criteria. In order to avoid any costly and time-consuming adjustments later, it is essential to incorporate from the beginning key environmental requirements into the design process, reviewed in Appendix 12 [*Issues to consider when developing environmental requirements*, p 102].

Design Strategies — They are developed in order to meet the defined design requirements. Appendix 13 [*Strategies for meeting environmental requirements*, p 103] presents a wide range of strategies that are available to satisfy environmental requirements.

Design Evaluation — The design is evaluated and analyzed throughout the design process. Tools for design evaluation range from LCA to single-focus environmental metrics. Cost and performances are part of the wide range of criteria to evaluate the design solutions.

SUSTAINABLE DESIGN AND WASTE MANAGEMENT: THE "CRADLE-TO-CRADLE" CONCEPT

The architect William McDonough and the chemist Michael Braungart brought this new challenging concept of 'cradle-to-cradle' that promotes the idea of encouraging economic growth in our natural resource-contrained world.

Through their concept, instead of doing what they called "*downcycling*" — i.e. transforming high quality products into lower and less sophisticated ones and then throw them away —, all the product components can be designed for continuous recovery and reutilization as biological or technical nutrients, hence, "eliminating the concept of waste". Therefore, they suggest that firms should directly design products completely safe in order to go back to nature or to industry forever (McDonough & Braungart, 2002).

EXAMPLE OF THE APPROACH OF DFE

Hitachi Home Electronics adopted the approach of DfE in its washing machine division (Esty & Winston, 2009: 199). The companies discovered that they could develop a process by which its washing machins were made with only six screws. By redesigning their products, it enabled them to make the disassembly easier, and therefore facilitate the recycling. It also cut the manufacturing time by 33 percent and reduced the number of parts needed in inventory. For the customers of Hitachi, it also led to higher reliability and lower repair bills since they discovered that the new machine required less services.

This resulted in an environmentally-friendly product, which has also improved their customer satisfaction, reduced their production costs, and disposal costs.

3.8 CHALLENGES RELATED TO INDUSTRIAL ECOLOGY

There are several challenges that participants may face. They range from additional costs, self-initiative and interdependence between the economic agents, to technical problems. On the other side, the systemic approach leads to adopting a two-sided approach based on economic and environmental interests.

3.8.1 ADDITIONAL COSTS

While industrial ecology may provide competitive advantage, in particular when it concerns exploiting resource efficiencies that contribute to cost leadership, and closing material loops; it may also lead to additional costs (Lifset & Boons , 2011:313).

It can be the case when the products are recycled and a waste management infrastructure needs to be settled. Moreover, tools such as 'Design for Environment' may lead to the development of products that require alternative business models and changes in consumer demand.

3.8.2 Interdependence Between The Actors And Demand For Self-Initiative

As shown before, such a systemic approach implies to fulfill certain conditions for self-organization (Lifset & Boons , 2011:315). In terms of industrial ecology, self organization would mean that firms voluntarily collaborate with each others and together increase the environmental sustainability of the system.

It requires not only the building of trust, but also of concrete organizational arrangements for knowledge exchange and availability of information about the supply of waste and potential uses within the systems. What is more, it calls for the existence of legal instistutions that allow contracts among private parties dealing with waste as well as other types of standard setting and monitoring (Lifset & Boons , 2011:314-315).

As a result, in order to solve their collective challenge which is to "contribute to increased environmental sustainability", industrial ecology is based on the coordination and interdependence of the activities of different actors, in terms of environmental concerns and economic value, as underlined by Lifset and Boons (2011:315). Industrial ecology depends thus on the self-initiative from different firms to engage in such exchanges, and not to jeopardize the whole model.

3.8.3 Unlikely Partnerships

As industrial ecology creates unlikely partnerships, such as between a fish farm and a power plant in the case of Kalundborg eco-industrial park, these networks of organizations raise new issues, among which:

- "How do we measure a firm's environmental footprint, as what one firm does cascades through the network?
- At what level do we optimize the environmental footprint—the firm or the network?
- How can we reduce the environmental footprint, given the complexity of the system?" (Hoffman & Bansal, 2011:17-18).

3.8.4 Technical Problems

An ultimate issue to reach a closed system is that many technical problems still exist. Some finished goods are impossible to decompose into the original raw materials that have been used along the process. For instance, during the re-melting process, zinced steel gradually loses its physical properties (De Guzman , 2010). Other elements are joined in such a way that they cannot be separated anymore (e.g. heavily coated metals).

Even if the material comes from nature and is biodegradable, McDonough and Braungart (2002) highlight that "it is often a subject of chemical processes that make it useless in recycling and not capable to being decompose properly". As it is shown in the previous section, through the supports of some tools, designing the process and/or product and incorporating environmental requirements from the beginning of the value chain are essential.

3.8.5 A DOUBLE INTEREST

On the other side, as underlined before, companies have become increasingly aware that managing and protecting their planet is protecting themselves as well. As a result, the concept of industrial ecology has a double interest: economic and environmental.

Focusing on reaching 'zero waste' emissions and improving resource efficiency, forward-thinking companies that explore industrial ecology will benefit from win-wins, or even from "synergistic multiple wins" (Hutchins, 2012):

As Harvard Business School professor M. Porter mentioned it, "pollution is simply waste: wasted resources, wasted energy, wasted materials"[25]. According to the latter, companies that can manage their waste will use their technology, raw materials and capital more productively. In addition to win-wins from reduced long-term cost, it will enable them to generate maximum value creation through innovation and collaboration across the business ecosystem to become more competitive in their market (Hutchins, 2012). By redesigning their process to use less energy and resources, such companies will indeed lower their exposure to volatile oil and gas prices (Esty & Winston, 2009:13).

As further developed in chapter 4, sustainable-driven companies mostly benefit from inspiring current employees and attracting new talented workers — those that are "more driven by values than paycheck" (Esty & Winston, 2009).

3.9 THE FUNCTIONAL ECONOMY

Combining industrial ecology and functional economy (also known as service economy) is fundamental to reaching a "sustainable growth". According to professor Dominique Bourg[26], it is indeed essential to develop industrial ecology. However, those exchanges would only save from 20% to 30% of the total resources (Bourg, 2008).

A study, *L'économie de Fonctionnalité: Vers un Nouveau monde économique durable* by Concorde Foundation, demonstrated that, in order to dissociate economic growth and natural resource consumption, and reach a sustainable growth, "the industries should also think in terms of functional economy: Move from a model based on the sale of a good to a model based on the use of a good". That is, they should produce fewer products and, at the same time, satisfy the overall needs. The functional economy is neither initially an ecological strategy, nor technological one. It is an organizational strategy, which consists in a form of change of the economic model (Bourg, 2008).

3.9.1 TOWARDS A SOCIETY OF SERVICES

As seen before, the traditional industrial system is facing new challenges that would inevitably lead to new changes: it is time to improve the industrial system. However, it should not be done through the production and sale of new products, but through the supply of **quality services**. In

[25] In Friedman T. L., 2009: 326
[26] In Fondation Concorde, 2010, and Bourg, 2008

other words, it is time to become a real society of services, where "an optimal use of the goods and resources would generate wealth"(Erkman, 2004:157).

As a result, instead of selling products, the functional system promotes the idea of **selling services**. The company remains the owner of the goods that it makes available to its customers, while its turnover depends on the use of its goods by its customers (Buclet, 2005). The user becomes indeed the economic agent, rather than the buyer-consumer.

3.9.2 Two Strategies To Support Functional Economy

The optimal use of resources and the supply of optimal service rely here on two strategies, developed by S. Erkman:

The strategy of sustainability — leads to a decrease in the speed of the resources flows.

The strategy of intensive use of goods — leads to a decrease in the volume of the resources flows.

The goal of those two strategies is to obtain a service with as little resources as possible per 'unity of use' (Erkman, 2004:160), e.g. it can be the number of kilometers covered for a car, the wash cycle for a washing or laundry machine, et cetera. The company's interest is not to sell as much as products as possible, but the most functional units. It is therefore fundamental for the material support of the service that the company sells to last as long as possible.

Strategy of Sustainability

This strategy consists in increasing the useful life of goods, which reduces the speed of the resources flows. It is important to note that the comfort for the user and the technological progress are still fundamental in the process. This strategy relies on four pillars (Erkman, 2004):

The prevention, which consists in designing products that, from the beginning, last a long time. Thanks to advanced technologies and design, there is no need to throw away the device once it is broken, just need to replace the part that is worn or out-of-date by the technology.

The maintenance, which extends the useful life of goods.

The utilization "en cascade", where the used goods are re-used for less demanding functions.

The resale services, which can be settled in order to increase the useful life of the goods and resources.

Strategy of intensive use of goods

This strategy is about selling the service, the satisfaction and the utilization, rather than the good itself. The consumer does not buy the plane or the autobus, but a journey, or the function of "photocopy", rather than the machine. This trend already exists in the actual economy, but it would need to be systematized, especially through a general implementation of renting services. For instance, a car is used on average one hour per day, and remains most of the time in its parking place. Such strategy promotes the idea that a same car could be used by several drivers, rather through the traditional renting process, or the "car-sharing" formula.

This strategy consists also in designing multifunctional goods. For instance, a device that offers fax/photocopier/scanners functions, as long as each of those functions are performed as well as with those traditional devices, which are bought individually.

SOME EXAMPLES OPTIMIZING THE STRATEGIES OF FUNCTIONAL ECONOMY

A real example would be the case of *Xerox*, which gave up producing new photocopiers and established instead a "strategy of remanufacturing", which optimizes the sale of a service, rather than the production of new photocopy machines. Instead of replacing the machines once they break and designing products with a limited useful life, i.e. so-called 'planned obsolescence', a functional system has been put in place by assembling different components, where the sustainability and intensity of the use of each is optimized (Sempels, 2001, and Erkman, 2004:157).

As a result, offering services rather than products to its end-customers combined with advanced technology has led Xerox to creating a very strong competitive position in its market (Reinhardt, 1999:57).

Another example developed by APESA, a French technological center in environment and cost control, would be *Michelin*, which has developed the approach of "pay the tire according to the kilometers covered"[27]. Michelin does not sell the pneumatic but sells the services provided by them, such as reinflation, maintenance of the sculptures and remolding when necessary. Nowadays the offer only concerns the trucking companies that own dozens of vehicles that are of the order of 10.000 km per year.

For the clients, it translates in a cost reduction related to a better exploitation of the pneumatics. As for Michelin itself, it means partially replacing a product (the pneumatic) by a service. The economic interest of Michelin is that the product lasts as long as possible, which is also interesting from an environmental point of view (APESA, L'économie de fonctionnalité, 2008).

More examples are developed in the book: Fondation Concorde, (2010), *L'économie de Fonctionnalité: Vers un Nouveau monde économique durable*, and the article of N. Buclet, *Concevoir une nouvelle relation à la consommation: l'économie de fonctionnalité*.

3.9.3 ECO DESIGN IS A 'MUST'

As cited above, one of the fundamental aspects of functional economy is the optimization of the length of the use of material resources, which diminishes the maintenance and increases the profitability of the operation. Functional economy implies that "eco-design" — redesigning processes and products to cut waste and pollution[28]— is a necessity and not a choice for the company anymore.

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[27] More details on the case of Michelin, see *Concevoir une nouvelle relation à la consommation: l'économie de fonctionnalité*, by Buclet (2005)

[28] Defined by Esty and Winston, 2009:298

It is a way to generate benefits and minimize resource consumption at the same time. As a result, companies attempt to improve the robustness of the product, to rationalize the maintenance, et cetera. (Bourg, 2008, in Briddle, 2011). It implies thus a new way of approaching innovation.

INNOVATION AND THE APPROACH OF FUNCTIONAL ECONOMY

At first, the sustainability of the product seems to go against innovation and technical progress, while both enable to develop products that consume less energy (Buclet,2005). Even though the sustainability of the products could lead companies to provide less new product lines, most of the new products of today are based on a small modification in the design and the optional functionalities. They are characterized as 'planned obsolescence' products— relatively short-term life products.

However, in functional economy, products are manufactured to last as long as possible. As a result, it is in the interest of the company producing such goods to innovate. According to Buclet (2005), such "innovation should, either reduce the price of the service (income distributed to the consumers), either increase the margin (income for the company), or a combination of both". In all cases, innovation reduces the costs of the use and maintenance of the products (Buclet, 2005).

The author, N. Buclet (2005) provides a list of how companies can reduce their costs and consider an approach of functional economy at the same time:

- Saving energy in the use of the good.
- Designing items integrated in the product in the most sustainable way.
- Replacing items at a lower cost of intervention.
- Designing the products in the idea that the modular format is standard, in order that an eventual technical progress (for instance in the sustainability of the product, or in reducing energy consumption) on the characteristic of a specific piece does not imply to replace the whole good, but only the unique piece.
- Imagining in advance the new functions of the service that the company can provide to the client.

Therefore, a constant policy of innovation is essential to reach those aspects of the functional economy cited above.

3.9.4 CONSEQUENCES FOR THE ENVIRONMENT AND ECONOMIC INTEREST

According to experts Buclet (2005) and Erkman (2004), those strategies would lead to a large decrease of material and energy consumption, especially in the field of manufacture and transportation (less in distribution), since the energetic and material investment of the beginning is longer preserved.

On the other hand, resource consumption will increase for the activity of maintenance and repairmen activities. However those activities consume much less energy, materials or infrastructures because they use resources already invested in the systems, the infrastructures and the existing goods (Erkman, 2004:166-167).

Moreover, more the company will decrease its resource consumption related to the manufacture and/or the use of its product (see the lists above of cost savings), more it will be competitive since it will be able to reduce the price of its services (Buclet, 2005).

Finally, the social aspect of sustainable development is also taken into consideration (Buclet, 2005). Among others, the resale services cited above must be developed and imply creating new qualified job, as of proximity to the clients.

3.9.5 CHALLENGES RELATED TO FUNCTIONAL ECONOMY

The authors, N. Buclet and D. Bourge, identify in their articles some key challenges related to the development of the functional economy:

- Putting in place a functional economy presumes, for many companies, to reinvent/create new jobs and reorganize their structure, their channels of distribution, and business model. Besides it requires having commercial sellers who have knowledge of the product lifecycle, understand environmental impacts, and are qualified to follow a relationship with their clients. As a result the initial investment is generally large, and it results in an important modification of the relation with the market.
- One of the main challenges of functional economy is the following: how to encourage the user to use the good, "with due care and attention"(Ed.: “en bon père de famille”). For instance, when an individual uses a car without being responsible of the maintenance, he/she may care less to preserve its sustainability.
- Functional economy can only be accepted and established if there are real changes in the behaviors, especially from the consumers/users. There can be some sort of reluctance not to be the owner of the good that they use anymore.
- An additional challenge of the development of functional economy is the necessity to enter in a much stronger relationship between the supplier — the owner of the good —and the client —the user. (APESA, L'économie de fonctionnalité, 2008)

Functional economy remains an experience that still needs to be proved. It is hard to know what are the limits, the possibility of applications, the real potential, in terms of resource consumption and waste production, et cetera., without experiencing it.

It is clear that the development of functional economy is going to disrupt our society, in terms of our landmarks and relationships between actors. However the challenges that our society is facing, in terms of climate change or waste management, are much bigger than what functional economy is putting us through, and are going to force individuals any way to modify their behavior, in particular in terms of consumption. As a result, changes, and the adoption of new principles are unavoidable. Functional economy seems to be a good alternative.

One could develop much more on the theory of functional economy. The book, “*L’économie de Fonctionnalité : Vers un nouveau monde économique durable”,* by the Concorde Foundation develops detailed definitions, examples and others on the approach of functional economy.

3.10 CONCLUSION

As a potential umbrella for all the individual firms' actions towards environmental challenges and performance, industrial ecology suggests a collective and systemic solution. Drawing its inspiration from the functioning of natural ecosystems, industrial ecology provides indeed a set of concepts and tools, which enable a systemic analysis of the environmental impacts of the industrial activities, and a view of the correlation between and within human activities and natural systems. The ideal goal of the approach is to reach a "mature ecosystem' — an integrated and closed system where energy and materials are constantly recycled and re-used. As S. Erkman said, "we cannot sustainable our life, without closing the loop".

In order to do so, voluntary collaboration and knowledge sharing between different economic agents, as well as mutual valorization of resources of each agent within the industrial ecosystem enable to reach collective solutions that lead to close the loop of the systems and improve the company's economic and environmental performances. The concept of eco-industrial parks and industrial symbiosis, a sub-field of industrial ecology, highlights this interrelationship of the participants and the interactions with the nature ecosystems.

Fundamental in the concept of industrial ecology, Life Cycle Assessment methodologies are promising tools that enable companies to identify and assess the environmental impacts of the product systems, as well as implement strategies to take up to those impacts. Regarding Life Cycle Design (LCD) and Design for Environment (DfE), such methodologies help companies integrate key environmental requirements directly into the design of their products and processes. They will prevent costly and damaging environmental mistakes, by integrating their footprint along the value chain.

Moreover they enable companies to use their knowledge to drive innovation, which is essential in the concept of industrial ecology. As Carl Pope, the former Executive Director of the Sierra Club, highliths on Innovation*, "All it takes is knowlegde*: Innovation around sustainable energy and resource productivity will lead to smarter materials, smarter design and therefore to a way out"[29].

Such systemic organizing framework leads to "synergistic win-wins", from reduced long-term costs to improved value creation. However companies may also face some challenges, in terms of additional costs, unlikely partnerships and interdependencies between different economic agents.

The concepts of industrial ecology and functional economy are complementary solutions to build systems that minimize the consumption of resources and energy. In order to reach a dynamic equilibrium in a world of increasing population and decreasing resource stock, combining industrial ecology with the functional economy is an optimal solution. A functional economy reveals to have a double interest, economic and environmental. Selling services rather than goods increases the useful life of the goods, and decrease the resource consumption. As a result, such

[29] In Friedman T. L., 2009:102

approach deals with environmental and resource constraints, but generates economic benefits as well.

The functional economy also implies collective actions. Such strategy separates the traditional roles of owner and user to form a society of services. As a result, it leads to new consumer behaviors and changes in the business model of companies, in order to optimize the use of the good and minimize resource consumption.

Finally, the concept of 'industrial ecology' is confronted to some limits and additional challenges than the ones previously underlined. First, it forces companies to completely, or partially, rethink the way they work. Secondly, such approach will work more efficiently if there exist geographical proximity between the "symbiosis" participants, which is not always possible. Finally, such process of industrial ecology efficiently works when the material and energy flows are important. It is the reason why such processes are often associated with industrial or activity zones. However a functional economy is the solution for companies that do not possess important material and energy sources, but generate large environmental burdens, such as Xerox or Michelin.

Based on the idea of business ecosystem, the following chapter, which deals with the value of stakeholders management, will stress the importance of interacting with and managing for all the firms' stakeholders (i.e. related business, consumers, suppliers and other external stakeholders). It will be shown that it ensures long-term growth and creates new value creation opportunities in the new Climate-Energy era which companies are heading to.

4 THE VALUE OF MANAGING STAKEHOLDERS

The previous sections highlighted collective and pro-active actions, and a systemic way of thinking in a sustainable development policy. They also reaffirmed the importance for firms to interact and forge new links with other firms and economic agents, which comprises the business ecosystem, in accordance with the natural environment. Hereafter we will focus more on one to the closest analogies of the business ecosystem: social ecosystem whose key point is the interdependence between each agent, not only other businesses, as demonstrated by forming partnerships between companies in the framework of the industrial ecology, but also all the stakeholders who influence or are influenced by the ecosystem.

Along this section, it will be demonstrated that a sustainable business is mainly the one that focuses on how the firm relates to its stakeholders. The importance of building the business model of sustainability-driven companies step by step by fostering sustainable relationships and effective collaborations with each of its stakeholders will be stressed.

The idea is not to present all the whole of the theory dealing with stakeholders, but to highlight the interdependence between each member of the business ecosystem of a firm, that the latter has to take into consideration. The notion of social ecosystem and some words on synergy will precede the section that presents the definition and the role of the different stakeholders. Finally, a section will explain the importance of managing a business for the stakeholders, calling on the stakeholder theory of E. Freeman, which rejects the shareholder theory of M. Friedman.

4.1 SYNERGY AND SYSTEMIC APPROACH

As previously seen, if they are to execute successfully their sustainability strategies, companies should adopt a broad, systems thinking approach to their business activities. We have seen that such approach could be applied through frameworks that play systemic perspectives and analysis. The concept of industrial ecology actually demonstrates the greater effect of this potential umbrella made of each individual strategies to reduce a firm's environmental impacts than acting individually, in term of economic and environmental performance.

In systems, the whole is primary, and the parts are secondary (Haines, 1998). Relationships and processes are what matters, not individual departments or units and events. Therefore, ***systems thinking*** also include forming effective partnerships and alliances with the firm's stakeholders, regulators and other influences, such as NGOs and Medias (MITSloan Management Review, 2009). Here, the idea is to create ***synergy***, defined by Haines (1998:52) as "the working together of two or more parts of any system, to produce an effect greater than the sum of the parts 'individual effects".

As it will be demonstrated in the next section, the impacts in terms of value creation are greater when companies attempt to identify and manage for their stakeholders and their requirements, and to create new value creation opportunities.

4.2 Interdependence And Co-evolution Within Business Ecosystems

Chapter 2 showed that business ecosystem is used as a metaphor for a dynamic system that describes the increasing complexity of relationships among all the members of the organization, of their ecosystems. We previously underlined that it is essential for companies to become proactive in order to develop mutually beneficial relationships with each member of the organization, i.e. customers, suppliers, lead producers, competitors and extended list of members (Moore, Business Ecosystem, 2005). Moreover, many authors have also emphasized on the features of *interconnectedness* and *cooperation* within the business ecosystems.

As previously defined, the business ecosystem is indeed an analogue of the ***social ecosystem***, which is characterized by a large number of interconnected entities that depend on, interact with, and influence each other. They are thus *co-evolving* with each other in an endless reciprocal cycle, which implies the interdependencies of all the entities of the ecosystems, and the idea that the evolution of one entity affects the evolution of another. As a result, they share the success or failure of the network as a whole (Moore 1993: 75, and Peltoniemi & Vuori, 2004:11).

4.3 The Stakeholder Theory

Along the years, the introduction of sustainable development, and the rise of global concerns towards the environment and social issues have led to changing mentalities and behaviors. Firm's managers realized that the shareholder theory of M. Friedman must be reviewed to be able to respond to those growing awareness, as well as local and global issues. Edward Freeman suggested a different approach, the stakeholder theory, which takes into consideration the interests of all the stakeholders of the firm, further normalized through the introduction of the international guidance of social responsibilities, ISO/FDIS 26000. The author also offered a different approach: moving from 'Corporate Social Responsibility' to 'Company Stakeholder Responsibility'.

4.3.1 From Shareholders (Friedman) To Stakeholders (Freeman)

Milton Friedman (1970) believed that businessmen who promote social conscience and take their responsibilities for providing employment, eliminating discrimination, and avoiding pollution are "unwitting puppets of the intellectual forces that have been undermining the basis of a free society these past decades" [30]. Their responsibilities are only to conduct the business in accordance with their desires, which, according to M. Friedman, are to make as much profit as possible.

Even those who agree with M. Friedman that the main "social responsibility is to increase profits" [31] cannot ignore their obligation to do more anymore, in "a voluntarily basis". As previously underlined, the aim is not just to tackle environmental concerns, but also for a whole set of social issues, such as poverty alleviation, education and healthcare (Esty & Winston, 2009:23).

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[30] See Friedman M. (1970), *The Social Responsibility of Business is to Increase its Profits*.The New York Times.
[31] Ibid

That is the reason why companies have been intensively focused on the framework of 'Corporate Social Responsibility' (CSR). Among the whole variety of definitions of CSR, which will not be developed here, the most widely recognized in academic literature, is the one of A. Caroll and A. Buchholtz in their book *Business and Society* (2008). They defined CSR as:

> "The economic, legal, ethical, and discretionary expectations that society has of organizations at a given point in time"

4.3.2 From Corporate Social Responsibility To Company Stakeholder Responsibility

Contrary to M. Friedman's shareholder theory, Edward Freeman (2006) offered a "creating value for stakeholders" approach, which seems to fit today's society more. According to him, capitalism is "a system of social cooperation—a system of working together to create value for each other, value which none of us could create on our own".

Therefore, companies should wonder how to make customers, suppliers, communities, employees and financiers better off. He went even further in considering that the term of 'Corporate Social Responsibility' does not fit with his approach, and that should be replaced with the idea of 'Company Stakeholder Responsibility', for:

- ***Company*** — signals that "all forms of value creation and trade —all business— need to be involved".
- ***Stakeholders*** — suggests that the main goal is to create value for key stakeholders.
- ***Responsibility*** — implies the interdependence of ethics and what we do in the workplace.

For more details on the principle of Company Stakeholder Responsibility, please refer to the article Freeman E. R. et al. (2006) *Company Stakeholder Responsibility: A New Approach to CSR*. The idea of creating value for stakeholders is further developed in the following section, *the managing-for-stakeholders approach*.

4.3.3 Definition And Classification Of A Stakeholder

E. Freeman has given the most quoted definitions of a 'stakeholder' in business literature[32]: In a wide point of view,

> "A stakeholder is any group or individual who is affected by or can affect the achievement of an organization's objectives"

In a narrower point of view,

> "A stakeholder is any identifiable group or individual on which the organization is dependent for its continued survival".

[32] See Rawlins B.L. (2006), *Prioritizing Stakeholders for Public Relations.* Institute for Public Relations

The second definition includes stakeholder groups, which have interests in the company, regardless the company's interest in them.

One stakeholder has unlikely the same interests in and demands on the firm than any other. As a result, when a conflict arises, it is important for the success of the company to prioritize each stakeholder according to the situation (Rawlins, 2006).

For instance, authors, such as B.L. Rawlings (2006) and G. Kassinis (2011), suggest that the managers prioritize conflicting stakeholder interests according to three key stakeholder attributes — *power*, *legitimacy*, and *urgency*. Kassinis (2011:85) emphasized, "the greater the combination of these attributes, the greater the group's importance to managers and, consequently, the more influential it is over firm decisions and outcomes".

Another widely used classification of stakeholders' criterion is the one that differentiates *primary stakeholders* from *secondary stakeholders* (Mullerat, 2010).

Primary stakeholders are those who have a direct interest or stake in the organizations — shareholders, customers, business partners, employees, suppliers, sub-contractors, communities, and natural environment.

Secondary stakeholders are those who have an indirect interest— public institutions, special interest groups, trade and industry groups, competitors, media, and governmental regulatory bodies.

4.3.4 ISO/FDIS 26 000

In 2010, international standard ISO/FDIS 26000 introduced guidance for social responsibilities, with the objective of maximizing the organization's contribution to sustainable development.

In order to reach such goal, organizations should respect seven principles. Along with the principles of 'transparency' and 'ethical behavior', the fifth one refers to the '**Respect for Interests of Stakeholders'**, i.e. "an organization should respect, consider and respond to the interests of its stakeholders" [33]. It also underlines that individuals or groups, other than owners, members, customers and citizens have specific interests that should be taken into consideration.

For more information on the principle, stakeholder identification, and engagement, which are central to addressing an organization's social responsibility, refer to the *Guidance on social responsibility* (ISO/FDIS 26000, 2010), from page 12 to 19.

4.4 Firm-Stakeholder Interactions And Value Creation

First of all, the approach of E. Freeman, 'Managing-for-Stakeholders', and the role of the stakeholder, as a co-producer in the value creation process would introduce the importance of

[33] See ISO/FDIS 26000, 2010:12

interacting and collaborating with their stakeholders to support collective and pro-active actions towards a sustainable development policy. Then, some of them will be further underlined.

4.4.1 MANAGING-FOR-STAKEHOLDERS APPROACH

"The very idea of managing for stakeholders is that the process of value creation is a joint process".

E. Freeman (2006)

As underlined previously through the approach of Company Stakeholder Responsibility, businesses, and the executives who manage them have become aware of the importance of managing all the stakeholders of a company, and that they should create value *for* them (Freeman, 2006).

Not only can they influence the practices of an organization by exerting pressure on them, but they can also impose costs (directly or indirectly). Stakeholders targeting firms due to their poor environmental record, for instance, NGOs, can indeed directly cost firms money (e.g. lawsuits leading to financial obligations on firms), or damage the firm's reputation from the point of view of investors, suppliers, customers, and potential employees; indirectly imposing costs on firms (Kassinis, 2011:84).

On the other hand, such '**managing-for-stakeholders'** approach enables firms to obtain enough knowledge that stakeholders will be more likely to share about their utility function, i.e. their preferences (Kassinis, 2011:85), so that their needs will be better met. This knowledge may give rise to *value creation opportunities.*

According to the author G. Kassinis (2011:85), given the importance of stakeholders, understanding their drivers may indeed allow firms "to modify their tactics and re-prioritize the allocation of resources to more effectively and efficiently stakeholder demands", which would contribute to creating new market opportunities and encouraging entrepreneurship, leading firms to value creation, and improved firm performance.

A real example could be the one of Royal Dutch Shell, a global oil and gas company, which has spent millions on countless meetings with local communities, regional governments, and populations. "The goal is to make sure that everyone who can seriously affect Shell operations is heard early and fully" (Esty & Winston, 2009:66). Shell took the fourth place in Forbes Magazine's annual ranking of the world's biggest companies 2012[34].

4.4.2 STAKEHOLDERS AS CO-PRODUCERS OF VALUE

According to the author, G. Kassinis (2011:90-93), "a firm and its stakeholders are all involved in the value-creation process, the resulting value being the outcome of a co-production process". In this process, the roles of the stakeholders are essentially "production" ones, which affect, positively or negatively, the improvement of firm performance.

[34] See Forbes Magazine (2012), in http://www.forbes.com/global2000/list/. Retrieved from May 14, 2012.

Mutual knowledge and trust between firms and their stakeholders over time will improve the likelihood of collaboration, which support in return the process of change, growth and value creation. Furthermore, status and reputation are also essential, given that they demonstrate the skills and trustworthiness of potential partners (Kassinis, 2011:94, and Russo and Minto, 2011). It represents quite a challenge considering that firms may face a multitude of conflicting stakeholder pressures and interests, and the complexity, diversity and heterogeneity that may characterize some stakeholder groups, which firms have to interact and build relationship with (Rawlins, 2006).

4.4.3 Firm-Stakeholder Relationships

The section broadly synthetizes key firm-stakeholders interactions, and their requirements in the framework of a sustainable development policy and of strategies to reduce firms' environmental impacts. It underlines the importance of the collaborations and interactions between each of the stakeholder groups, which have direct or indirect influences on the firm, and the latter in an organizational environment.

Interaction With Consumers

Over the last decade, there has been a real increase in consumer willingness to buy products that are considered as environmentally friendly. It seems that consumers would prefer to purchase products that use fewer scarce resources, are non-polluting, and are less harmful to the physical environment and people (MITSloan Management Review, 2009, and Gershoff & Irwin, 2011:366).

Consumers' growing environmentally interest and awareness have influenced firms' position and strategy. Satisfying their demands is indeed crucial for firms, given that these latter are very sensitive to the way customers perceive them. The reason is that customers are directly responsible for the firms' well-being and performance (Kassinis, 2011:90). They have the power to either 'reward', or 'punish' firms for their actions, including environmental-related ones.

Among other things, a firm's consumers can collaborate with firm' external stakeholders (e.g. NGOs, regulators, media) and target the firm if they are "unhappy" with its environmental performance record (e.g. through boycott). However, despite consumers' willingness for 'green' products, sales of those products often lag behind competitors, which offer less or no 'green' products (UNEP, 2005, in Gershoff & Irwin, 2011:366).

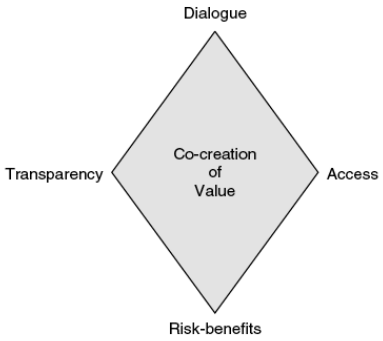
It is important to note that one of the reasons why consumers' interests may differ from their purchase behavior in terms of 'green' products is that many factors impede their ability to accurately evaluate the benefits of those products and associated costs (Gershoff & Irwin, 2011:367). For instance, the environmental benefits of buying a product with a "green" label may be difficult to observe. However Gershoff and Irwin (2011) point out that a customer-firm interaction, as described in the following, may increase the consumer willingness-to-pay for the firm's products or services— an important element of firm's financial performance. Moreover, it may also lead to increased customer loyalty, also crucial to financial performances.

Co-creation Experiences of Prahalad and Ramaswamy (2004)

In his article *Co-creation experiences: The next practice in value creation* (2004), C.K. Prahalad and V. Ramaswamy pointed out that, in the traditional conception of value creation process, consumers were "outside the firm". The firm and the consumers had distinctive roles of production and consumption, respectively. Interactions between companies and customers were not seen as a source of value creation. Nowadays, we have moved into a world where consumers are more knowledgeable and expect more transparency from the firms. Moreover, consumer-to-consumer communication and dialogue provide consumers with an alternative source of information and perspective.

According to the authors, "high-quality interactions" between the company and an individual consumer enable the latter to co-create personalized experiences with the company. Such interactions are the key to explore new sources of competitive advantage. As a result, co-creation is about jointly created value, by both the firm and an "informed, networked, empowered and active" consumer.

In order to build a system of co-creation value, managers should build blocks of interaction between their companies and consumers through Prahalad and Ramaswamy 's DART model.



- **Dialog** — interactivity, deep engagement and the ability and willingness to act on both sides
- **Access** to and **transparency** of information (no information asymmetry between firm and individual consumer)
- **Risk-benefits** of a course of action and decision

Figure 8: Building Blocks Of Interactions for Co-creation Value (Prahalad & Ramaswamy, 2004)

To conclude, the role of the company and the consumer converge. They become collaborators in co-creating value. Even more because companies must be aware that, as David Douglas, chief sustainability officer for Sun, told T. Friedman for his book (2009:387), "the best outgreening ideas often come from below—from those closest to the action".

Governments, Regulation And Tax Policies

In order to support and enforce the role of business in the sustainable development, it is essential that governments provide clear policies and regulatory frameworks on energy efficiency and fuel standards: such as a renewable energy mandate, or a cap-and-trade system. They also must set the right tax policies, such as carbon or gasoline tax, which will work as a **price signal** which the market will respond to (Friedman T. L., 2009: 297, and K. Gopalakrishnan (chairman of the BASD), in Esty & Winston, 2009:xv).

For instance, the ***European Union*** has put pressure on companies by setting a cap-and-trade system that indirectly taxes carbon emitters, and requires companies under the "extended

producer responsibility" engagement, to "take ownership of their products' environmental challenges throught the product life cycle"(Esty & Winston, 2009: xv). As the New York Times (2007)[35] emphasized: through a combination of high gasoline taxes, small cars and efficient public transportation, Europe has managed to restraint oil consumption.

Among other things, in order to simultaneously protect both the environment and human health, the Registration, Evaluation and Authorization of Chemicals (REACH) regulation in the European Union also forces companies "to evaluate the human health and environmental impact of a broad range of chemicals, and then track them throughout their supply chain"(Klassen & Vachon, 2011: 269).

For instance, thanks to European regulation, General Electric has become one of the largest actors in the clean power area, active into the third-generation innovation — i.e. wind turbines. Indeed, countries such as Denmark, Spain, and Germany have been imposing standards for wind power and offering long-term subsidies, leading to create a large market of wind turbine in Europe (Friedman T. L., 2009:304).

In the North America, states, provinces and cities are also involved and have created policies to adressing carbon emissions, encouraging green building and reducing waste. For instance, California and several Northeastern states have launched carbon allowance trading regimes as well (Esty & Winston, 2009:xv).

Moreover, the U.S. Securities and Exchange Commission (SEC) and the Financial Accounting Standards Board (FASB) as well as the European Union expect transparency from companies, and have required them more than to report on emission and pollution, but also to share information about their environmental performance and how it affects their finances (Esty & Winston, 2009:76). They should price their "externalities", such as pollution, waste and CO_2 emissions, in order to reflect the true risks and costs that companies face and create (Friedman T. L., 2009:309).

Such clear policies and regulatory frameworks are putting pressure on companies, stimulating the demand for clean power technologies, and Research & Development by companies and universities, as well as encouraging more investors to commercialize those innovative products (Friedman T. L., 2009:297).

While some companies still consider them as imposed costs, Michael Porter (1991) argued that appropriate planned environmental regulations and price signal could improve both the environment and the competitiveness of a firm, creating an environment that conduct to innovation, and leading to reductions in expenses and improvements in quality (M. Proter (1991), in Friedman T. L., 2009: 325-326, and 329).

[35] In Friedman T. L., 2009:105

Finally, companies that are proactively pursuing and expecting such changes and price signals will be less vulnerable to sudden regulatory changes (MITSloan Management Review, 2009). As mentioned in chapter 1, they will be better position to have a voice in shaping the policy rather than simply reacting to it.

PARTNERSHIPS WITH NGOS

As exposed in the Appendix 14, [*2007 Global Trust in Institution*, p 104], large environmental NGOs, such as Environmental Defense, World Wildlife Fund, Sierra Club, Greenpeace and plenty others have had a considerable influence and credibility towards the public that companies cannot ignore.

While NGOs can help firms create market opportunities for environmentally friendly investments, products or services (Kassinis, 2011:88), Esty and Winston (2009:71) pointed out that "a company without a plan or strategy for dealing with them runs a growing risk of getting dunked".

As a result, companies should rather create partnerships with influential NGOs than confront them. If they do not comply with laws and NGOs requirements, the risk of being sued for pollution or ecological harm is indeed very likely and very expensive, in terms of direct costs, but also for that it badly affects their relationships with others stakeholders, the reputation and image of the company (Esty & Winston, 2009:78).

For instance, in the mid-1990s, executives of consumer products giant Unilever realized that the supply for one of their product lines, frozen fish sticks business, was facing a big threat due to the world's oceans running out of fish. In partnership with World Wildlife Fund, the company set up the Marine Stewardship Council— "an independent body to promote sustainable fisheries around the world" — that certifies fisheries in order to limit the total catch. "As one of the world's largest purchasers of fish, it is in Unilever's commercial interest", said former Co-CEO Anthony Burgmans, "to protect the aquatic environment from fishing methods that will ultimately destroy stocks" (Esty & Winston, 2009:31).

PRESSURES FROM SHAREHOLDERS

Investors are more and more including companies' environmental strategy as a variable in their financial analysis (Esty & Winston, 2009:92). Launched in 1999, the Dow Jones Sustainability Indexes (DJSI) is the first global index to track the financial performance of sustainability-driven companies worldwide.

The recognition by important stakeholders, such as legislators, customers and employees — "leading to a better customer and employee loyalty" —, as well as public recognition, are part of the benefits for a company to be included in the DJSI. Most importantly, those companies benefit from "increasing financial benefit because of investment based on the index" [36]. Being a member of the DSJI demonstrates indeed the eligibility of the company.

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[36] See the website: *Dow Jones Sustainability Indexes (DJSI)*, in http://www.sustainability-index.com/ (2011)

For instance, in 2009, the Dow Jones Sustainability indexes named TNT Express the world's number one industrial Goods and Services company (including "industrial transportation") in terms of energy and environmental practices (TNT official Website, 2010). TNT earned the "highest score in two of the indexes dimensions – economic and social – and showed a score improvement in the environmental dimension"[37]. However, in December 2011, the company Olympus Corporation (Olympus) was removed for the regional Dow Jones Sustainability Asia Pacific Index due to the recent disclosure of a long-term accounting scandal at the company (DJSI,2011).

Other management infrastructures such as $FTSE_4$Good Index Series (FTSE), Ethical Investment Research Service (EIRIS) or Sustainable Asset Management (SMA) are infrastructures settled down to identify companies that are more environmentally responsible (Esty & Winston, 2009:92). According to Niall Fitzgerald, chairman of Reuters, "these rankings will matter more and more […] because people will understand that if you don't operate responsibly wherever you are, your ability to operate in those places will diminish"[38].

Pressures From Financial Industries

Following tenacious NGOs movements and bad public opinions on the environmental or social risks of projects, which they lend money for, banks have realized that the risks to the their reputation is even more threatening than default risk (Esty & Winston, 2009:95). As the Rainforest Action Network, an environmental organization, noted, "influence those who hold the purse strings, and you don't need to force change directly on companies creating the problems"[39].

As of today, the banks attempt to invest more in sustainable-driven companies or projects, or to convince companies to take their responsibilities (Vaxelaire, 2011). Among different initiatives from banks, 10 global banks including Citigroup, Credit Suisse and ABN AMRO (in October 2009; 67 financial institutions joined the agreement) announced, in 2003, a financial industry benchmark: "The Equator Principles"[40]. It consists in a set of new standards for how banks should make decisions about project-financing loans, and for determining, assessing and managing environmental and social impacts in such area.

The voluntary agreement requires proving that those impacts have been considered when developing the project. Projects, such as a pipeline in Peru, or a mine in Romania, can therefore be rejected, abandoned or modified, because environmental considerations were not taken seriously (Esty & Winston, 2009:95).

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[37] See *TNT on top of the Dow Jones Sustainability Index for third consecutive year*, in http://www.tnt.com/express/en_nz/data/news/tnt_on_top_of_the.html (Posted: Thursday, 3 September 2009)

[38] In Esty & Winston, 2009: 92

[39] Ibid: 95

[40] See The « Equator Principles » (revised version of 2006) can be found at http://www.equatorprinciples.com/

EMPLOYEE INTEREST

While companies want committed employees, employees want companies which they can commit to (Esty & Winston, 2009:90). According to a Stanford Business School's survey, "97 percent would forego some salary (on average $11 480 per year or 14 percent of their expected income) to work for a company that cares about employees, stakeholders, and sustainability"[41].

In addition to that, Monster.com (one of the largest employment websites in the world) found, in 2008, that 92 percent of undergraduate students they surveyed "want to work for a green company". Indeed, they more and more choose their employers according to the values of the latter (Vaxelaire, 2011).

How employees perceive a firm's actions is also critical for a firm's success. G. Kassinis (2011:91) believes that given that "increased employee awareness leads to improved individual behavior and practices", if the company wants to transfer knowledge regarding best practices and adopt those practices, which improve firms' environmental performance, employees must be at the heart of the firm's organizational efforts.

Therefore, managing employees' needs is more than "downside risk reduction and cost control", but "potential upside benefits in increased productivity, lower turnover, and inspired employees" (Esty & Winston, 2009:91). Individual engagments from the employees are further developed in chapter 5 (5.2, p 64).

SUPPLY CHAIN STAKEHOLDERS

Environmental and social concerns have real impacts on the entire supply chain, which is becoming relevant units of analysis and changes (Hoffman & Bansal, 2011:17). The latter has been defined by Benita M. Beamon (1999), as "complex networks of firms — from raw materials, to components, to logistics, and other services — that collectively provides a particular good or service to consumers or end-users"[42].

As a result, while we expect buyers to insist for their suppliers to meet more severe environmental standards, firms' multiple suppliers and external stakeholders (regulators, competitors, and NGOs) also seem to put pressure on their customers. According to Klassen and Vachon (2011:270), they are the key drivers of supply chain management practices that incorporate sustainable dimensions. This is what is called "greener supply chain management", which defines as, "a strategic and transparent integration of material, information, and capital flows to achieve environmental and economic objectives through the systemic coordination of key inter-organizational business processes".

The Appendix 15 [*Greener supply chain management*, p 105] defines the different steps to achieving such supply chain.

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[41] In Esty & Winston, 2009:90

[42] In Klasson & Vachon, 2011:270. See her book, *Measuring supply chain performance,* Ohio : International Journal of Operations & Production Management

An example would be the one of Wal-Mart (Esty & Winston, 2009:xiii), which has put pressure on its 70.000 suppliers, in order to reduce their waste and fossil fuel use. They even ask their suppliers to fill out detailed "scorecards" on their packaging, energy use and carbon footprints. Moreover, due to growing recognition, and concerns about the vulnerability of their supply chain, the company has even set its own environmental standards for some of its products, such as toys.

Additional Key Stakeholder-Firms Interactions

In brief, additional interactions include:

Competitors — According to Esty and Winston (2009:84), it is imperative for companies to keep an eye on their competitors. Indeed "one company's leadership and bold action can change the competitive field, sometimes in dramatic cays".

Rising Media Attention— An increasing numbers of business publications have given a particular interest in sustainable development, in particular, business-environment attention. Plenty of them have produced many high profile cover stories and have had special sections on green business (Esty & Winston, 2009:xiii). As a result, companies must really pay attention in how they operate. Media will be looking for stories where business claims their so-called environmental or responsible interests. However for those, which have legitimate and certifiable sustainable stories to tell, then the interested audience will be greater.

Local Communities — Conversations with local communities are now a business imperative. It is vital for companies to engage local communities, before, during and after any geographically expanding operations. (Esty & Winston, 2009:89).

Finally, a survey launched by MIT Sloan Management review led to the conclusion that improving their sustainability-related communications with the stakeholder groups, such as employees, senior leadership, government and regulators, investors, shareholders and/or capital providers, and mostly consumers would deliver the greatest benefits to the organization (refer to Appendix 16 [*Stakeholder groups and improvement of sustainability-related communications*, p 106]).

4.5 Conclusion

In our evolving and dynamic world, the set of players that affect a firm's business model is growing in numbers, diversity and power. As a result, sustainable-driven companies must carefully consider each of their stakeholders, not only their customers and shareholders, but also the whole range of stakeholders that can have direct or indirect influence on the companies' activities.

As previously underlined, companies should adopt a systemic approach, in which all the actors of the system interact with each other, and create synergies by forming effective partnerships with the firm's stakeholders within their business ecosystem. By developing mutually beneficial relationships and knowledge, they would share the success and the failure as a whole. Such perspective would indeed enable companies to understand the relevant issues and evolving needs of each of their social actors.

As co-producers in the process of value creation, the firm's stakeholders can indeed directly or indirectly affect the firm's performance and its ability to create value. Stakeholder theory and the managing-for-stakeholders approach actually argue that meeting the needs of the firm's key stakeholders optimizes firm performance, leading to a "win-win" relationship.

When addressing sustainable development, whether a company responds or not to stakeholders' requirements may generate costs for the firms; through tax policies and other price signals from the governments or local authorities, for example. Damages in terms of corporate reputation from media and non-governmental organization (NGO) campaigns or boycott, shareholder expectations and changing customer preferences can also have large negative impacts. However, it might also generate a set of new opportunities for companies. For instance, it can lead to the recruitment of new talented and productive employees, the launch of environmentally-friendly products, as well as the pursue of long-term growth, innovation and technical progress to drive to a sustainable development, et cetera.

Forward-thinking companies that consider such potential risks are already seeking new and preventive approaches to mitigate the impacts of their operations on the environment and the society. They attempt to shape any regulatory regime rather than face them later, as well as they inform their public about the efforts put through in order to reduce the problems associated with any environmental pressures, pressures from local communities or non-governmental organization and media.

Among other things, such companies form partnerships and alliances with critical group influence, such as NGOs, regulators, communities, and even other companies, as in the framework of the industrial ecology, in order to jointly develop innovative solutions. Thomas Friedman (2009:358) defines it as a 'system of cooperation', "It takes an ecosystem of the right government policies, the right investments and the right actors to save an ecosystem of plants, animals and forests".

As a result, it would help the firm reach greater positive outcomes, in terms of the environment and the economy, while taking heed the third, social, pillar.

5 LEADERSHIP AND COMMITMENTS FROM BUSINESS LEADERS

"Visionary leadership encourages extra effort, which translates into improved firm performance."

Kassinis G. (2011:91)

As demonstrated in Appendix 17 [*the most important organizational capabilities in terms of addressing sustainability*, p 106], corporate responsibility, jointly created value, pro-active and collective approaches such as the industrial ecology, and sustainability agendas and strategies demand growing commitments from senior business leaders.

First of all, the present chapter explores the theory of the Simon Sinek's golden circle of 'inside-out' communication, and the difference between those who lead and inspire, and those who do not. Afterwards, James Moore's first definition of business ecosystem, which insists on the role of a leader within the ecosystem to enable the members to move towards a shared vision will be further developed. Lastly, it will lead to underlining the role of top-managers, and their commitments towards their sustainability-driven actions as well as the engagement of the employees by those top-managers to reach greater results.

5.1 'WHY' TO ADDRESS SUSTAINABILITY AND ROLE OF LEADERSHIP

Simon Sinek's golden circle[43] shows that everybody knows *what* they do, *how* they do it, but few people know ***why*** they do it. Such idea refers to the purpose of employees' actions, their believes, and why their organizations exist, which differentiate those (individuals or organization at large) who lead and inspire from those who do not.

The fact that a company addresses sustainability in its business leads to great changes, which translates in terms of reputation and image. It also translates in financial improvements, if their customers, suppliers, employees and other external stakeholders understand the purpose of their sustainability-driven actions, as well as if those looking forward companies communicate from inside-out (i.e. they should start from why, then how, and finally what, not the opposite around).

Those who lead and have the ability to inspire others play an essential role in aligning their employees' and others stakeholders' values with those of the company, in attracting and informing consumers, and other external stakeholders that can have direct or indirect impact on their business. Indeed, according to the latter, "the gold is to do business with people who believe what we believe. (…) People buy why we do, not what we do".

"The role of leadership is to invent actions that naturally have the consequence of transforming people's thinking", said Chris Gibson-Smith, BP Amoco's executive director for policy and technology. In other words, according to Packard and Reinhard (2000), confronting challenges such as climate change will stimulate the company's employee to think more imaginatively. As

[43] See Appendix 18 [*Golden Globe of S. Sinek*, p 107]

developed further, they may become more committed to their jobs and to the company, even more if the employees see their values reflected in the company's goals.

5.2 The Importance Of A Leader Within Business Ecosystem

In fast changing and dynamic environments, leaders are essential for companies to adapt to continuous waves of innovation and change within their business ecosystem. They also play a crucial role in driving positive outcomes over the long term, and successfully implementing any initiatives, such as environmental ones, and a shared vision, because, according to Berry and Rondinelli (1998), "proactive environmental management requires a champion, success depends on securing the backing of top management"(Friedman T. L., 2009, and Russo & Minto , 2011:34).

By essence, the role of an executive is indeed to develop new ideas and tools for developing new strategies, and making the right decisions when it comes to innovation, business alliances, pressures from customers and suppliers, etc. (Moore, Predators and Prey, 1993).

5.2.1 CEO's Conviction And Authenticity In Sustainable Development

When worldwide group such as General Electric (GE), DuPont, Interface or Wal-Mart Stores incorporate sustainability challenges into their business model, it is usually due to their CEOs (Elkington & Love, 2011:642).

Their decisions and plan of actions are usually influenced either by the fact that their industries have been exposed to issues such as climate changes (as in the case of DuPont, American chemical company), or by the fact that the CEOs have perceived new opportunities into those challenges (as in the case of GE when CEO Jeff Immelt announced the company's new initiative called "ecomagination, in 2004"[44]). But it may also be that they decided it is time to act (as with Interface Inc., "worldwide leader in design, production and sales of environmentally-responsible modular carpet"[45], and Wal-Mart (see 5.2.2., p 64)). The Interface founder, Ray C. Anderson, once said, "I had a revelation about what industry is doing to our planet. I stood convicted as a plunderer of the earth. In the future, people like me will go to jail"[46].

Once top managers are convinced with sustainability-driven actions and align their own values with those of the company, then such policy of change can be an integral part of the firm's strategy and lead to sustainable results (Vaxelaire, 2011). Therefore a company will not *do* sustainable development but incorporate it plainfully within and outside the company.

Moreover because "growing awareness of environmental issues can lead to improved practices", translating the vision for change, and aligning employee's interests with this vision are critical (Russo & Minto, 2011:34). Therefore, the role of a proactive senior leadership about such environmental issues is to signal the importance of the natural environment for business

[44] See GE's website on Ecomagination, http://www.ecomagination.com/

[45] See Interface Official website, in http://www.interfaceglobal.com/ (Retrieved 18/05/2012)

[46] In Elkington & Love, 2011:642

operations, to translate environmental challenges into opportunities, as well as to shape the norms and values of employees related to the environment.

5.2.2 ENGAGING INDIVIDUALS

Commitments of senior management could also actively encourage ideas that emerged from lower level of the organization, as well as influence others in the top management to take more pro-environment actions, for instance (Russo & Minto, 2011:34). It appears indeed from Russo and Minto's paper (2011:34) that firms which have one or more individuals with specific responsibility for the environment have higher levels of commitment to improvement.

Top managers of sustainability-driven companies should actually involve their employees further. As a result, it will solicit employees' input, and creativity as well as drive innovation (Werbach, Strategy for Sustainability, 2009:129). As we mentioned before, "the best outgreening ideas often come from below — from those closest to the action", rather we refer to consumers or employees. Indeed A. Werbach (2009:188) believes that "engaging a workforce in a strategy for sustainability is an innovation strategy".

"All of these initiatives will make us a mire competitive and innovative company".

Wal-Mart former CEO L. Scott, (in Esty & Winston, 2009: 7)

The largest employee sustainability project is likely to be Wal-Mart's *Personal Sustainability Project* (PSP) (Esty & Winston, 2009: 230-231, and Werbach, Strategy for Sustainability, 2009:129-136). First of all, since 2005, Wal-Mart former CEO Lee Scott (from 2000 to 2009) has demonstrated his commitment to improve the company's environmental performance. He established goals such as cutting energy use by 30 percent, using 100 percent renewable energy, as well as improving resource productivity and eliminating waste across the supply chain.

In addition, they assumed that "if we could learn how to help individuals become personally sustainable, then we might also learn how to affect the two hundred million of people who regularly shop at Wal-Mart in America"[47], said L. Scott. They first started by identifying daily practices that could express an individual's values and integrate sustainability in their own lives. That is small actions that are not only good for employees, and the organization, but also for the planet (e.g. from preparing a family dinner once a week to serving vegetables and turning off the TV to carpooling and helping local schools building a recycling program).

Those "personal sustainability practices" have drawn every employee into the company's sustainability project and help drive engagement at work as well. It drives innovation, and greater well-being for both employees and company. Thanks to its commitments, and transparency towards its activities, challenges and engagements, Wal-Mart has become an example in addressing sustainability. "For us, there is virtually no distinction between being a responsible

[47] In Werbach, Strategy for Sustainability, 2009:132

citizen and a successful business; they are one and the same for Wal-Mart today" said L. Scott (Esty & Winston, 2009: 29)

5.3 CONCLUSION

Through his golden circle, Simon Sinek emphasizes the idea that companies that or individuals who know *why* they perform such actions or strategies will be those who lead and inspire. In terms of performance and commitments from their stakeholders, the idea is even greater for sustainability-driven companies: it leads to some severe cultural and organizational changes, as it is the case in the frameworks of the industrial ecology or the functional economy.

The sincere commitments from CEOs and managers, as well as engagements from individuals underline the importance of individual and collective awareness in the attitude and day-to-day behaviors of those actors. The role of those business leaders is indeed essential: if there is a great coherence between the values they proclaim and their behaviors, the adoption of such sustainability-driven actions will be less difficult and more credible.

Finally, as demonstrated with Wal-Mart's employee sustainability project, aligning the values and objectives of the company with those of their employees will result in increasing employees' productivity and creativity, as well as driving innovation and engagement, in their personal lives and at work. A. Werbach (2009:188) believes that "engaging a workforce in a strategy for sustainability is an innovation strategy".

6 ACTUAL CASES

The two following cases are interesting in order to both illustrate what has been said so far and possibly add some theoretical characteristics.

The first case develops the overall analysis of the closing loop systems illustrated by the example of an industry having a significant impact on the environment: cement production. For years, the cement industry has indeed been setting up initiatives and policies to integrate the concept of industrial ecology in its day-to-day management, in order to attempt minimizing its environmental footprint and respond to changing business context.

Secondly, facing severe challenges, in particular in the debate of plastic bottles and tap water vs. mineral water, as well as growing pressures, Spadel Group has modified its business strategy along a real 'policy of change', with each of pillars of the sustainable development in mind. It also managed to interact and hold dialogues with its stakeholders to identify new value creation opportunities.

6.1 CASE OF CLOSING-LOOP SYSTEMS WITH HEIDELBERGCEMENT BENELUX

CBR Cement— one of the three subsidiaries in Belgium of the HeidelbergCement, the leading international building materials group — has been committed for years to industrial ecology through distinctive policies and initiatives to minimize its environmental impacts, and meet increasingly severe European legislations. When addressing sustainability, it was particularly interesting to analyze an industry, which is, along with the mining, steel, petroleum and petrochemical sectors, one of the most polluting ones. In the following, an overall presentation of the initiatives and policies of CBR Cement to reach a closing loop system in their manufacturing process is undertaken.

To begin with, a brief introduction of the HeidelbergCement international group can be found in Appendix 19 [*Presentation of HeidelbergCement Group*, p 108].

All the information came from the official website of HeidelbergCement Benelux, and CBR's policy of eco-responsibility. The company's sustainable development reports from 2005 to 2010, and a paper from *Business and Society Belgium* on the industrial ecology and the example of HeidelbergCement (Feb, 2012) also helped elaborating the case study. Special thanks must be addressed to Pascale Wauters, Corporate Communications Manager of HeidelbergCement Benelux and Alexandre Dulière, Eco-responsibility advisor of CBR Cement, for having agreed to answer all my specific questions.

6.1.1 COMMITMENTS TO INDUSTRIAL ECOLOGY: HEIDELBERGCEMENT BENELUX AND CBR CEMENT

HeidelbergCement Benelux's strategy results from its determination to act as an *eco-responsible* producer in the building materials sector in order to fulfill its social, environmental and economic responsibilities in a comprehensive and integrated manner. As demonstrated in Appendix 20 [*HeidelbergCement Benelux*, p 108], HeidelbergCement Benelux is present all over Belgium and

The Netherlands since the 1980s, and in particular in Belgium through its three subsidiaries, **CBR** (cement), **InterBeton** (ready-mix concrete), and **Sagrex** (aggregates).

In the analysis, the focus will be on *CBR Cement's activities committed to the concept of industrial ecology* through its policy of using alternative fuels and raw materials, provided from waste and by-products. The former originates either from their own waste recovery process, or from other industries. The latter is used as new inputs for its own industry in order to close the loop in their production process.

What is more, following a Life Cycle assessment (LCA) analysis to conduct to an Environmental Product Declaration (EPD), the additional impacts of CBR's activities on the environment — atmospheric releases and transport — and their solutions to take up to those challenges will be further presented. It will be complemented with a review of the European objectives, and the requirements from an environmental management system (ISO 14001), which CBR must take into consideration. Some additional remarks and constraints to reach a mature ecosystem will be finally developed.

As part of their policy of eco-responsibility, HeidelbergCement Benelux attaches also great importance in dialogue and exchange with its stakeholders in order both to integrate, understand and answer their requirements, and to be transparent regarding their activities, and initiatives. In Appendix 21 [*Stakeholders of HeidelbergCement Benelux*, p 109] the list of all their stakeholders and different examples of their commitments towards them can be found.

Life Cycle Assessment (LCA) and Environmental Product Declaration (EPD)

CBR applies **the EPD methodology** that is based on the **Life Cycle Assessment methodology** (ISO 1440) to its 18 types of cement. According to Cembureau (2008), the European Cement Association, ISO/TR14025 defines an EPD as a norm that gives "verified (by a peer group) quantitative information on a number of standardized environmental effects" of the product through all the stages of its manufacture, use and disposal[48].

As schematized in Appendix 22 [p 111], for intermediate products such as cement, they adopt the approach of 'cradle-to-gate', which only includes the stages from mining the raw materials — natural stones and formations like limestone, clay and mineral aggregates — to manufacturing the intermediate product (excluding the effects of transports, final use, repair and disposal). However it does include the products that are purchased by the cement industry, and the several types of wastes — mainly hazardous ones — produced by the latter.

Therefore the environmental impact of cement is only a part of the total impact as the cement is incorporated in many products, such as concrete. As developed further, industrial waste or by-products can be used as alternative fuels and raw materials in the cement industry, as it is the

[48] See Appendix 22 [*LCA analysis and EPD parameters,* p 111] to have an idea on the environmental effects that an EPD is taking into consideration

case for CBR's activities. An EDR takes into account the beneficial contributions of such alternatives to the environment.

Such certification will allow CBR to assess the environmental effects of their products and to communicate on them with their customers in order, then, to be able to conduct their own analysis. The idea is to form a partnership with their clients so as to find collective and efficient solutions in order to reduce the environmental impacts of the whole building process. The first LCA analysis was conducted in 2007, and finalized in 2010. The next one will take place in 2013. It will thus take into consideration the company's initiatives in term of environmental efficiency.

The Use Of Alternative Fuels And Raw Materials

For information, as schematized in Appendix 23 [p 112], the manufacturing of cement follows three steps (Cembureau, 2008):

- The extraction of the raw materials in the quarries.
- The manufacturing of clinker — cement base constituent — combining at a very high temperature with a mixture of four mineral elements (CaO, SiO_2, Al_2O_3, Fe_2O_3).
- The cement is then produced by grinding the clinker, calcium sulfate, fly ash, or slag.

As demonstrated in Appendix 24 [*Breakdown of sources of emission of CO_2*, p 112], the manufacturing of cement consumes **large quantities of non-renewable materials** (mineral and fossil fuels), and is also an **important source of CO_2 emissions** (5% of global CO_2 emissions (Lafarge, 2012)). In response to those environmental challenges, CBR Cement, which produces and commercializes approximately 3.2 million of tons of cement a year, has committed to industrial ecology by adding value to waste thanks to its policy of using alternative fuels, also derived from biomass (from 18% in 2007 to 30% in 2010), and alternative raw materials, sourced from industrial waste and by-products.

It has a double interest: economic and environmental. It reduces CO_2 emissions by minimizing the use of primary fuels (coal, oil, etc.) and non-renewable natural raw materials. Moreover, it results in a system of energy recovery and reduction in energy costs, by limiting its dependency on traditional fuels.

1. CBR and Recyfuel

The temperature of a cement kiln, a thermally insulated oven, varies from 1450 to 2000 degrees Celsius, which represents an intensive heat requiring large amounts of energy. In order to reduce their consumption of non-renewable fossil fuels, **the use of alternative fuels** is very well integrated in their production processes: used tires, animal meal, sewage sludge or sawdust[49], provided, among others, by its **Recyfuel**. The latter is a waste treatment for hazardous waste. A brand new plant was commissioned in 2010. Its technology is unique in Europe and co-managed by CBR and Sita (Suez Environment Group).

[49] See Appendix 25 [*CBR's use of alternative fuels,* p 113]

In three of the four production plants of CBR located at **Lixhe** (Liège), **Antoing** (Tournai) and Harmignies, which respectively produced 1.2 million tons of clinker, 688,481 tons of clinker, and 157,079 tons of white clinker in 2010. 55% of their average energy needs are covered by alternative fuels, mainly provided from *Resofuel* (impregnated sawdust) and *fluff* (plastic waste tires), both produced by Recyfuel.

By 2015, CBR's objective is to reach 64% of its energy needs covered by alternative fuels (see Appendix 25 [p 113]) for which 37% would come from biomass — biomass has the advantage to be "climate neutral", and can be bought locally.

2. Alternative raw materials from by-products of other industries to CBR

Clinker is the main constituent of cement, and is obtained by heating a mixture of approximately 80% of limestone and 20% of clay at very high temperature, which generates large amounts of CO_2 (Lafarge, 2012).

Fly ash (from coal-fired power plants) and **blast furnace slag** (from the steel industry) are by-products generated by other industries, which have the same hydraulic compulsory properties as clinker (Lafarge, 2012). As a result, they are used as alternative raw materials for CBR's cement production to reduce their clinker content in the cement. This will, as consequence, also reduce the consumption of natural, non-renewable raw materials (limestone), the energy use for the production of clinker and the levels of CO_2 emissions. At a European level, the cement industry targets a clinker content of maximum 79%, while CBR has already reached 62% since 1990.

To obtain the blast furnace slag, CBR has contracts with local companies, such as *Arcelor*, located at 500 meters from CBR Gent, and *Tata Steel* in IJmuiden (in the Netherlands, close to ENCI, Dutch subsidiary of HeidelbergCement). Regarding the fly ash, CBR Lixhe has contracts with *Eon*, the Belgian coal-fired power plant located in the harbor area of Antwerp. It benefits thus from water-facilities at the port. It also enjoys contracts with *VliegasUnie* (in the Netherlands). On average, 60% of the fly ash that they purchase is produced locally.

3. CBR and Eternit

Among the **alternative raw materials** used in Antoing plant, some of the waste is also provided by **Eternit**, market leader in roofing and façade products in Belgium[50]. Its plant of Kappelle Op den Bos produces materials for roofing and façade, such as fiber-cement, consisting of 75% of cement and 25% of cellulose. In order to reduce its environmental impact and minimize the production of final waste, Eternit has developed a series of processes to re-use waste of cement recovered at all stages of the lifecycle of its products.

Parts of the solid wastes from the production of fiber-cement are first transported to an external site where they are crushed and reduced in small pieces. Then everything goes directly to the Antoing plant for the production of clinker as they have similar chemical compositions. Eternit provides 6000 tons of fiber-cement waste per year to CBR, leading the company to significantly

[50] More on Eternit, see http://www.eternit.be

reduce its use of non-renewable natural raw materials. As of today, only the waste from Eternit has the quality required to power the production process of CBR.

Reduction Of Atmospheric Emissions

After greenhouse gas, the second most important environmental issues that the cement industry faces is **atmospheric releases** (primarily of NOx, SO_2), and dust for which the exposure leads to healthy and safety issues relating to workers and community.

Illustrated in Appendix 26 [*CBR: Monitoring atmospheric emissions*, p 114], CBR has developed continuous emissions monitoring devices and regular maintenances to reduce those emissions and respond to strict regulations and systematic controls. As a result, in 2010, CBR stood under the authorized limits of emissions set by the European directive IPPC (Integrated Pollution Prevention and Control). Among others, thanks to the establishment of Selective Non-Catalytic Reduction at Antoing, Lixhe, and Harmignies, a method using amnomia reagents, CBR will reduce NOx emissions by 30% as soon as 2015 in comparison with 2009.

Optimized Transport

Cement is essentially transported by road. Although they estimated that each boat is the equivalent of 11 trucks, potentially leading to an economy of 1.600 journeys per year. Transport by water being the ideal environmental solution, CBR encourages this means of transportation to its customers that are located along waterways, as well as for the delivery of its raw materials.

As schematized in Appendix 27 [*Origins of Raw Materials and Alternative fuels*, p 115]**,** most of the raw materials for the manufacturing of cement are produced very close to the production sites. In 2006, the remaining was delivered by boat (54%) or by road (46%). Only 35% of raw materials and fuels for clinker production are transported by boat either due to strict environmental legislation, or for other reasons (no river roads or too short distance) (CBR-InterBeton Environmental Report 2007).

Since 2011, as part of the project of 'Build over Water', and 'Regionale Watergebonden Distributiecentra' of the Flemish Institute of Mobility (VIM), both CBR (in particular the production site of Lixhe) and Eternit deliver their goods at a loading dock, these latter being further transported by river to the distribution center, where customers will collect their order.

European Objectives and ISO 14001:2004

CBR Cement is part of the **Emission Trading System (**EU **ETS)**. This European Union policy has developed key tools since 2005 to reduce industrial greenhouse gas emission, and help meeting the target of 8% below 1990 levels under the Kyoto Protocol in order to combat climate change in a cost-effectively manner (European Commission, 2010). Based on the cap-and-trade principle, it covers and limits the greenhouse gas emissions that can be emitted by factories, such as those making cement, power plants and other installations (e.g. combustions plants, oil refineries, et cetera.). The companies receive "emission allowances" (one allowance equals one ton of CO_2), which can be sold to (in case of surplus), or bought from one members of the system.

Moreover, by definition, **ISO 14001** (revised in 2004) has been a reference for HeidelbergCement in order to provide a "framework for a holistic, strategic approach to the organization's environmental policy, plans and actions" [51]. Indeed, ISO 14001 is a standard related to environmental management systems (EMS) that assists companies in "meeting and continuously improving their environmental and economic performances, whilst complying with any application legislation" (ISO 14001, 2011).

Meeting those requirements for such an EMS provides *external stakeholders* (such as customers, community and regulatory agencies) with some kind of insurance that the organization is developing organizational processes and activities that make up for their impacts on the natural environment. It also ensures *employees* to assure that they are working for an environmentally responsible organization. Finally, it requires and assures a commitment to compliance with *environmental regulations and legislation* as well as a commitment to continual improvement (ISO 14001, 2011). Today all the CBR plants (100%) are certified ISO 14001.

Additional Initiatives and Remarks

1. Environmental Efficiency

In 2005, 1 739 438 tons of non-renewable raw materials were saved due to the use of alternative raw materials, largely from fly ash and blast furnace slag. In 2006, the substitution rate accounted for 52%, a small increase compared to 2005[52].

As a result, as exhibited in Appendix 28 [*CBR's evolution of CO_2 emissions*, p 116], thanks to its strategies of optimization of the production process, and its policy fostering the use of alternative fuels and raw materials, CBR has reduced its CO_2 emissions per ton of cement produced by 21% over the last 20 years.

Among other things, as underlined in Appendix 21, their initiatives toward the protection of biodiversity reflects their goal to protect natural ecosystems, and therefore the human health, depending on the health of other components of the ecosystem. It also enables CBR to modify its image, which is often associated with a "destructive industry", said Mrs. P. Wauters.

2. Economic matters

Before CBR managers realized that it had a positive impact on the environment, this policy encouraging the use of alternative fuels and raw materials, such as animal meal or slag, was first developed for an **economic purpose**. It started as a service to the community in the 1990s, as they optimized hazardous wastes into their production process. It enabled the community and the government to get rid of them. Then they turned out to be much cheaper than coal.

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[51] See ISO (2011), *ISO 14000 essentials,* in http://www.iso.org/iso/iso_14000_essentials (Retrieved May 03, 2012).

[52] See Appendix 28 [*Substitution rate of alternative fuels*, p 116]

In 2008, CBR signed the *Charter for Sustainable Management of Waste* with the Walloon Region, to make its facilities available for recovery by "co-incineration of waste" from activities of collective interests or public services.

The development of ETS also pushed the companies to intensify their use of alternative fuels and raw materials to reduce their greenhouse gas emissions and be able to sell their allowances to the market when they are in surplus. "It demonstrates that environmental and economic well-fares are not antagonistic ideas", outlined Mr. A. Dulière.

Among other things, such policy has forced CBR to make large investments. For instance, an investment of €27 million, for a capacity of 85 000 tons a year, has been made with Sita to build the new co-managed platform of Recyfuel. Through this this strategic investment, CBR will be able to maintain the consumption of fossil fuels at a lower level.

3. CONSTRAINTS TO CLOSING THE LOOP

First of all, there is no **geographical proximity** as it is located within an eco-industrial park. However, the waste or by-products that are used as inputs in their production process are locally and regionally provided within Belgium (e.g. Arcelor and CBR Gent), which optimize those exchanges of waste and resources, and generates some synergies.

Mrs. P. Wauters mentioned additional constraints that inhibit CBR to reach the 100% closed-loop system and explain why CBR remains dependent on the fossil fuels. She talked about **technical obligations,** in terms of adequate calorific value from the fuels, and the quality of their products**.** She emphasized the fact that "the use occurs actually in strict *technical conditions* in order to satisfy both the protection of health and the environment, and ensure the quality of finished products at the exit of the plant".

It also depends on the **availability of the waste** in their markets, which turns out to be very fluctuant, as well as on the **type of kiln and cement** of each production site. In Lixhe, 69,1% of energy needs are covered by alternative fuels. In the total volume of alternative fuels, 44,2% are provided by biomass, and 10% by used tires of cars and trucks. Yet, only 35,2% are covered by alternative fuels in CBR Harmignies. The reason is that CBR Harmignies' kiln is based on wet process, which is more energy-hungry[53]. On average, "only" 55% of the energetic sources come from alternative fuels and raw material.

They also have to respect a **strict set of environmental specifications** ("cahier de charge") and **legislative requirements**. For instance, while the legislation differs from one country to another (for safety and quality reasons), in Belgium, they cannot use any type of waste in the manufacture. As of today, only Eternit is providing industrial wastes to CBR with the quality required to power the production system. Nonetheless, the legislation is different in the Netherlands than in Belgium. As a result, the production site of Maastricht (ENCI) has used 84% of alternative fuels (including 40% in Biomass) in 2010.

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[53] See the Appendix 30 [*Repartitions of fossil and alternatives fuels by CBR site of production*, p 117]

Finally, Mrs. P. Wauters added the **role of the suppliers and customers** in the process of reducing the transport by road. "We encourage our suppliers and customers to work this way", said the latter, "and to optimize their deliveries of their products by waterways".

As a result, one may want to call on **type II system,** i.e. the **'semi-cyclical system'**. Still, the manager of the policy of eco-responsibility, A. Dulière, believes that it is a **long-term project**. In the future it will be possible to use 100% of alternative fuels and raw materials, and to develop additional initiatives that would address sustainability. As such, it would enable CBR to **reach the ideal and sustainable type III system**.

4. DRIVERS OF A CORPORATE SUSTAINABLE INVESTMENT

Mr. A. Dulière mentioned three main drivers for encouraging CBR to develop a sustainable development policy:

- **Government legislation** as developed above: CBR was forced to reduce their carbon footprint and respond to legislative requirements.
- **Consumer interest**: CBR suggests to their customers to close the loop in order to differentiate themselves from their market competitors. It would enable them to sell their products at a higher price because they would offer "sustainable concrete".
- **Environmental efficiency:** The natural environment has imposed some constraints that CBR cannot avoid (in terms of climate change and the use of nonrenewable resources).

Finally A. Dulière believes that they have developed several initiatives for their **employees** (in terms of security and well-being), which will bring the firm more talented and motivated employees (See Appendix 21 [p 109-110]).

5. ROLE OF THE SENIOR BUSINESS LEADERS

During the discussion with A. Dulière, we tackled the role of the senior business managers in the CBR's sustainable development policy. The latter underlined that the role of the managers of each department is to communicate on CBR's main objectives in terms of sustainable development policy, i.e. being "the trendsetter in sustainability". The role is also about aligning those sustainability objectives with the vision and objectives of the firm's employees.

6.1.2 CONCLUSION

Through its plan of actions regarding the framework of industrial ecology, HeidelbergCement Benelux, and thus its subsidiary CBR, have set a pro-active and collective sustainable development policy: sustainability being core to the business strategy of the group.

It is interesting to see how CBR has reorganized its production system through the 4 strategies of actions previously developed by S. Erkman:

- ***Circularizing the economy:*** The re-use of industrial waste and by-products, and use of biomass to close the loop of its manufacturing process has enabled CBR to considerably reduce their ecological footprint and energy use.

- ***Minimizing the losses***: LCA methodology has helped the group identifying and minimizing their main environmental impacts (i.e. greenhouse gas and atmospheric releases), and find solutions to improve them. Furthermore, CBR has used alternative fuels and raw materials derived from biomass, industrial waste, and by-products which can be re-used and safely burnt in cement kilns
- ***Decarbonizing the economy:*** It has also enabled CBR to minimize its dependency on traditional fuels.
- ***Dematerializing the economy:*** Mutually beneficial partnerships between Eternit and CBR, or other industries and CBR, have helped the company optimizing its production process and waste management. It has therefore helped satisfying their needs while using less natural resources and energy.

By using a method that is consistent with the nature preservation, CBR illustrates how such a **systemic way of thinking and joint collaborations** lead to positive results, whether in terms of **economic advantages** (e.g. reducing its energy costs, and alternative fuels being cheaper than the coal), or in a way to **reduce the company's environmental footprint** (among others, reducing energy consumption, use of nonrenewable fuels, and level of CO_2 emissions).

As a result, such forward thinking company is benefiting from **win-wins** in the form of reduced energy costs and collaborations across its business ecosystem —with other industries, companies and other external stakeholders such as NGOs, as well as its customers and suppliers— to find a collective and efficient solution to reduce the environmental impacts of the whole building process, and therefore improve value creation. Such long-term objectives and systemic perspectives will ensure the ability of the future generations to meet their needs.

However, some **constraints**, whether legislative or technical, have prevented CBR to reach the ideal sustainable industrial ecosystem. Yet, Mr. A. Dulière, eco-responsibility advisor, remains convinced that "the things are setting up, and operating to achieve a '100%' sustainable result in the near future".

Finally, it was interesting to realize that the policy of use of alternative fuels and raw materials was first introduced as a service to the community. The company helped others get rid of their hazardous waste, which turned out to be cheaper than coal. Few years later, when restrictive environmental legislations and growing awareness developed, CBR realized that it also had an environmental advantage. They have decided then to intensify their policy of alternative fuels and raw materials, and to introduce additional initiatives to minimize their overall environmental burdens and respond to the increasingly stricter legislation. As a result, once again, it has been shown that economy and environment are not antagonistic concepts.

6.2 Case On Stakeholders Management With Spadel Group

Although sustainability has always been fully integrated in Spadel's DNA, primary to ensure natural resource protection and purity of mineral water, Spadel formalized its sustainability strategy in 2010-2011 to respond to a changing world, and rising concerns and issues. Thanks to the collaboration of Roland Vaxelaire, founder and CEO of Responsibility Management, direct

contacts with the CSR manager of Spadel, Ann Vandenhende, enabled us to analyze how Spadel is interacts with, and manages for its stakeholders when addressing sustainability.

After briefly presenting Spadel and its sustainability strategy, the case will be used in order to illustrate how much interacting and holding dialogues with its stakeholders is essential for implementing a real policy of change, and for identifying actual opportunities of change and improvement. Indeed, partnerships and collaborations with its stakeholders have always been part of Spadel' strategies.

The information was provided by the CSR Manager of Spadel, Ann Vandenhende, during an interview. It also comes from the company's official website and sustainable development report of 2010, as well as a document titled *Sustainability at Spadel* (2011) co-realized by Ann Vandenhende and Dirk Leroy, specialist in sustainable development at Sustenuto consulting group.

6.2.1 SPADEL CORPORATE RESPONSIBILITY STRATEGY

For over 5 centuries, imported from the town of Spa, Belgium (in the Ardennes mountains), one of Europe's most renowned conservation areas, Spa Natural Spring water has been bottled and exported all over the Benelux, France, the United Kingdom and some other parts of the world. Thanks to the recognized highest quality of Spa water, and the purity of its sources, Spadel Group has successfully kept its position as a leader in the markets for water and lemonade in the Benelux. Developed in Appendix 31 [*Spadel' structure*, p 118], Spadel Group consists in four production sites, and many distinct brands.

Spadel's philosophy, '*When the man protects the water, the water protects the man'*, demonstrates how protecting natural resources and ensuring the purity of mineral water are fully part of the group's genes. Indeed, 'responsibility', through rigorous protection of their water resources, has always been essential to Spadel's *raison d'être* and activities, in order to guarantee a pure mineral water for the future generations.

Even though sustainable development has always been part of Spadel's DNA, the executive comity recently decided to formalize their sustainability strategy, and set up a CSR committee in order to respond to the evolving local and global challenges the company is facing and differentiate itself from their competitors in the market. In 2010, Spadel published its first sustainability report.

Spadel's "corporate responsibilities strategy" is fully aligned with its *raison d'être* (*The water, the man, the natural environment close to us*) and values (*Passion, Proximity, Progress and Openness*). It has been summarized in three pillars[54]:

[54] See the Appendix 32 on their *ambitions in brief* of each of their three pillars [p 119]

- ***Nature's best close to you*** — Protection of the natural resources, the environment, biodiversity, 'naturality' (guarantee of natural ingredients and healthy lifestyle) and responsible sourcing.
- ***Creating a positive footprint*** — Increased use of renewables, energy efficiency, carbon footprint reduction, and water footprint reduction. By 2039, Spadel aims at realizing a positive footprint in every aspect of the value chain.
- ***Spadel as a great place to work and a responsible partner for society*** — Activities concentrated on the 'great place to work' ambitions.

6.2.2 SPADEL-STAKEHOLDERS INTERACTIONS, AND MANAGING-FOR-STAKEHOLDERS APPROACH

The company's goals are to "reduce the negative impacts of their activities, and optimize their positive ones". In order to do so, and reach the ones translated in three pillars, Spadel has always attached importance to dialogue and exchange with its stakeholders so as to identify value creation opportunities and improvements in their business model (presented in Appendix 34 [*Key stakeholders and Stakeholder Meeting BE-NL*, p 120]).

MANAGING-FOR-STAKEHOLDERS

In the preparation of their first sustainable development report, and the development of their strategy, Spadel's management first undertook some *benchmark studies* (from the economic to the social and environmental standpoint) so as to identify the sectorial challenges for their industry and the sustainable-driven initiatives of their competitors. Afterwards, based on the analysis already existing, they undertook a *materiality analysis* to identify and prioritize those issues — 'material' means "the issues are of high concern to the company's stakeholders and also of high relevance to the company"[55]— which showed that stakeholders want this industry to more directly address its carbon and water footprint, as well as the protection of the natural environment.

Summarized in Appendix 33 [*Spadel's main issues*, p 119], 28 issues emerged. They were presented to the executive comity (Comex[56]) in order to achieve an effective and performing corporate responsibility strategy, aligned with the business strategy of Spadel and a positive approach in every aspect of the company's value chain. It has resulted in the three pillars (from today to 2039), summarized above.

In January 2012, Spadel formed two groups of stakeholders (one from Belgium, one from the Netherlands). They were composed of their out-of-home clients (including *Colruyt*, *Albron*), non-governmental organizations (including *Natuur and Milieu* and *Natagora*), local authorities (*the City of Spa*), private organizations (*Fost Plus*), their professional federation (*Fevia*), et cetera.[57] It

[55] In Symantec, 2012

[56] See the annual Report 2011 for more information on the composition of Spadel's Comex

[57] See Appendix 34 [*Spadel Stakeholders Meeting*, p 120] for a full view. Stakeholders were selected using the 'stakeholder mapping' (ISO 26 000 guideline)

allowed to identify the opportunities of changes and improvements as well as to individually assess the expectations and the visions of each of the company's stakeholders

The meetings' topics were about the level of ambitiousness of the sustainable strategy according to the stakeholders, and a review of each of the three pillars. And some of the recommendations and remarks made were to be debated and taken into consideration by the Comex in the near future. For instance, among the overall recommendations, they mentioned the need for a better balance between the ambitions towards the environment protection and the protection of human health.

The main reason why the CSR Manager, Ann Vandenhende, decided to proceed this way is mainly to gain some time. It was really urgent for Spadel to respond to the issues that emerged from the benchmark studies. It is also to ensure that the Comex was fully involved in the development of the corporate responsibility strategy, and that the strategy is aligned with the new *raison d'être,* the objectives and the company's business strategy. According to her, it is very complex and costly to gather all the stakeholders at the same time and same place, and to start from scratch.

SPADEL-STAKEHOLDERS INTERACTIONS

The pressure to develop such strategies and objectives has mainly come from Spadel's **customers from out-of-home sectors and large distributions**, i.e. where the contracts are important. Macdonald, Quick, Delhaize or Colruyt have also developed policies related to the sustainable development, and request, for their customers, products that are aligned with their policy. What is more, there exists a price war between the suppliers and the customers. In such view, Spadel was encouraged to make great changes and improvements in their strategy. The group was also to be more transparent in terms of information and activities (among other things through an annual report), and to hold dialogues with their main customers during the stakeholders meetings, as underlined before.

In the development of the new identity of Spadel, the firm's **employees** have been implied in the new definition of the firm's values through workshops and open dialogues, in order to ensure that their values were aligned with those of the firm and that they felt engaged in the new strategy. Employee satisfaction surveys were conducted, which demonstrates high interest and sensibility for the field of sustainable development. However, according to Ann Vandenhende, the sample was not complete and demonstrative enough, as the survey was only conducted in Brussels and Spa.

Plans of action towards the reduction of energy and water use have also been put in place inside Spadel so as to personally integrate employees in the new strategy (e.g. low energy electronic materials, less individual printers, promotion of sustainable purchasing policies towards their employees, etc.).

The **European Directive** on packaging and packaging waste (2004/12/CE) has imposed restrictions and targets for recycling for the different materials that are part of the composition of household wastes, such as plastic bottles. The **Selective collection and recycling system of Belgium**, *Fost Plus*, has also put pressure on Spadel to act on its recycling system.

As a result, all of Spadel packaging is 100% recyclable, whether it is one-use packaging where the material is PET or re-usable bottles (made of glass). The material PET is more flexible, lighter and resistant than PVC (polyvinyl chloride). What is more, it reduces the weight and the volume of the bottles, and it is "100% recyclable"[58]and respectful towards the environment. Thanks to *Fost Plus*, over 75% of PET bottles are collected and recycled. Still, in the Netherland, the collect is mandatory and allows recycling 95% of bottles.

Aware that the ecological footprint of bottled water is many times bigger than the one of the tap water, Spadel has unsurprisingly been confronted to some **pressure from non-governmental organizations**, such as the international advocacy environmental group, *WWF*. The latter has campaigned against bottled waters, and demonstrated that resources were wasted in bottling and transporting water (WWF, 2012). In the Appendix 34 [*Spadel Stakeholder Meeting],* one can see that WWF was invited to the stakeholders' meeting of January 2012 and that they were part of the debate.

Yet, since the foundation of Spadel, the company has recognized its responsibility towards the environment and the society at large. For instance, since 2009, Spa Reine has offered *UNICEF* the equivalent of 40 million liters of purified waters for children per year,. Such gesture was part of WaSH campaign, which promotes access to water, sanitation, and information about the rules of basic hygiene to people from emerging countries[59].

In 2010, Spadel became one of the founding partners of the campaign *GoodPlanet*, which has the mission to "sensitize and educate the public to the Belgian environmental protection and calls for a more respectful way of life on Earth and its inhabitants"[60]. Forest, water and biodiversity are the main themes of *GoodPlanet* sustainable management, which are aligned with Spadel's mission to "protect the best nature, natural mineral water, not only for us today but for our future generation".

As a result, the supply chain of Spadel has been transformed along the years in order to respond to the pressures from the firm's multiple suppliers and external stakeholders (as mentioned above, particularly from customers, regulators and NGOs). The main actions towards a ***greener* supply chain management** include:

- Spadel has conducted an analysis of its carbon footprint and energy efficiency according to the *LCA methodology*[61]. Besides assessing CO_2 emissions for the complete lifecycle of each Spadel product, it allowed the company to identify the phase of the products' lifecycle where the impacts are the most important and to design strategies to reduce those identified impacts. In Spadel's case, the *packaging production* (PET or glass), and the

[58] See Spadel official website for more detail on recycling PET, http://www.spadel.com/le-developpement-durable/le-recyclage-du-pet

[59] For more information on their partnership, see UNICEF website, http://www.unicef.be/fr/page/spa

[60] See Spadel Newsletter of Feb. 2012, *Just Dropped*

[61] See the Appendix 35 [*LCA approach of Spadel and Carbon footprint*, p 121]

bottling phase from manufacturing[62] were identified as the most impacting phases.

- *The weight of each bottle* of Spadel brands was considerably reduced, leading to a decrease in the percentage of raw materials (for instance, the weight of the Bru bottle (1.25l) went from 64.1 gr in 1985, to 43.6 gr in 2007, which represented a decrease of 32% of raw materials).
- The PET bottles of Spa Reine contain 50% of *recycled PET*, reducing considerably their requirements for raw materials.
- Since 2004, the plant of Spa Monopole ensures *water transport* of finished goods between Liège and Antwerp for overseas exports. That is a decrease of 150 journeys on the roads and a reduction of 75% in terms of CO_2 emissions. Moreover, Spadel is a regional player. Therefore it never has to deal with long distance transports.

In 20 years, Spa Monopole plant has reduced CO_2 emissions by 40%. What is more, 89% of the plant's industrial wastes are sorted and recycled. It represents a double interest: environmental and economic.

The main **shareholder**, Marc du Bois, who holds 85% of the stakes, attaches great importance in sustainable development, which makes it easier than if Spadel had multiple shareholders with distinct interests, and a taste for short-term profit and objectives.

Spadel followed the **Global Reporting Initiatives** (GRI), which is "a non-profit organization that promotes economic, environmental and social sustainability"[63]. It provided Spadel and many other companies and organizations with a sustainability reporting framework. It enables them to set goals, measure and report their sustainability performance as well as manage changes.

6.2.3 CONCLUSION

Even though the sustainable development has also been part of Spadel's strategy, the company, which is the leader in the markets for water and lemonade in the Benelux, has set a CSR committee, and formalized its corporate responsibility strategy since 2010. And the latter revealed to be fully aligned with the company's raison d'être and values.

Spadel Group realized that it could no longer avoid responding to those evolving local and global issues generated by our natural ecosystems. Neither could it ignore its responsibility towards the society at large. An annual report on sustainable development was also introduced so as to be transparent on the company's actions and activities towards all stakeholders.

More importantly, in order to identify additional value creation opportunities, and to respond to the pressures coming from their stakeholders, including customers, NGOs and regulators, Spadel attempts to assess their individual requirements and to take them into consideration in its strategy.

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[62] See the Appendix 35 [*LCA approach of Spadel and Carbon footprint*, p 120]

[63] For more information: Global Reporting Initiative Official Website, https://www.globalreporting.org/, and Appendix 8 [p 98]

The executive comity also played an important role in initially defining the sustainable strategy in order to align the objectives and the new *raison d'être* with the ones of the business strategy. According to CSR Manager, Ann Vandenhende, top management should be part of the development and realization of a strategy, if one wants it to perform well and integrate each of the stakeholder ("to grow individually"), in particular employees and suppliers, in the business model of the company. .

The Brussels-based, independent communication consultancy firm, *Akkanto* conducted a survey on the **reputation** of Belgian companies on a sample of 14 000 people [64]. In two years, Spadel has made a major improvement: moving from the 5th place in 2010 to the 2nd today (lagging behind Colruyt which comforted its number one position in the matter) (Akkanto, 2012). The survey used the RepTrak™ methodology, which measures several indicators, such as innovation, workplace, citizenship, performance, et cetera.

Sustainable development has enabled Spadel to demonstrate its involvement in a policy of change, and to respond to a changing world. Furthermore, it allowed the company to minimize its environmental burdens and reduce long-term costs.

[64] For more explanation on the *Reptrak Methodology* :
http://www.akkanto.com/component/flexicontent/item/55

7 FINAL CONCLUSION AND RECOMMENDATIONS

The objective of this chapter is to present the main conclusions of the present thesis and some recommendation for topics that could be further investigated.

7.1 CONCLUSION

We are undoubtedly heading towards an Energy-Climate era, where Mother Earth imposes severe constraints on individuals, organizations, and governments. And those constraints can no longer be ignored by the business world. Our world is facing a warming trend, where forests, soils, water and fish stocks are being used beyond their limits by human population growth, rapid industrial development and a growing energy- and resource-consuming lifestyle; what T. Friedman calls "a Hot, Flat, and Crowded world". Mostly caused by human activities, environmental damages, from climate change to biodiversity decline and scarcity in natural resources, have damaged our natural ecosystems — our evolving, and dynamic biological systems. What is more, associated costs have risen along such destructive process. It is disrupting our society at large, and the business world, forcing companies to enter the 'green' revolution, in coherence with sustainable development and three pillars it encompasses: economic, social and environmental.

The green revolution and sustainable development have led forward-thinking companies to create a set of new opportunities and capture new market openings and businesses. While such conceptions imply a new way of managing a business, not only do they lead to reduced environmental burdens, but also to societal challenges, as both are inextricably linked. They also enable them to 'outgreen' their competitors, through efficient initiatives, investments and innovations that promote long-term growth. They gain, therefore, greater competitive advantage. As D. Esty and A. Winston (2009) put forward, "no company can afford to ignore green issues. Those who manage them with skill will build stronger, more profitable, longer-lasting businesses-and a healthier, more livable planet".

As a result, businesses, capable of dealing with the complex challenges of a changing world will be better prepared to build a business able to respond to the future and its inevitable shocks, and lead. As A. Werbach (2009: 195) highlights: "solving problems once they are occurred is a lot more costly than preventing them altogether".

Not only are a green revolution and sustainable development a step towards long-term progress, they also involves ***three interconnected elements***.

Firstly, it implies a **holistic and pro-active approach** in which interrelationships and collaborations between distinct economic agents within their business ecosystems are essential. Drawn from biological mechanisms, *business ecosystems* refer to a complex and dynamic network where the organizations and their members interact and cooperate to develop mutually beneficial relationships. Combined with the concept of *business ecology*, they encompass the relationships within the entire ecosystems, in accordance with the natural environment. The company then plays the role of co-creator with other organisms of the business ecosystem. Together, they create new sustainable opportunities, and reach a "healthy" ecosystem.

Performing an overall analysis of the entire ecosystem and the interconnectedness between all its members rather than focusing on the viewpoint of the individual organizations is mandatory in order, not to harm the environment, but to regenerate it. As a result, companies must adopt a *systemic way of thinking* in our complex and rapidly evolving world where businesses are sensitive to the natural world, confronted to multiple stakeholders with different interests and requirements, and to non-linear decision-making processes. 'Systems thinking' is defined by G. Haines (1998) as a worldview and way of thinking whereby the entity is seen as a whole, and the relationships within the system are the primary concerns. Such perspective provides a holistic view of the environmental challenges, and helps companies adapting and identifying the set of new opportunities. It also supports a better understanding of the dynamic interaction between the environment, the economy and the society.

As a second element, such approach involves a review of the companies' ***raison d'être*** by interacting and cooperating with other organisms within and outside the business ecosystem — i.e. among the whole set of actors that might have direct or indirect impacts on its activities — so as to develop *a jointly innovative solution*, in accordance with the business and the natural environment. As Thomas Friedman (2009:358) emphasized: "it takes an ecosystem of the right government policies, the right investments and the right actors to save an ecosystem of plants, animals and forests".

Drawing its inspiration from the functioning of natural ecosystems, *the concept of industrial ecology* suggests a collective and systemic solution. It encourages cooperation among distinct firms, or traditionally separates industries, in order to build a highly integrated and closed system, where the waste produced by one company is used as a new resource for another, or returned harmlessly to the ecosystem. The goal is therefore to achieve the ideal "mature" ecosystem, and reach an "eco-industrial dynamic equilibrium", where the natural and industrial ecosystems are balanced and co-exist in symbiosis, rather than degrading each other.

Such system encourages the creation of "eco-industrial synergies". It implies that a high proportion of material and energy be exchanged and that information flows between the agents, at the scale of a territory, a sector or within an "eco-industrial park". The latter encourages such synergies in a given region, reaching a physical proximity of the infrastructures and economic agents, such as the Kalundborg eco-industrial park in Denmark.

Thanks to the support of innovative tools, such as 'Life-Cycle Assessment', 'Life Cycle Design' and 'Design for the environment', this collective approach optimizes energy and material use, and minimizes environmental burdens. Forward-thinking companies benefit from "synergistic multiple wins". In addition to reduced long-term cost, redesigning their process in order to use less energy and resources will lead to maximum value creation and an enhanced market competitive advantage.

Among other examples, the case of *CBR Cement Belgium* enabled to demonstrate that such systemic perspective and joint collaborations do lead to positive outcomes. The company's policies fostered the use of alternative fuels and raw materials provided by other businesses and industries to feed the cement production process. It has generated economic advantages (e.g.

reducing energy costs and alternative fuels being cheaper than the coal), and reduced the company's environmental burdens (among other things, reducing energy consumption, the use of nonrenewable fuels and level of CO_2 emissions).

Combining industrial ecology with the concept of *functional economy* is a complementary solution to reaching such dynamic equilibrium in a world of increasing population and decreasing natural resource stock. A functional economy reveals to have a double interest: economic and environmental. Selling services rather than goods increases the useful life of these latter, and decreases resource consumption.

The social ecosystem, which stands as the closest analogy to the pro-active approach associated with the concept of business ecosystem stresses the importance of the interdependence of all the actors of the ecosystem, including all the stakeholders who influence, or are influenced by the company. As the case of *Spadel Group* demonstrates, *creating synergies between, building sustainable relationships with and setting up an effective management for stakeholders* enables sustainable-driven companies to understand their evolving needs and relevant issues. Therefore, they are able to identify new value creation opportunities. By developing mutually beneficial relationships and knowledge, they would indeed share successes and failures as a whole.

Responding to environmental challenges does not only enable companies to set preventive approach aiming at mitigating their impacts on the environment, but also to avoid facing additional costs leveraged by their stakeholders. As co-producers in the process of value creation, the firm' stakeholders can indeed directly or indirectly affect its performance and ability to create value, whether through price signals (e.g. tax policies), regulatory frameworks from their government, or in terms of reputation damages from media and non-governmental organization (NGO) campaigns or boycott.

The third element is the **role of business leaders and their commitments** in this approach of co-creation with the entire ecosystem. Jointly created value, collective solutions as well as overall sustainability agendas and initiatives demand growing commitments from senior business leaders. Their role is to communicate the purpose of such sustainability-driven actions to their stakeholders, from their customers to their suppliers and, in particular, their employees, which will enable to differentiate those who inspire and lead, from those who do not.

Those three interconnected elements demonstrate that every actor within the business ecosystem plays the **role of co-creator,** in order to achieve a sustainable and healthy ecosystem, and successfully lead to a sustainable business. **Collective impacts call for collective actions.** As a result, collaboration and efficient partnerships with other organisms of the business ecosystem, in accordance with the natural one, are essential. They have all the needed tools at their disposal to lower long-term costs, and improve their productivity and reputation. To quote Al gore's motto: "If you want to go quickly, go alone. If you want to go far, go together". More importantly, the related concepts and approaches illustrate that protecting the environment and generating positive profit are not antagonistic ideas. Indeed as Hoffman and Bansal (2011:14) emphasized,

"there exists a win-win relationship between the interests of business and the environment, not a trade-off".

7.2 Additional Recommendations

The final part of the conclusion reviews some additional topics or remarks that could or should be further investigated.

As mentioned previously, environmental damages are mainly due to human activity; in particular associated with large-scale manufacturing as well as the transportation, commercial and residential sectors. As a result, companies play an essential role in this evolution. For this matter, the present thesis tackles particularly **large corporate companies** with a high proportion of material, energy and capital flows. The role and engagements of **small and medium Enterprises (SMEs)**, the predominant form of enterprise in the European Union[65], should also be fully recognized.

The role of political and administrative powers could also be more emphasized to encourage economic agents towards a policy of change. Unless being extremely courageous or visionary, companies cannot act on their own. National and international public authorities should demonstrate the political will to ensure that sustainable-driven companies are not overwhelmed by competition, for instance in terms of products and price acceptance or setting, or even individual interests. Companies should have more than the feeling that there is a political evolution towards a model of sustainable development, and that they are being supported in their efforts.

As previously underlined, "there exists a *win-win* relationship between the interests of business and the environment, not a *trade-off*". However, given the competitiveness of certain businesses and the current financial crisis, the importance of the economic side should certainly not be neglected. As a result, it would be essential to **create new indicators** to measure and demonstrate the 'win-win' relationship. In such a step-by-step approach, both costs and benefits should be quantified, and the efforts brought in each of the three pillars should be valued.

As De Guzman (2010) emphasizes: "it is better if we take the proactive approach now rather than to suffer the worst which could otherwise be avoided". Given the scale of needed urgent efforts ("later is over"), and the fundamental shift that the previously developed concepts imply (whether organizational, cultural, or individual), **intermediate stages** could be further investigated. It comprises, for instance, more severe directives towards proper recycling system or waste recovery process within the company, or through the education. Once again, public authorities play an important role. As a matter of fact, even though it is a long-term investment, a **proper education and trainings** of today's youth is an absolute priority, creating a culture that encourages intelligent understanding, long-term thinking and cooperative actions.

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[65] See European Commission Website (2012), Sustainable and responsible business, in http://ec.europa.eu (Retrieved May 21, 2012)

7.3 OTHERS

For additional information on this vast and endless subject, I would to like to recommend some readings or videos that I found particularly interesting and that helped me conduct my thesis.

First of all, the books *Green to Gold* (2009), by Esty and Winston, and, *Hot, Flat & Crowded* (2009), by of T. Friedman have guided me throughout the elaboration of the present thesis. It was encouraged to deepen their research and challenge their sustainable strategies.

The book, *Responsibilité sociale de l'Entreprise*, by Philippe de Woot (2005), was also very interesting and changed my perception of the roles of companies and individuals, and their responsibilities towards a global awareness and actions.

The videos of Annie Leonard, on the *story of Stuff project* (Ed.: http://www.storyofstuff.org) have particularly caught my attention. Not only are they very well made, but I really did relate to them.

The website Ted (Ed.: http://www.ted.com), which offers a large panel of conferences from experts and intellectuals on plenty different topics has inspired me to tackle some concepts or issues within my thesis.

Finally, I hope you enjoyed reading the present thesis as much as I did writing it.

Lauren Buysschaert

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9 APPENDIX

Appendix 1 : Executives Defining Sustainability

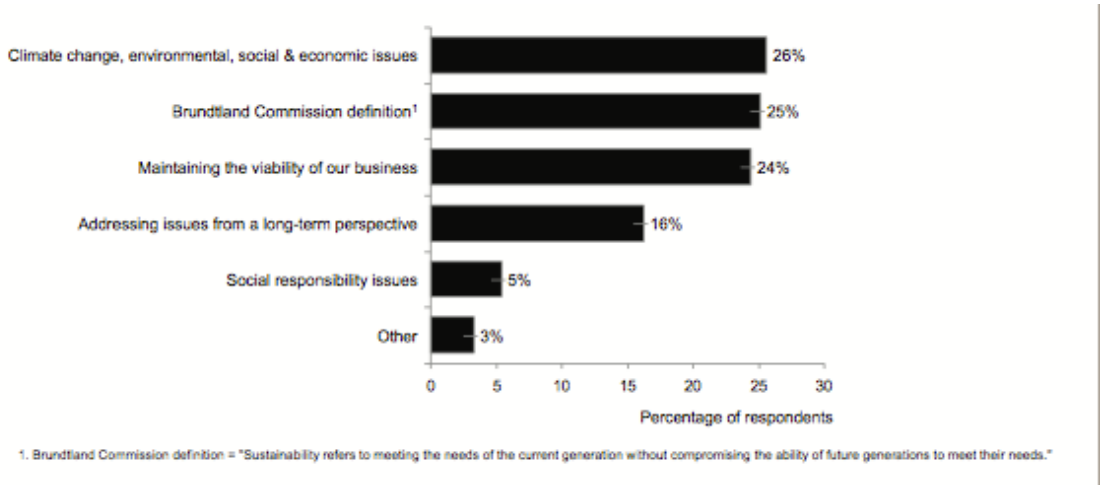
Source: MIT Sloan Management review 2009

As part of their project called the *Sustainability Initiative*, MIT Sloan Business School and partner The Boston Consulting Group launched a survey of more than 1 500 corporate executives and managers about their perspectives on the intersection of sustainability and business strategy.

"Which of the following statements best describes the way in which your organization defines sustainability?

- Sustainability refers to climate change issues
- Sustainability refers to other environmental issues
- Sustainability refers to corporate social responsibility issues
- Sustainability refers to maintaining the viability of our business
- Sustainability incorporates climate change, environmental, social, and economic issues
- Sustainability refers to meeting the needs of the current generation without compromising the ability of future generations to meet their needs
- Sustainability refers to addressing issues from a long-term perspective Other"

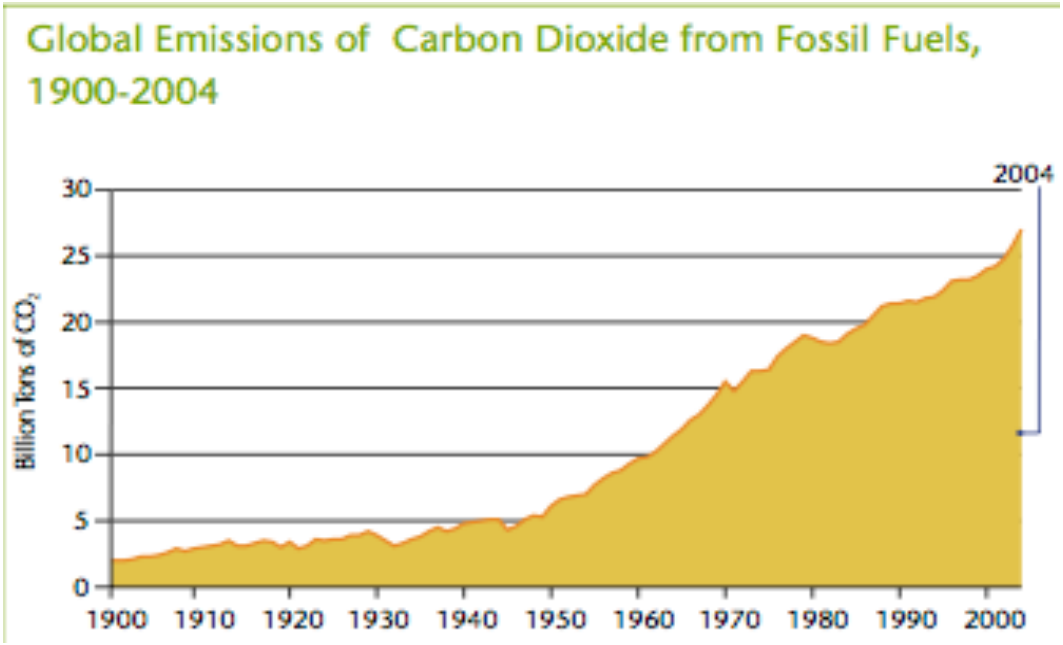
The answers to that question result that most of the respondents define sustainability as referring to the three bottom lines, and according to Brundtland definition, as well as maintaining the viability of their business.



Appendix 2 : Global Emissions Of Carbon Dioxide From Fossil Fuels (1900-2004)

Source : World Resources Institute, 2005

"In the past 200 years, more than 2,3 trillion metric tons of CO_2 have been released into the atmosphere due to human activities. One-half of these emissions have occurred in the last 30 years".



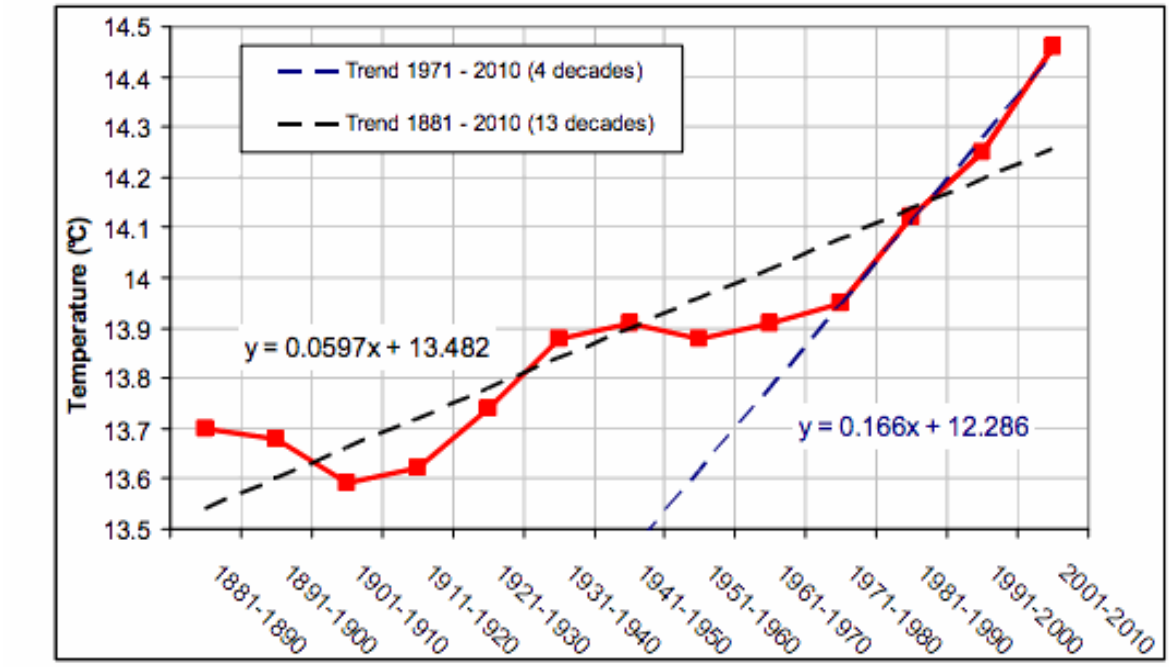
Appendix 3 : The Temperature Trends

Source: World Meteorological Organization

The global temperature increase rate has been "remarkable" during the previous four decades:

"The global temperature has increased since 1971 at an average estimated rate of 0.166°C per decade compared to the average rate of 0.06 °C per decade computed over the full period 1881-2010"[66].

For more information on climate change, please refer to Climatepogress.org — the global warming blog.



Temperature trends (World Meteorological Organization)

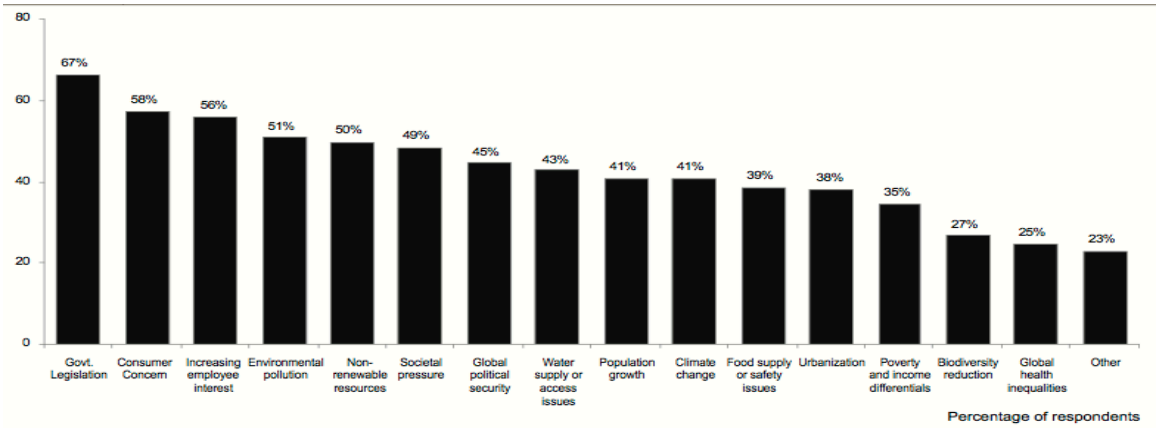
[66] Romm (2012). *Manmade Climate Change Accelerated In 2001-2010*, World Meteorological Organization Reports

Appendix 4 : Key Drivers Of Corporate Sustainability Investment

Source: MIT Sloan Management review 2009

As part of their project called the *Sustainability Initiative*, MIT Sloan Business School and partner The Boston Consulting Group launched a survey of more than 1 500 corporate executives and managers about their perspectives on the intersection of sustainability and business strategy.

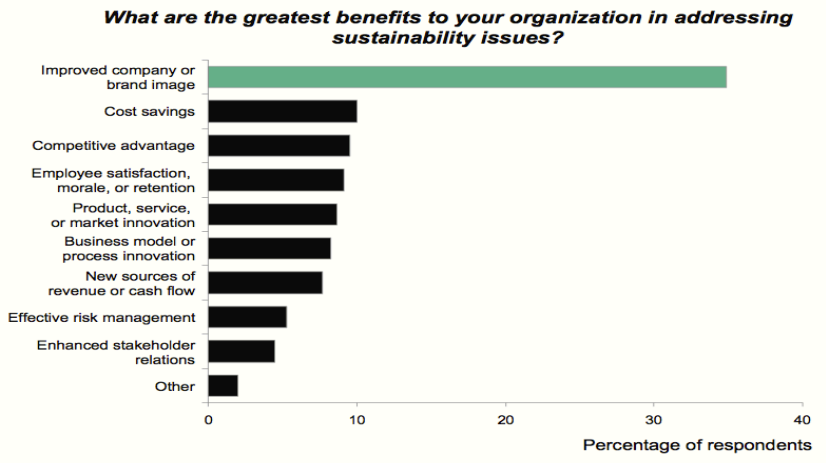
It results that the main forces that are having the greatest impacts on companies in order to address sustainability-related issues are the government legislation, consumer concern, and increasing employee interest:



Appendix 5 : The Main Benefits Of Actions In Addressing Sustainability Issues

Source: MIT Sloan Management review 2009

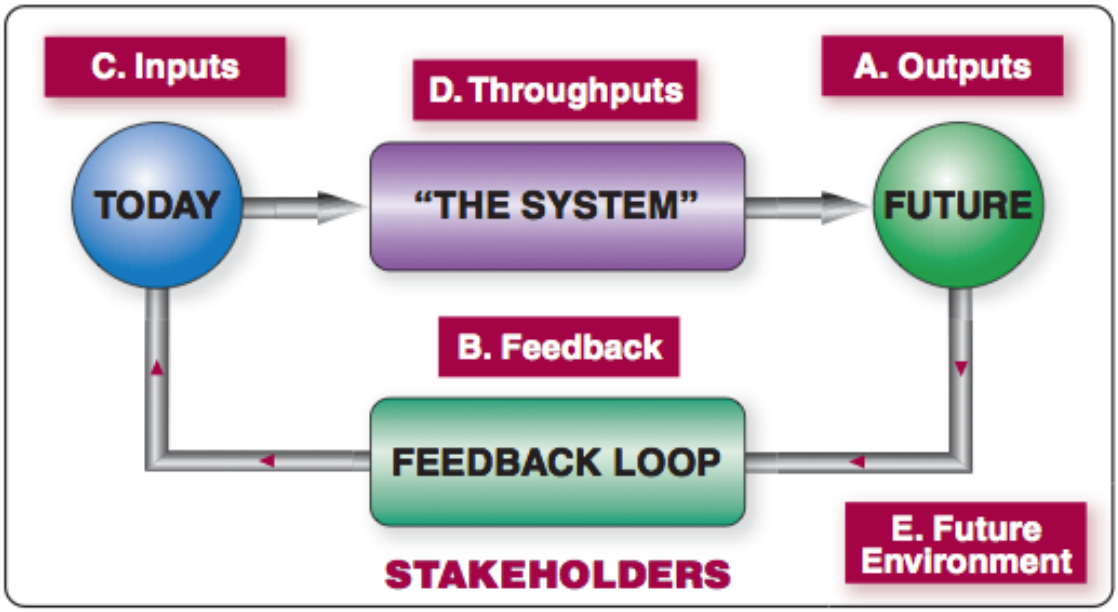
It results that that most respondents cited — by a large margin — an improved image as the principal benefit of addressing sustainability.



Note: Data reflect the top-ranked response from the 1,560 business leaders who participated in our survey

Appendix 6 : The Systems Thinking Approach

Source: Stephen G. Haines (2005), *Systems Thinking and Learning*



"A New Orientation To Life" (Haines, 2005)

Five Strategic Questions : « Backwards Thinking » (Haines, 1998)

A **"Where do we want to be ?** (i.e. our ends, outcomes, purposes, goals, destination, vision)

B **How will we know when we get there ?** (i.e. the customers' needs connected to a quantifiable feedback system)

C **Where are we now ?** (i.e. today's issues and problems)

D **How do we get there ?** (i.e. close the gap from C → A in a complete and holistic way)

E **Ongoing :** What will/may change in the future environment ?"

Why Thinking Matters : « How you think.. is how you act… is how you are. »

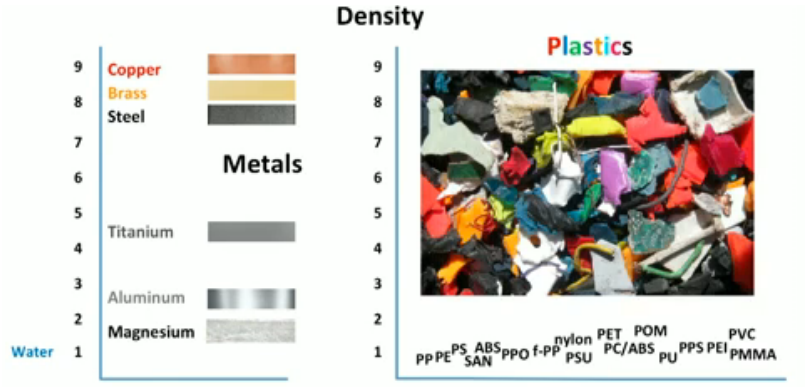
Appendix 7 : Example Of Closing Materal Loop: Mike Biddle's Sustainable Plastic Business Model

In a TED conference, "We can recycle plastic", Mike Biddle presents a new sustainable business model to deal with plastic and therefore eliminate the most abundant type of waste of our total waste stream.

While most people consider montains of waste as useless rubbish, Mike Biddle sees them as 'above-ground mines'. The reason why he sees them as mines, it is because, according to him, there are a lot of valuable raw materials that went into making all this this garbage in the first place. He believes that it is extremely important in our resource-constrained world that we take those raw materials out of the waste stream, and re-use them in our business model.

Plastic is one of the most important environmental issues, as it is based on the extraction of oil, for which we need to look for always further and drill always deeper. As a result, this practice has extreme environmental and economic implications since less than 10% of the plastic trash is recovered. Moreover the amount could go as low as 5%, as most of the trash is either incinerated, or landfilled.

It has been demonstrated that plastic is one of the throw-away materials, that are consumed and produced the most around the world on a volume basis. It is therefore more valuable than steel, for instance, the most common metal, of which 90% is recovered, and reused for another purpose.



Metal vs. Plastic (Source: Biddle, 2011)

As the above figure shows, metals have different densities, different electrical and magnetic properties, and even colors. As a result, it is easier for either a human or a machine to separate these metals from one another and from other materials, than plastics. They have indeed overlapping densities over a very narrow range. In addition to have many different colors, they can have also either identical or very similar electrical and magnetic properties. Therefore, it is not possible to separate them by using the traditional technics.

Finally, most of them are sent in developed countries, such as in Mumbai, India, where its population first stores them and then attempts very hardly to separate the plastic by color, by

shape, or by touch, using any technics they can— mostly the "burn and sniff" technic where they burn the plastic and smell the smoke in order to determine the type of plastic.

Mike Biddles has found a cheap and energy efficient way to recover the plastic, which in turn is an environmantal, economic and more importantly healthly technic, i.e. a sustainable solution:

TRADITIONAL PLASTIC BUSINESS MODEL:

Traditional Plastic Business Model (Source: Biddle, 2011)

In few words, the traditional way to make plastics is from oil or petrochemicals. They break down the molecules, recombine them in very specific ways to make all the plastic that we consume every day.

A SUSTAINABLE WAY TO MAKE PLASTIC: INDUSTRIAL ECOLOGY APPROACH

Sustainable Business Model (Source: Biddle, 2011)

They first start with waste, which is certainly much cheaper and more abundant than oil. They take out from the minesall the things that are not plastics, such as metals, carpeting, rubber, wood, glass, paper, etc. The first step of the process is similar to the traditional recycling. By using magnets and air classification, they filter the material. At the end of the process, they obtain a mixed plastic composite: many different types of plastics, and many different grades of plastics.

Afterwards the multi-step separation process begins. They grind the plastic down to very small sizes. Thanks to a highly automated process, they sort the plastics by type and by grade. At the end of the process comes one type, one grade plastic, what they call "pellets", which is "the currency of the plastic industry" and the exact same material that they would get from oil. As a result, thanks to this mechanism, the waste — the "old stuff"— goes back into "the new stuff".

Because they do not break down the plastic into molecules, or recombine them, but they use a mining approach to extract the materials, this mechanism leads to much lower capital costs in their plant equipment, as well as enable them to make hige energy savings, amounted to 80-90%,

compared with the traditional way. Furthermore, their plant can make any type of plastic, instead of investing a lot of money in a chemical plant for only one type.

As a result, their customers can enjoy from a huge CO_2 savings. They succeed to **close the loop** with their products and get to make more **sustainable products**.

To conclude, M. Briddle brought a new example of industrial ecology: he has closed the loop and used the waste as an input for the plastic industries. It is not only sustainable from an environmental perspective, but also from an economical standpoint as well.

Appendix 8 : Sustainable Development Strategies for Environmental Impact Reductions

Source: Garner A. (1995). Industrial Ecology: An Introduction

Following sustainable development strategies were defined by the U.S. Environmental Protection Agency (1993):

Waste Minimization — "The reduction, to the extent feasible, of hazardous waste that is generated or subsequently treated, sorted, or disposed for".

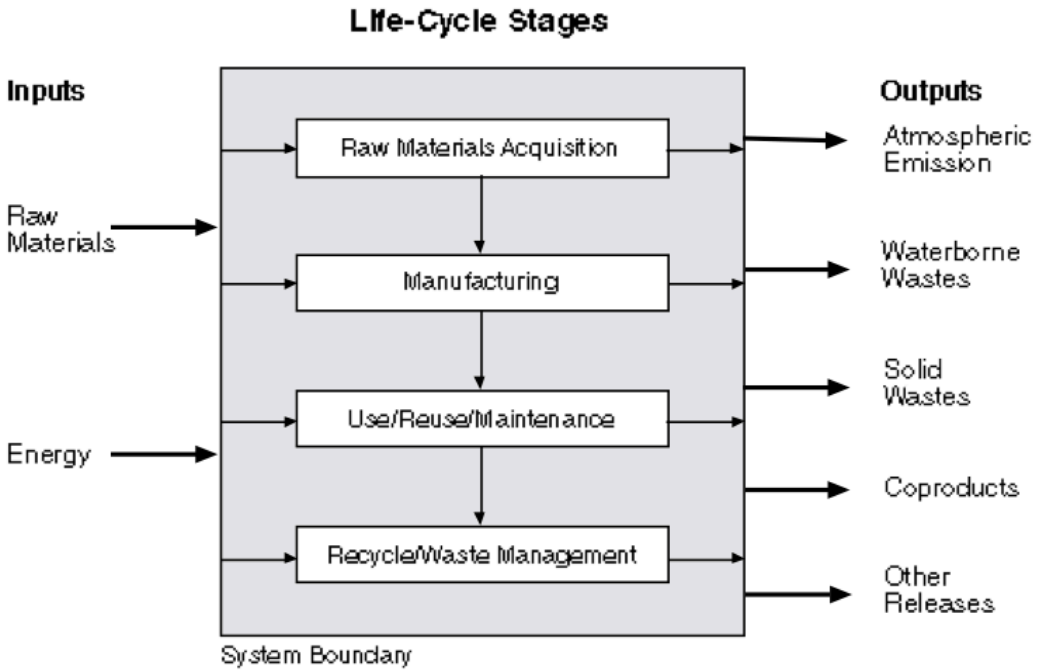
Source reduction — "Any practices that reduces the amount of any hazardous substance, pollutant or contaminant entering any waste stream or otherwise released into the environmental prior to recycling, treatment or disposal".

Total quality environmental management (TQEM) — "Used to monitor, control, and improve a firm's environmental performance within individual firms"

Other frameworks have been developed to reduce environmental impacts, and enlarged to the concept of sustainability, such as ***Global Reporting Initiatives*** (1997) which provide individual firms a sustainability reporting framework to set goals, to measure and to report their sustainability performance.

Appendix 9 : Process Flow Diagram

Source: Garner A. (1995). Industrial Ecology: An Introduction



Life cycle Stages (Source: B. W. Vigon et al., "Life Cycle Assessment: Inventory Guidelines and Principles" (Cincinnati: U.S. Environmental Protection Agency, Risk Reduction Engineering Laboratory, 1993), 17))

Appendix 10 : LCD and DfE: Similitudes and Differences

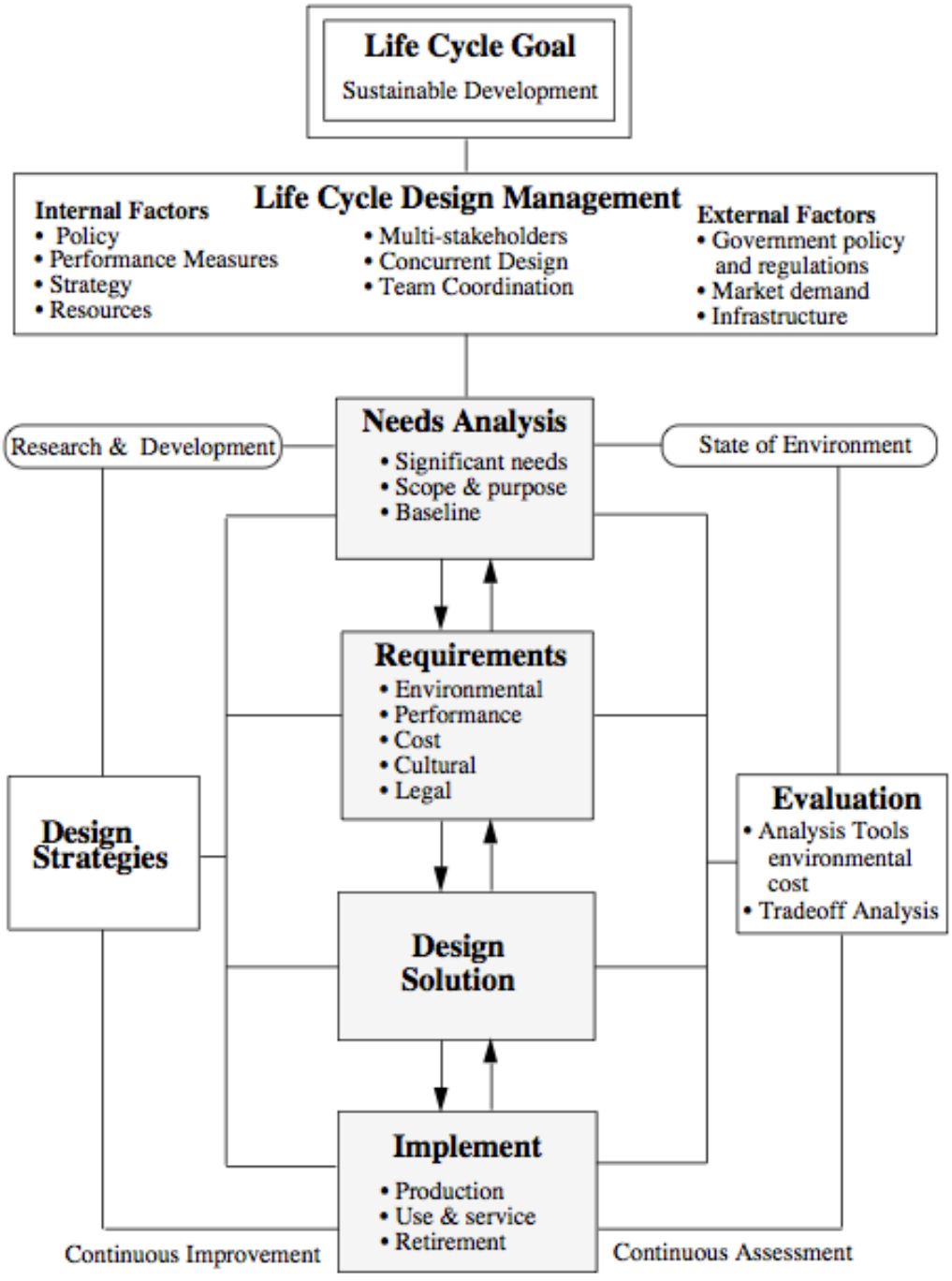
Source: Garner A. (1995). Industrial Ecology: Introduction

According to A. Garner (1995), "both have similar goals but evolve from different sources":

Similitudes	Differences	
	Life Cycle Design	Design for Environment
Use both a series of matrices in an attempt to develop and then incorporate environmental requirements into the design process.	It seeks to minimize the environmental consequences of each product system component: product, process, distribution, and management.	It is based on the product life cycle framework and focuses on minimizing environmental issues in the products and process design.

Appendix 11 : Life Cycle Design

Source: Garner A. (1995). Industrial Ecology: Introduction



Life Cycle Design (Source: Keoleian And Menerey, 1993)

Note: When Sustainable development is the goal, both *internal* — corporate policies, companies' missions, product strategies — and *external* factors — government policies and regulation, consumer demands, competition — can affect the design process. Each factor is taken into consideration in the analysis.

Appendix 12 : Issues To Consider When Developing Environmental Requirements

Source: Garner A. (1995). Industrial Ecology: An Introduction

Hereafter are the key issues that need to be considered in the second phase of the Life-Cycle design analysis.

Materials and Energy

Amount & Type
- renewable
- nonrenewable

Character
- virgin
- reused/recycled
- reusable/ recyclable

Resource Base
- location
- local vs. other
- availability
- quality
- management
- restoration practices

Impacts From Extraction and Use
- material/energy use
- residuals
- ecosystem health
- human health

Residuals

Type
- solid waste
- air emissions
- waterborne

Characterization
- constituents
- amount
- concentration
- toxicity
- hazardous content
- radioactivity

Environmental Fate
- containment
- bioaccumulation
- degradability
- mobility/transport
- ecologial impacts
- human health impacts

Ecological Health

Stressors
- physical
- biological
- chemical

Impact Categories
- diversity
- sustainability
- resilience
- system structure
- system function

Scale
- local
- regional
- global

Human Health and Safety

Population at Risk
- workers
- users
- community

Exposure Routes
- inhalation, contact, ingestion
- duration & frequency

Accidents
- type
- frequency)

Toxic Character
- acute effects
- chronic effects
- morbidity/mortality

Nuisance Effects
- noise
- odors
- visibility

Environmental Requirements (Source: Keoleian Et Al., Life Cycle Design Framework and Demonstration Projects (Cincinnati: U.S. Epa Risk Reduction Engineering Lab, July 1995), 45).

Appendix 13 : Strategies For Meeting Environmental Requirements

Source: Garner A. (1995). Industrial Ecology: An Introduction

Hereafter are all the strategies to meet the environmental requirements developed in the previous phase.

Product Life Extension
- extend useful life
- make appropriately durable
- ensure adaptability
- facilitate serviceability by simplifying maintenance and allowing repair
- enable remanufacture
- accommodate reuse

Material Life Extension
- specify recycled materials
- use recyclable materials

Material Selection
- substitute materials
- reformulate products

Reduced Material Intensity
- conserve resources

Process Management
- use substitute processes
- increase energy efficiency
- process materials efficiently
- control processes
- improve process layout
- improve inventory control and material handling processes
- plan efficient facilities
- consider treatment and disposal too

Efficient Distribution
- choose efficient transportation
- reduce packaging
- use low-impact or reusable packaging

Improved Management Practices
- use office materials and equipment efficiently
- phase out high-impact products
- choose environmentally responsible suppliers or contractors
- label properly
- advertise demonstrable environmental improvements

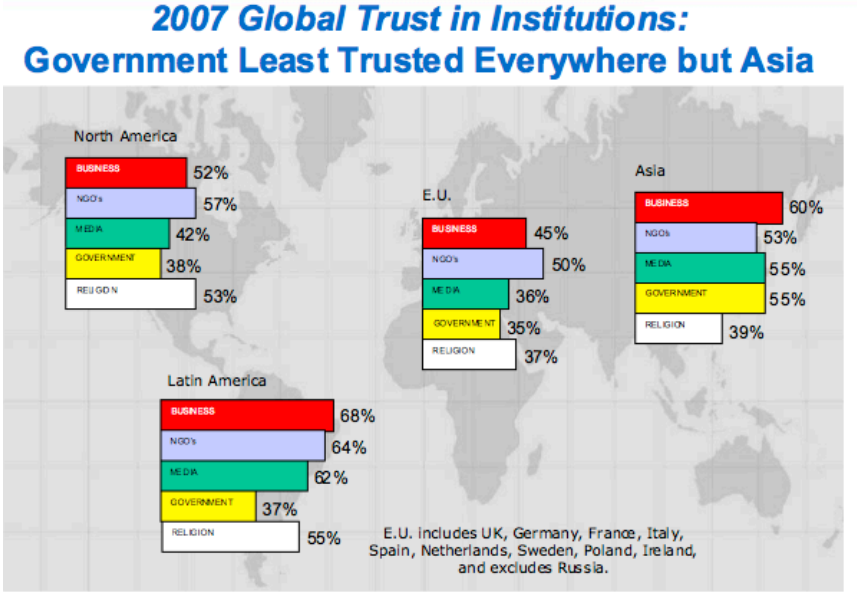
Source: Keoleian et al., *Life Cycle Design Framework and Demonstration Projects* (Cincinnati: U.S. EPA Risk Reduction Engineering Lab, July 1995), 51.

Strategies for meeting environmental requirements (Source: Keoleian et al., 1995)

Appendix 14 : 2007 Global Trust In Institution

Source: Eldman Trust Barometer 2007,
in http://www.slideshare.net/edelman.milan/edelman-trust-barometer-2007,
Strategy One (24/04/2012)

"It shows that NGOs credibility and trust is extremely strong compared with governments and companies".



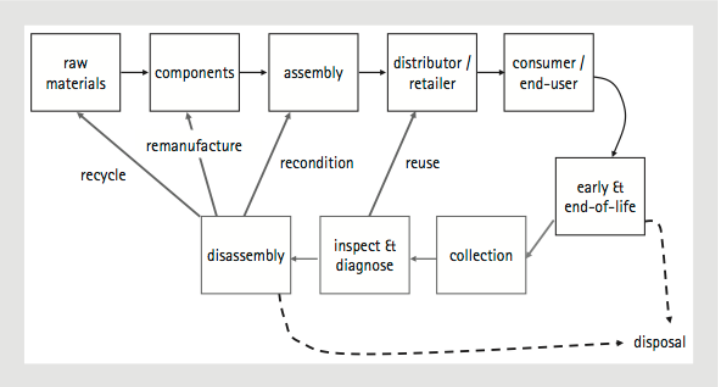
Edelman Trust Barometer 2007

Appendix 15 : Greener supply chain management

Source: Klassen & Vachon (2011), Business and The Natural Environment: Greener Supply Chain Management

Similar to what it has been seen in the previous chapter of industrial ecology and the third system type, the supply chain involves (Klassen & Vachon, 2011:270-271):

- ***New design*** of environmental-friendly products; including life-cycle assessments (LCAs), and other tools to enable environmentally conscious design, improve length of life of products, and consume less resource.
- ***Material selection, extraction, and sourcing,*** which imply energy savings through improved efficiency and encourage closing material cycles (also refer to closed – loop supply chains).
- ***Logistics and delivery***
- ***End-of-life management*** (with options as recycling, remanufacturing, or waste management).



Extending The Supply Chain: Closing The Loop (Source: Klassen And Vachon, 2011)

As it is shown in figure 12, the closed loop system not only includes the classic 3 R's (i.e. Reduce, Reuse, and Recycle), but it adds two more R's: Recondition, and Remanufacturing (Klassen & Vachon, 2011:275). Therefore, as it has seen previously, this system has the advantage, for manufactured goods, to be profitable, and to reduce environmental impacts by reusing materials, reducing energy use and reducing the need for disposal (Klassen & Vachon, 2011:275).

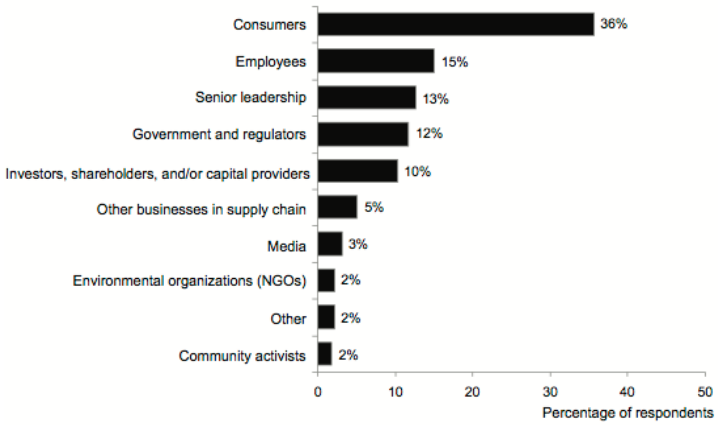
For more details and understandings on greener supply management systems, and closed loop supply chain, refer to R. D. Klassen, and S. Vachon, in *Greener Supply chain management* (in the Oxford handbook, *Business and Natural Environment,* from page 269), and J.D. Abbey, and V. Daniel R. Guide, Jr, in *Closed-Loop Supply Chains* (in the Oxford handbook, *Business and Natural Environment*, from page 290), respectively.

Appendix 16 : Stakeholder Groups And Improvement Of Sustainability-Related Communications

Source: MIT Sloan Management review 2009

As part of their project called the *Sustainability Initiative*, MIT Sloan Business School and partner The Boston Consulting Group launched a survey of more than 1 500 corporate executives and managers about their perspectives on the intersection of sustainability and business strategy.

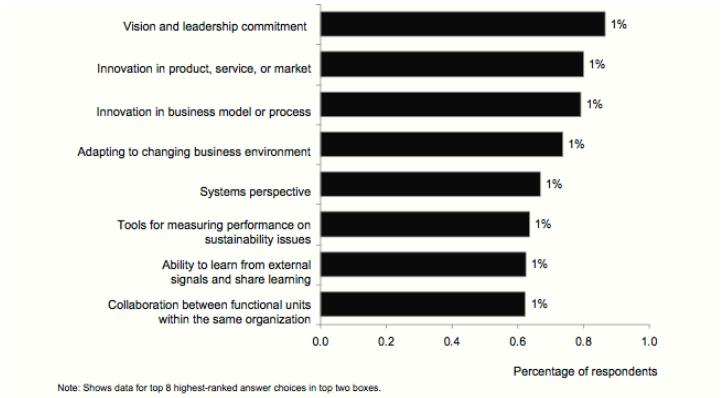
It results that improving their sustainability-related communications with the stakeholder groups, such as employees, senior leadership, government and regulators, investors, shareholders and/or capital providers, and mostly consumers would deliver the greatest benefits to the organization.



Appendix 17 : The Most Important Organizational Capabilities In Terms Of Addressing Sustainability

Source: MIT Sloan Management review 2009

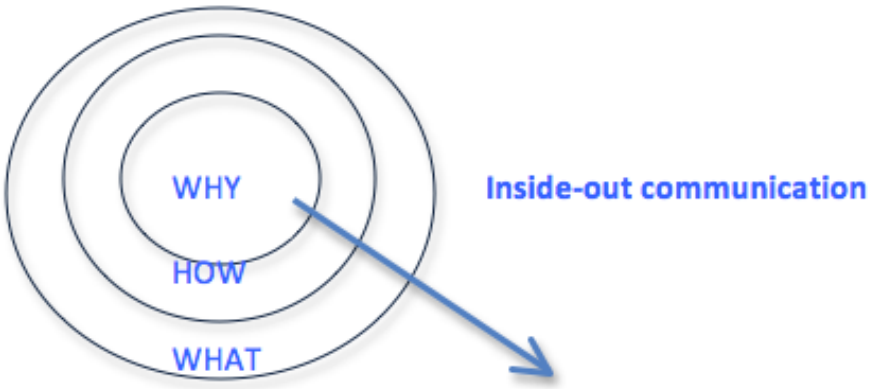
It results that according to the whole respondents vision and leadership commitment appears to be the most important organizational capabilities in terms of addressing sustainability.



Appendix 18 : Golden Circle Of S. Sinek

Source: S. Sinek (2009), Start with why: How great leaders inspire action

According to Simon Sinek, companies should communicate from "inside to out". They should first start from **why** they do to **how**, and finally **what** they do, rather than the opposite, because "the gold is to do business with people who believe what we believe. (…) People buy why we do, not what we do".



Appendix 19 : Presentation Of HeidelbergCement

Present in more than 40 countries across the world, HeidelbergCement has come a long way from the foundation of the first cement plant in the South German region, Heidelberg, in 1873 to one of the leading international building materials group it is today. Leader in aggregates and a prominent player in the fields of cement, concrete and other downstream activities, such as ready-mixed concrete, concrete pipes, asphalt, and other related products and services, the company has started to expand itself internationally from the 1960s first in France, cement company Vicat, and USA, Lehigh Cement, to all over Europe, Asia, North America, and Africa-Mediterranean Basin.

Pillar of HeidelbergCement's corporate strategy, sustainability is translated into high commitments to ecological, social, and economic goals, and sustainable cement production, as well as the company applies the highest standards in quality, environmental protection, and occupational safety.

More precisely, environmental protection is central to its strategy of sustainability, predominant goals being climate protection and conservation of resources. Moreover the company is a member of the World Business Council for Sustainable Development (WBCSD) — global association dealing exclusively with business and sustainable development — and is dedicated to lower its CO_2 emission levels and to use natural resources responsibly. As an example, increasing use of alternative raw materials and fuels, and continuous optimization of production procedures are integral parts of HeidelbergCement's strategy of sustainability.

Appendix 20 : HeidelbergCement Benelux

Source : Annual Report of Sustainable development of HeidelbergCement Benelux 2010

HeidelbergCement Benelux is present all over Benelux, in three activities, cement, ready-mix concrete, and aggregates.

Appendix 21 : Stakeholders Management Of HeidelbergCement Benelux

Source : HeidelbergCement Benelux, Sustainable development report - 2010

Market	Civil Society	Personnel	Shareholders
Clients	Public authorities (communal, regional, and federal)	Management	HeidelbergCement Group
Suppliers and service providers	NGOs	Employees	
Federations	Residents	Trade Unions & delegates	
	Press and Media	Pensioners	
	Schools, and academic authorities		
	Students, and job seekers		
	Visitors of their production sites		

HeidelbergCement Benelux defines their stakeholders as "individuals and organizations affected by our activities and that can influence our plans and ambitions". They attach great importance in dialogue and exchange with their stakeholders in order to listen, understand, and answer to their requirements as well as to be transparent regarding their activities, realizations and projects.

Their commitments towards their stakeholders mainly include:

SATISFACTION OF THEIR CUSTOMERS

HeidelbergCement attach great importance to the satisfaction of their customers, to offer them sustainable and quality products and all range of services.

DEDICATED EMPLOYEES AND TOP EMPLOYERS

Their action plan to reach the safety target of "Zero accidents" has been developed through the introduction of certificates of performance, OHSAS 18001 (Occupational Health and Safety Assessment Series), toolbox meetings and trainings in order to ensure safety and reduce the rate of accidents in the workplace. Moreover, HeidelbergCement Benelux is planning to become *Top Employer* by 2015, which requires optimizing their human resource policy. For instance, the group organizes annual evaluations towards their blue-collar workers in order to identify their

competences and requirements. In return, the group's goal is to have dedicated employees and a decreasing absenteeism rate, often related to high workloads, stress and a lack of motivation.

PARTNERSHIPS WITH NGOS

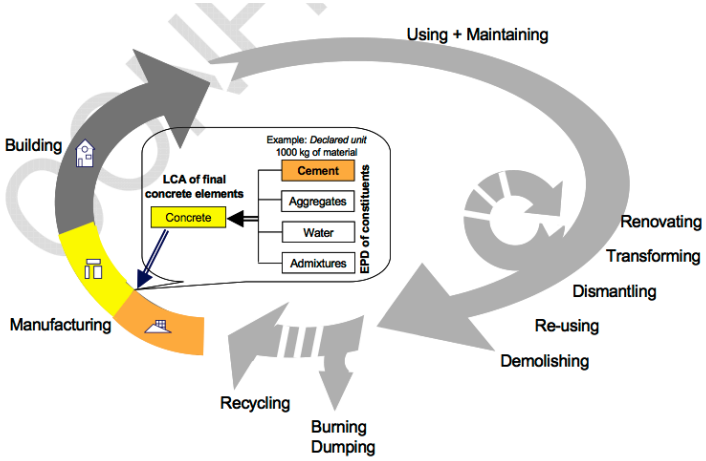
In 2011, the three subsidiaries in Belgium signed a partnership agreement with **Natagora**, nature protection association, active in Brussels and Wallonia which promotes a full cohabitation between the industrial activities and the natural ecosystems (animals, plants, insects, etc.). The respect of the biodiversity is translated into many scientific collaborations, biodiversity management plans, and concrete actions for several years. In addition, HeidelbergCement signed a global partnership with **Bird Life International** in October 2011.

CAP 2020

As part of its policy of eco-responsibility, it implies for CBR productive dialogues and exchanges with different actors of the building sector. As a result, CBR joints the Walloon cluster CAP 2020, which groups together companies from the building sector — builders, architects, and producers of materials and services — that adopt the European 2020 targets for reducing massive energy consumption. It is an open place of exchanges, of value creation, and of incentives to innovation. The cluster's objectives cover all dimensions of sustainable development.

Appendix 22 : LCA analysis and EPD Parameters

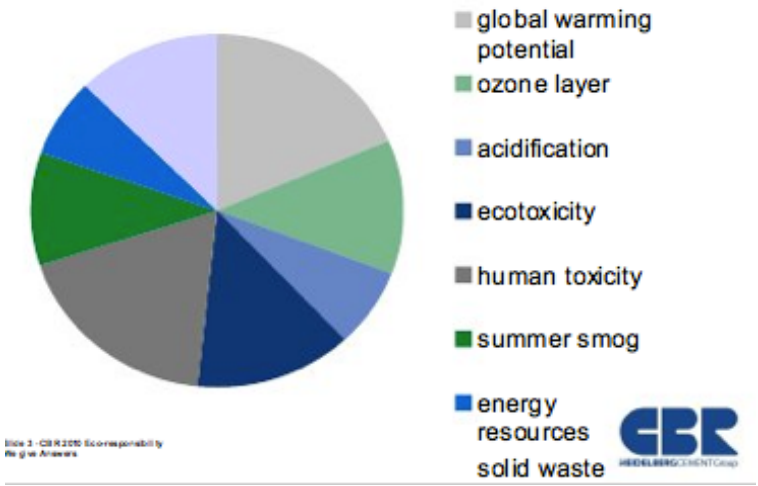
An EPD analysis of the cement is only prepared for the cradle-to-gate life stages of cement (See *manufacturing* process of graph below).



LCA analysis of the whole building process

Source: Cembureau Environmental Product declaration for cement

The parameters described below are taken into consideration in the EPD analysis.



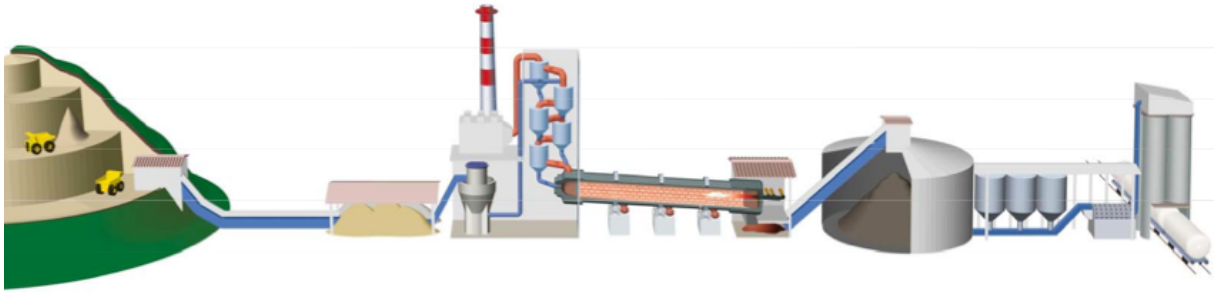
EPD parameters - CBR 2010

Source: Official website of CBR and their politic of eco-responsibility (http://www.eco-responsibility.be/)

Appendix 23 : Main phases of Cement Manufacturing

Source: Cembureau 2008

Hereafter a scheme of the Cement manufacturing process :



Appendix 24 : Breakdown of sources of emission of CO_2

Source: CBR Environmental Report 1999

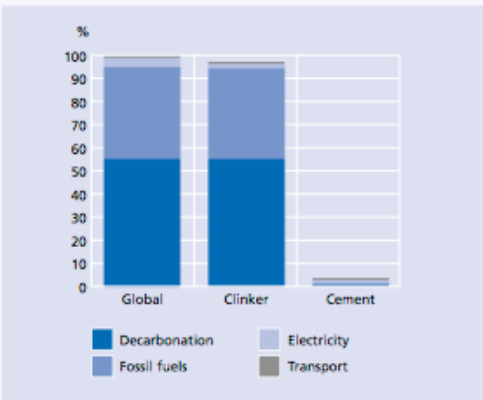
1. Burning of clinker : "95% of emissions are due to decarbonisation — reaction by releasing the CO_2 contained in the limestone raw materials — and the use of fossil fuels which when burned release the carbon that has built up over several million years. The remaining 5% are due to points 2 and 3".

From the graph, over 56% of all emissions result from the decarbonisation of raw materials, and almost 39% from fossil fuels.

2. Production of electricity "consumed during grinding of cement, fuels and raw materials, during preparation of the powder and the slurry, the preparation of fuels as well as that consumed by the dryers, kilns, fans, coolers, etc."

3. Transport of raw materials and fuels.

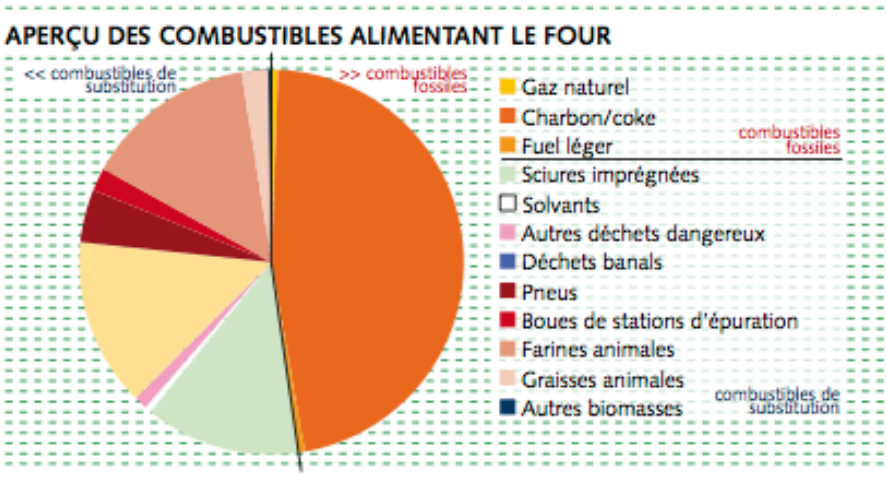
Emissions due to transport and electricity consumptions account for 5% of the total.



Breakdown of sources of emission of CO2 (CBR Cement Belgium, 1998)

Appendix 25 : CBR's Use Of Alternative Fuels

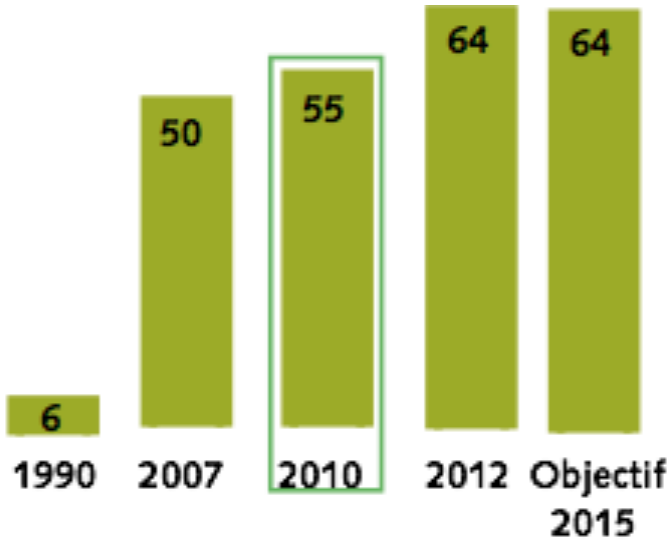
Source : CBR-InterBeton Environmental report 2006



CBR: Alternative fuels vs. Fossil Fuels

Source : HeidelbergCement Benelux, Sustainable development Report - 2010

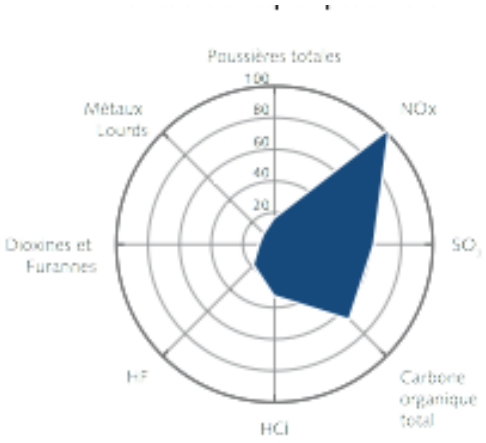
In 2010, 55% of the average energy needs of all the CBR production plants was covered by alternative fuels.



CBR: Use of alternative fuels (in %)

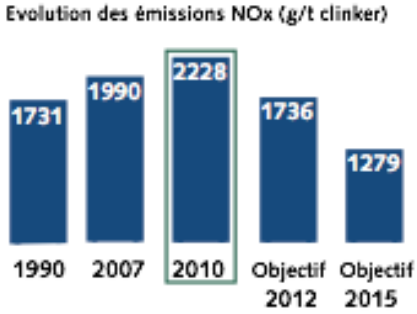
Appendix 26 : CBR: Monitoring Atmospheric emissions

Source: HeidelbergCement Benelux, Sustainable development Report - 2010



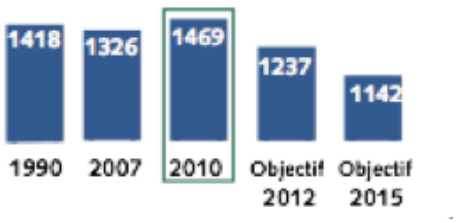
CBR: Atmospheric emissions in 2010

"The 100% value is the emission limit, the limit authorized for the environmental permit".



Evolution of NOx Emissions (g/t clinker)

"Thanks to the establishment of SNCR, the 2015 objective is to reduce NOx emissions by 30% (compared to 2009)".



Evolution of SO2 Emissions (g/y clinker)

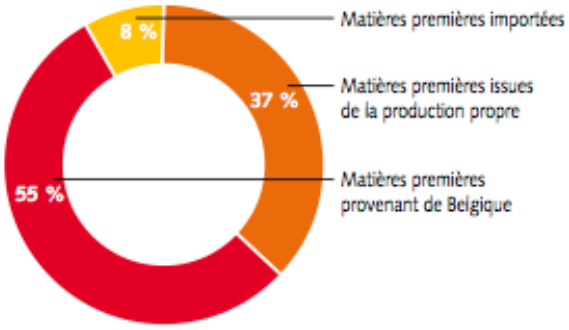
"In order to reduce SO_2 emission by 10% in 2015 (compared with 2009) CBR is planning to largely invest in new infrastructures in Antoing".

Appendix 27 : Origins of Raw Materials and Alternative fuels

Source : Sustainable development report - 2007/2008

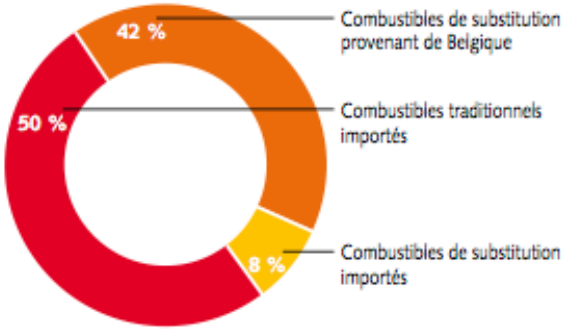
While more than 90% of raw materials come from local supplies, alternative fuels (42% of the energy mix) come from suppliers located in Belgium.

ORIGINE DES MATIÈRES PREMIÈRES (en %)



Plus de 90 % des matières premières proviennent de fournisseurs locaux.

ORIGINE DES COMBUSTIBLES (en %)

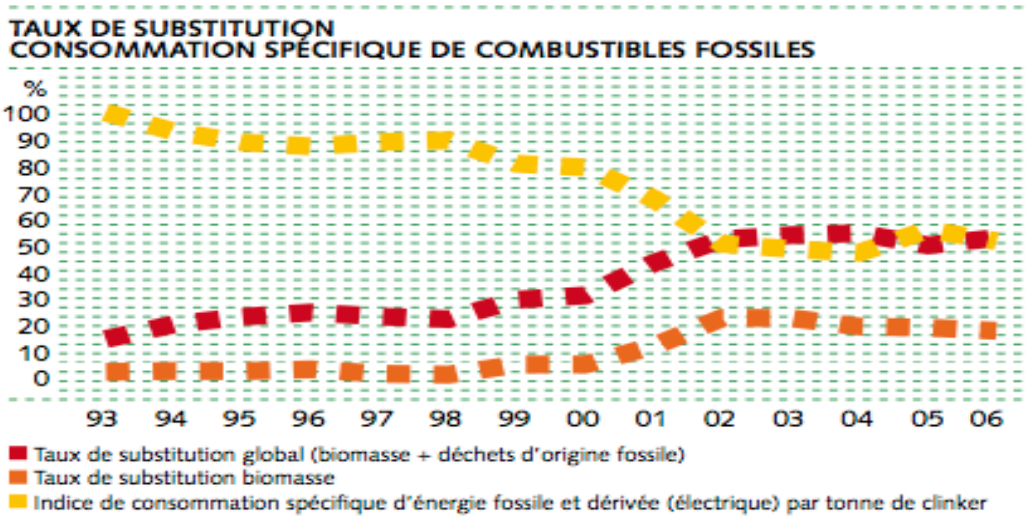


La moitié de notre approvisionnement énergétique repose sur des combustibles de substitution, dont la majeure partie provient de Belgique. Les combustibles traditionnels sont importés car ils ne sont pas disponibles en Belgique.

Appendix 28 : Substitution rate of alternative fuels

Source : CBR-InterBeton Environmental report 2006

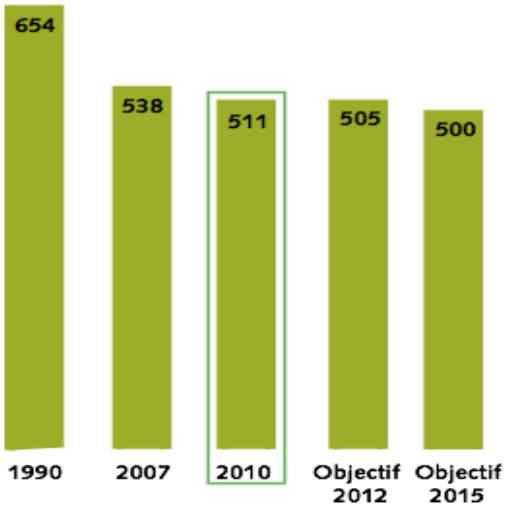
In 2006, the substitution rate accounted for 52%, a small increase compared to 2005.



Appendix 29 : *CBR's Evolution Of CO_2 Emission*

Source : HeidelbergCement Benelux, Sustainable development Report - 2010

CBR has reduced its CO_2 emissions per ton of cement produced, by 21%, compared to 1990.

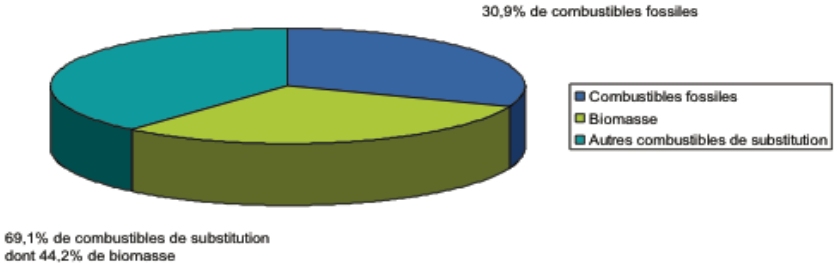


CBR: Evolution in kg of CO_2 /t cement

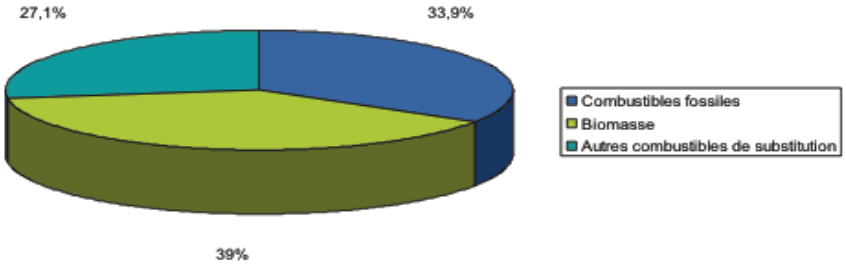
Appendix 30 : Repartition of fossil and alternatives fuels by CBR site of production

Source : Environmental and safety reports of Lixhe, Harmignies, and Antoing 2009/2010

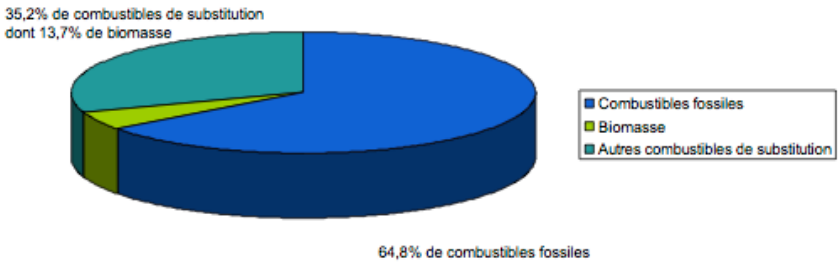
In 2009, CBR Lixhe covered 69,1% of its energy needs by alternative fuels.



In 2009, CBR Harmignies covered 35,2% of its energy needs by alternative fuels.

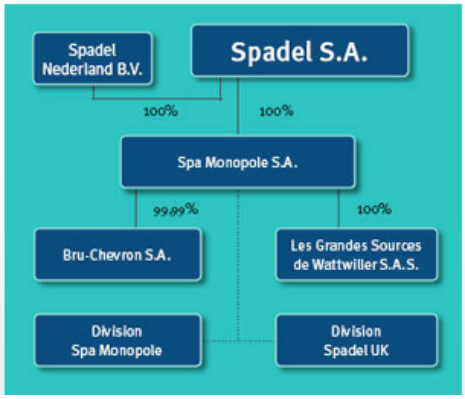


In 2009, CBR Antoing covered 66,1% of its energy needs by alternative fuels.



Appendix 31 : Spadel' Structure

Source : Spadel official website in http://www.spadel.com/groupe/presentation-spadel



The structure of Spadel Group consists in four production sites, and many distinct brands:

- Spa Monopole (Belgium) — ***Spa*** — gives access to mineral water, recognized for being sodium free and lower in total mineral salts than all leading European bottled waters (Mascha, 2012). Such mineral water is qualified as underground water, naturally pure (never chemically treated) and protect from pollution. "The water of Spa is the water that purifies". The land around the spring has been protected from pollution for centuries (more than 30 000 ha of pure sources and nature). It conducts to 5 distinct brands:
    - Spa Reine
    - Spa Marie-Henriette
    - Spa Barisart
    - Spa Fruit
    - Spa Citron
- 'Les grandes Sources de Wattwiller' (France)— ***Wattwiller*** — gives access to mineral water mainly for the French and Japanese markets (acquisition by Spadel in 2004).
- Lorcé (Belgium) — ***Bru*** — gives access to natural sparkling water (acquisition by Spa Monopole in 1942).
- Trap (Wales) —***Brecon Carreg*** — gives access to mineral water (acquisition by Spadel in 1983).

The main mission of Spadel Group is "to produce and commercialize, while respecting the environment, quality products based on natural water that bring added value to consumers". Optimal management of quality and environment, in its activities, as well as in its products and services, is an integral part of Spadel Group's objectives[67].

[67] More on Spadel Group: Spadel Official website, http://www.spadel.com

Appendix 32 : Spadel's Ambition In Brief

Source: Spadel Annual Report 2010

Appendix 33 : Spadel's main issues

Source: Le Roy Dirk, and Vandenhende Ann (July 2011), *How to establish a sustainability strategy and create ownership at executive and board level?,* Sustenuto

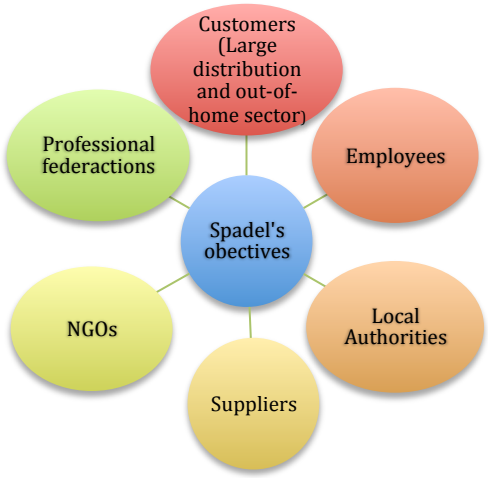
The 28 issues can be summarized as the following:

- **"Health claim issues** (differentiation from tap water, ingredients lemonades, obesity, ensure purity or safety)
- **Supply chain and procurement issues** (upstream with retailers, downstream with suppliers)
- **Social issues** (internally: issues related to employees, diversity, accidents, ... ; externally: minimal labor standards in supply chain,...)
- **Economic issues** (diversification, new 'enhanced water' products, water solution provider, consolidation, increased market share of store brands, competition of tap water, ...)
- **Water-related issues** (water resource management, climate change, protecting catchment areas, water footprint, water risk management, improving water efficiency, guaranteeing supply ...)
- **Carbon footprint** (carbon labeling, transport efficiency and sustainability, reduction of energy use, reduce refrigeration in innovative ways, ...)
- **Waste footprint** (reduce, recycling & re-use, optimizing the format of water bottles, biodegradable and compostable plastic, sustainable raw material sourcing, sustainability of marketing materials, disposable cups, ...)
- **Quantitative targets and objectives**
- **A genuine stakeholder analysis**
- **More and better reporting** (transparency)
- **Increase the coherence of CSR actions** (by e.g. the installation of a CSR committee)
- **Increase third party verification of non-financial information**
- **Subscribe UN Global Compact and follow GRI"**

Appendix 34 : Key Stakeholders and Stakeholder Meetings BE-NL

Source: Spadel Stakeholder Meeting on Corporate Responsibility Strategy Report (Feb., 2012)

Hereafter, key stakeholders of Spadel Group:



Spadel Key Stakeholders (Spadel,2011)

Hereafter the stakeholders that were present in the 'stakeholder meeting Belgium and The Netherlands' in January 2012.

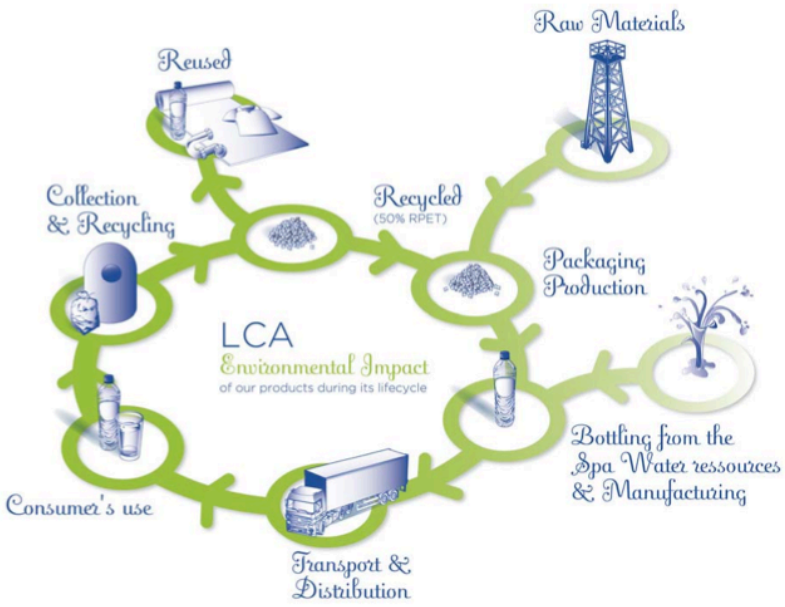
Stakeholders NL	Sources	Who are they?	Type of Interaction
Milieu centraal	http://www.milieucentraal.nl/	Independent educational organization that provides consumers with practical information on environment and energy in daily life.	Environment
Natuur & Milieu	http://www2.natuurenmilieu.nl	Environmental organization commited to create a healthy natural environment. By working together with people, businesses and governments we want to make a difference with renewable energy, sustainable mobility and healthy food.	Environment
Blonk Milieu advies of CE Delft	http://www.cedelft.eu/	Independent research and consultancy organization specialised in developing innovative solutions to environmental problems.	Environment
Nederlands Verpakking Centrum	http://www.nvc.nl/	Organization leading in education and training, proactive information services and in promoting joint sustainable innovation in packaging.	Packaging
Voedingscentrum	http://www.voedingscentrum.nl/	Independant organization to which people can turn with any questions they have on safe and more sustainable food.	Health
NIGZ (Nationaal Instituut voor de Gezondheidsbevordering en Ziektepreventie)	http://www.nigz.nl/	Intstitution that supports health promotion practitioners in schools, work places, health care and in the community	Health
Albert Heijn	http://www.ah.nl/	Supermarket Chain	Customer
Albron	http://www.albron.nl/	The largest catering company in the Nederlands (at school, university, etc.)	Customer

Stakeholders BE	Sources	Who are they?	Type of Interaction
Natagora	http://www.natagora.be/	Association aimed to protect the nature, preserve the biodiversity in Wallonie, and Brussels.	Nature and Biodiversity
City of Spa	http://www.spa-info.be/		Local Authority
Karott SA	http://www.karott.be/	Nutrition expert ; Provides communication consulting services to health and nutrition sectors in Belgium.	Health and nutrition
Fevia	http://www.fevia.be/	Profesional Federation aimed to represent, develop a sustainable food industry through the promotion of the best economic, social, and environmental conditions.	Professional Federation
Fost Plus	http://www.fostplus.be/	Private organization which promotes, coordinates, and finances the selective collection, sorting, and recycling of household packaging waste in Belgium.	Recycling and packaging
Colruyt	http://www.colruyt.be/	Belgian family company that is one of the major players in the country's retail network - discount supermarket chain.	Customer
Quick	http://www.quick.be/	Chain of hamburger fast food restaurants.	Customer
Réseau écoconsommation, Réseau consommateu	http://www.ecoconso.be/	Association network, experts in the field of environment, consumer protection.	Association network
Protos	http://www.protos.be/	Non-governmental organization aimed to work on a better orkd for the underpriviligeled people, in the area of water, to better water management.	Water management
WWF	http://www.wwf.be/	International non-governmental organization working on issues regarding the conservation, research, and restoration of the environment.	Nature

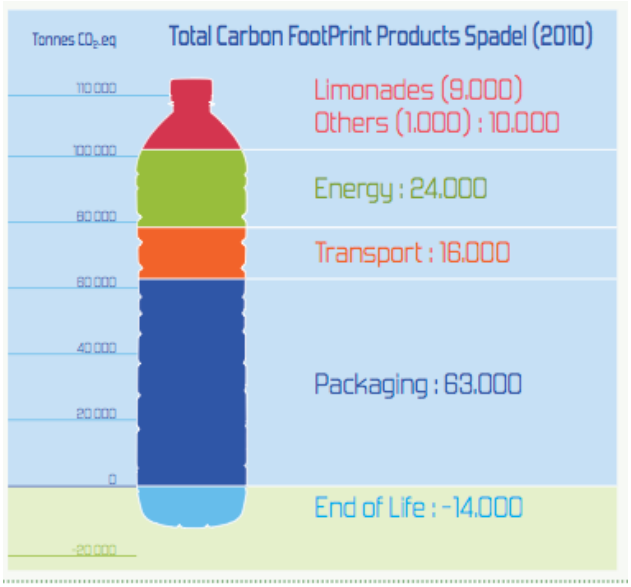
Appendix 35 : LCA approach of Spadel and Carbon Footprint

Source: Spadel Sustainable Development Report 2010

Life Cycle assessment is a method to evaluate the environmental impacts of Spadel from raw material extraction to the packaging production, manufacture, distribution, and recycling at the end of its useful life.



It results in a total ***Carbon Footprint*** of Spadel products (2010):



Major part of CO_2 emission concerns the *packaging* (addition of those related to packaging (bottle) and to end of life (recycling)). Then come *energy* and *transport*. 'Others' concern the production of lemonades, energy consumption of the distribution centers and emissions from the company's cars.