FLANDERS DC

INSPIRING CREATIVITY

Knowledge Partner

Vlerick Leuven Gent Management School

the Autonomous Management School of
Ghent University and Katholieke Universiteit Leuven

RESEARCH REPORT

IDENTIFYING OPPORTUNITIES IN CLEAN TECHNOLOGIES

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FLANDERS DISTRICT OF CREATIVITY

Flanders District of Creativity is the Flemish organization for **entrepreneurial creativity.** It was founded in 2004 by the Flemish Government as a non-profit organization and enjoys broad support. Flemish businesses, academia, and public institutions use Flanders DC as a platform for cooperation in the pursuit of a more creative Flanders region.

Creativity is the key ingredient in making companies more successful and in helping regional governments ensure a healthy economy with more jobs. Flanders DC inspires creativity and innovation:

1. by learning from the most **creative regions** in the world,
2. by igniting **creative sparks** in everyday life and business, and
3. by providing **research, practical business tools and business training,** in cooperation with the Flanders DC Knowledge Centre.

1. Districts of Creativity: Inspiration from the most creative regions

Responses to global challenges are best found within an international network of excellence. With the single aim of learning from the very best, Flanders DC aims to unite the most dynamic regions in the world within the 'Districts of Creativity' network. Every two years, Flanders DC convenes the Creativity World Forum, bringing together government leaders, entrepreneurs, and knowledge institutions to exchange ideas about how to tackle pressing economic problems and make their regions hotbeds for innovation and creativity.

2. Raising awareness: The best way to predict the future is to invent it

Flanders DC encourages entrepreneurs and citizens to look ahead and find creative solutions today for tomorrow's problems. Flanders DC has developed an idea-generation tool to encourage people and organizations to take the first step toward innovation. In addition, Flanders DC has run an awareness campaign entitled 'Flanders' Future' and has collaborated with national TV station één (VRT) on an idea show named The Devisers (De bedenkers).

3. The Flanders DC Knowledge Centre: Academic support

The **Flanders DC Knowledge Centre** serves as a link between Flanders DC and Vlerick Leuven Gent Management School. Each year, the Flanders DC Knowledge Centre publishes several reports and develops various tools, case studies and courses. All these projects focus on the role of creativity in a business environment and identify obstacles to, and accelerators of competitive growth.

The **Creativity Talks** – brief monthly, interactive info sessions – update you on these research activities. See www.creativitytalks.be for a current calendar and subscription information.

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In addition to these research projects, the Flanders DC Knowledge Centre has also developed the following tools and training sessions:

- **Ondernemen.meerdan.ondernemen**, an online learning platform
- **Creativity Class** for young high-potentials
- **Flanders DC Fellows**, inspiring role models in business creativity

FLANDERS DC FELLOWS

- **Creativity Talks**, monthly seminars on business creativity and innovation
- **Innovix,** online innovation management game
- **Flanders DC Academic Seminars,** research seminars on business creativity and innovation
- **TeamScan**, online tool

TEAMSCAN

- **Web 2.0 Readiness Scan**
- **HR Toolbox**

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1.1 Background

The natural environment has risen to the top of the agenda of policy makers, social and environmental movements and business organizations alike. This evolution should not come as a surprise. Despite the beneficial impacts industrial activity brings in terms of economic growth, employment, innovation and many other domains, the empirical material that warns humanity about the potential detrimental impacts of this industrial progress is also mounting. In particular, concerns are raised about its impact on the carrying capacity of ecosystems and the vitality and health of biological – including human – life (WCED, 1987; Perman, Ma, McGilvray, & Common, 2003; Worldwatch Institute, 2003; World Resources Institute, 2005). As a result of a wide variety of consumption patterns and production emissions, industrial progress shows effects on local air or water pollution, biodiversity losses, soil degradation, waste accumulation, as well as global scale effects of climate change, desertification, flooding and resource depletion, among others. Besides the questions that environmentalist movements have over time been raising on the morality of such human and organizational impact on the natural environment and the losses of intrinsic value embedded in it, a number of economists have argued that these effects are also depleting the very resources our economies are dependent upon (Stern, 2007; Costanza et al., 1997; World Resources Institute, 2005; Common & Stagl, 2005).

In order to respond to these environmental challenges, there has been a (recent) revived interest in the phenomenon of “clean technologies”. With the purpose of providing technical solutions to eradicate existing pollution, but also to provide more environmentally efficient production processes, clean technologies are hoped to provide the technical means to simultaneously tackle environmental challenges and stimulate further economic development. Yet despite its promise in facilitating sustainable development, the path to success for clean technologies is paved with challenges. Besides the challenges that come with any innovation for which new markets have to be developed, green technologies present a specific challenge to business. Standard economic theory suggests that firms using green technologies, thereby voluntarily refraining from causing negative externalities on the natural environment, face the peril of bearing costs associated with such initiatives that careless businesses do not (Coase, 1960; Hardin, 1968; Pigou, 1920). Besides the “low hanging fruits” of eco-efficiency measures (Porter & van der Linde, 1995b), market rewards and market opportunities for internalizing environmental problems usually do not exist (Cohen & Winn, 2007; Dean & McMullen, 2007).

1.2 Research objective

The purpose of this report is to understand how “clean technology” entrepreneurs are able to identify and/or create opportunities despite the market challenges that were presented. In order to answer this question, we first analyze why the challenges for clean technologies exist, and how they relate to the processes by which entrepreneurs identify or develop opportunities. In the end, our aim is to provide a framework and a set of tools that are based on a thorough review of the literature and a number of cases that should enable entrepreneurs and their supporting ecosystem to identify viable opportunities in clean technologies themselves.

To make this overarching research objective more concrete, we will focus our work on three main research questions:

1. What are clean technologies and what is their importance?
2. What challenges do clean technologies face?
3. How do entrepreneurs create value in a way that overcomes these challenges?

2.1 What is clean tech?

The notion of "clean technologies" has infused the long existing discourse on "environmental strategies", "environmental management" and the likes with a new spirit. Although there are many reasons for this, one important one is without a doubt that it reconciles the progress imperative in Western thinking with an increasing awareness that our past progress is putting us in trouble if we want to maintain our current standard of living. Through innovation, it is hoped that new technologies will emerge that replace polluting processes with cleaner ones, or that reduce current pollution levels in a way that does not compromise our current comfort levels. These technologies, which we refer to as "clean technologies", are then "any product, service, or process that delivers value using limited or zero non-renewable resources and/or creates significantly less waste than conventional offerings." (Pernick & Wilder, 2007: 2).

Clean is more than green

Clean technology, or "cleantech," should not be confused with the terms environmental technology or "green tech" popularized in the 1970s and 80s. Cleantech is new technology and related business models that offer competitive returns for investors and customers while providing solutions to global challenges.

While greentech, or envirotech, has represented "end-of-pipe" technology of the past (for instance, smokestack scrubbers) with limited opportunity for attractive returns, cleantech addresses the roots of ecological problems with new science, emphasizing natural approaches such as biomimicry and biology. Greentech has traditionally only represented small, regulatory-driven markets. Cleantech is driven by productivity-based purchasing, and therefore enjoys broader market economics, with greater financial upside and sustainability.

Cleantech represents a diverse range of products, services, and processes, all intended to:
- Provide superior performance at lower costs, while
- Greatly reducing or eliminating negative ecological impact, at the same time as
- Improving the productive and responsible use of natural resources

www.cleantech.com

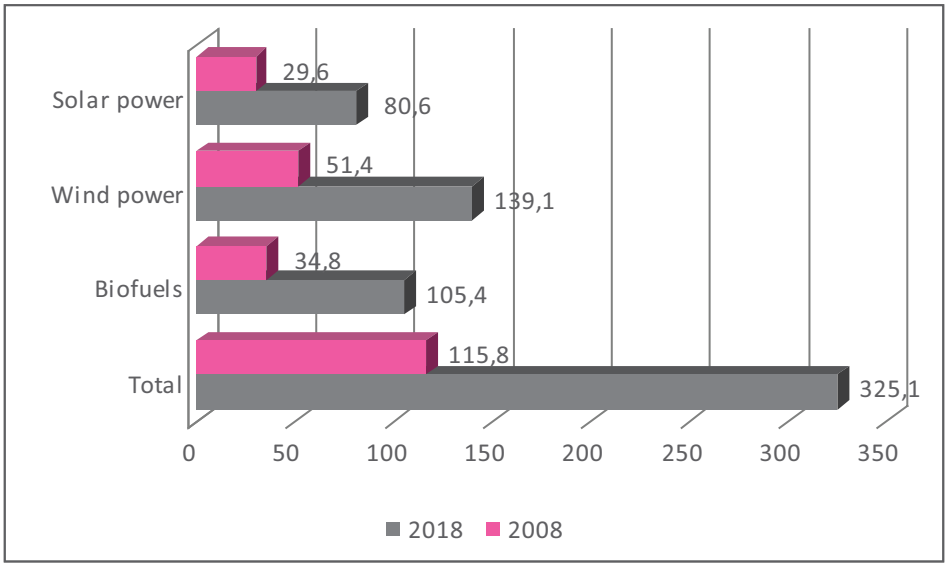
Emphasizing this new spirit that is associated with clean tech is important, as can also be noticed in the box "Clean is more than green". The box shows the definition of clean tech as proposed by the Cleantech Group, one of the leading clean tech venture networks in the world. From the outset, it is clear that they want to be perceived as something that is different than merely "environmental technology" or "green technology". Rather, clean tech aims to be associated with an optimism that environmental problems can be tackled by economically sound and innovative solutions, attracting investors and business savvy people to environmental problems that may previously have been scared off by the often pessimistic and business unfriendly discourse of environmental movements. Notwithstanding this clear focused positioning in the sphere of environmental strategies, the scope of clean technologies is as broad as environmental problems can be. Whereas some clean technologies aim to provide alternative energy production and storage means (e.g., solar panels, wind turbines, biofuels, geothermal, tidal or hydro power), others are focused on cleaning, recycling

or purifying waste streams in water, air and soil (e.g., reverse osmosis and other water filtration systems, low emission technologies, wastewater treatment or carbon sequestration systems). Yet others aim to generate new sources of materials (bioplastics, nanotechnology). Although each of these technologies shares a positive effect on the natural environment as a common denominator, they are at the same time so different that the label “clean technology” is almost the only thing they have in common. In contrast to information technology or biotechnology, clean technologies are active in different markets, have different technical attributes and face challenges that are grounded in different scientific areas (The Clean Technology Report, 2009). Solar cells are constrained by hours of daylight and efficiency, but with large potential in off-grid areas in developing countries. Wind turbines are challenged by mechanical problems constraining durability and wind speed variations, but may have a large potential in capturing energy in off-shore areas. Biofuels face mounting scrutiny due to their potential effect on food prices, but may provide additional solutions for the development of bioplastics. While cogeneration plants, wind turbines and solar cells are already gearing up for maturity, other technologies such as geothermal and tidal power are still in their infancy (Rubino, 2009). Yet there are two aspects that all clean technologies share: first, they are booming business, and second, they are booming despite the fact that standard economic theory would predict such success to be impossible. We will discuss each of these aspects below.

2.2 The success of clean technologies

After years of a slow and tedious growth, the size of clean technology markets has adopted growth rates that equal those of the computing boom in the 1980s, the internet boom of the 1990s and the biotech and nanotech booms of the early 2000s. Clean Edge, a clean energy consulting firm, has estimated the overall revenues for solar, wind and biofuel sectors to amount to 115,9 billion dollars in 2008 (Makower, Pernick, & Wilder, 2009). Compared to one year before, when revenues were about 75,8 billion, this means a growth of more than 50%. During that same time, total investments in clean energy technologies expanded by 4,7% from 148,4 billion dollars in 2007 to 155,4 billion in 2008. Furthermore, Clean Edge projects these revenues to grown aggressively in the future as well. As can be seen in Figure 1, it is expected that the total revenues will nearly triple in 10 years time.

Figure 1 Global clean energy projected growth in US$ billions (source: Makower et al., 2009)



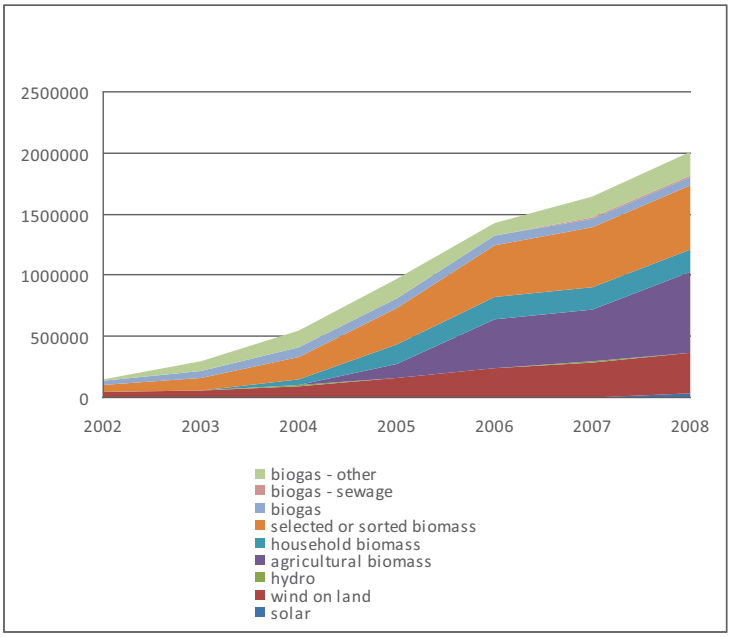
Besides this potential growth in revenues, clean technologies are expected to result in a tremendous direct and indirect growth in jobs. Again, Clean Edge suggests that between 2008 and 2018, the total amount of jobs in wind and solar industries will more than quadruple. Perhaps as a result of this, we see that particular regions in the world take the lead in absorbing clean technologies in their economies. Brazil, for example, sources half of its automotive fuel supply from bioethanol (Makower et al., 2009), a biofuel based on the fermentation of sugarcane, and should soon also produce 15% of its electricity based on the burning of sugarcane waste (The Economist, 2008). Similarly, Denmark already generates over 15% of its electricity from wind power.

Another indication of the success of clean technologies is the reorientation and investment of a number of highly visible and business savvy individuals and organizations into clean technologies. Vinod Khosla, one of the founders of Sun Microsystems and a renowned venture capitalist, Virgin founder Richard Branson, Google founders Larry Page and Sergey Brin and PayPal founder Elon Musk are but some of the business icons that have turned their funds and attention to the development of clean technologies (The Economist, 2008). Large companies like General Electric and DuPont are pouring large investments into developing clean technologies as well. Although not presenting a complete picture of the total amount of capital that is invested globally in clean technologies, Figure 2 displays the total amount of venture capital and number of deals in clean tech since 2001. As can be seen, the interest increased sharply as from 2002, with a steep rise in invested capital beginning in 2005. It is also very clear that the financial crisis had a significant impact on the amount of venture capital invested in clean tech. Presumably, this is because stock markets made it difficult for clean tech firms to go public, with investments remaining locked in as a result and becoming available for new investments.

Figure 2 Total venture capital invested in clean tech in the world (source: Cleantech.com)

The numbers as presented above stand in large contrast to the assumptions as typically proposed by standard economic theory that proposes that environmental initiatives, though desirable from a societal welfare point of view, are typically not valued by the market. The main reason for this is that environmental resources are unique in their difficulty to be included in market allocation mechanisms. As a result, markets tend to foster environmental degradation rather than environmental improvement. In order to better understand these challenges, and how entrepreneurs may be able to deal with these challenges, the next chapter is dedicated to the challenges associated with clean technology venture development.

Figure 3 Number of green energy certificates distributed per year in Flanders (1 certificate = 1000 kWh) (source: VREG, 2009)



Since we depend on our natural environment for oxygen, food, water, space, leisure and so many more functions in our lives, a logical conclusion would be that human beings would naturally take care of these very resources on which we depend. Over time, however, economists have provided great analyses to explain a phenomenon that we have been increasingly able to notice: human beings generally experience serious difficulties to voluntarily take care of the natural environment. Ronald Coase, and most recently, Elinor Ostrom, for example, received a Nobel Prize based on their insights of why people and organizations generally tend to produce environmental degradation. A key concept in their analysis is that there are many situations where the market mechanism does not provide the right **incentives** for them to take care of the environment, simply because natural resources are either underpriced, or not priced at all.

As a matter of introduction, a simple example to illustrate the importance of incentives: Imagine you are selling apples at 2 euro per kg and your neighbour at 1 euro per kg. In this situation, it is most probable that consumers would be more inclined to buy apples from your neighbour. Because you find yourself not selling anything as a result, you experience an economic "incentive" to sell your apples at a lower price and match the price of your neighbour. In other words, the market mechanism provides information about the value of the apples to your neighbor (as a result of, for example, the expenses he wants to see covered, or his strategic positioning) and to consumers (how much apples are worth to them) and forces you to think about whether you are producing and selling apples in the most efficient way. In order to understand the challenges of clean technologies, it is important to understand that the natural environment typically does not provide such information to producers or that the information is drowned in a flow of conflicting incentives Furthermore, if we want to understand how clean technology are nevertheless able to have success, we need to see how producers can overcome these challenges. Explaining where this lack of information comes from is the goal of this particular chapter.

3.1 The natural environment as a common good

One of the most important reasons why people do not receive incentives from the market to take the natural environment into account, is simply because environmental issues are often not included in market transactions. Many natural resources are "common goods": they are indivisible in nature, which hinders the necessary allocation of property rights that allow market transactions to put a price on the consumption of the common good (Perman et al., 2003). Having a price is important, because it provides the user of natural resources with the information necessary to understand how valuable the consumption of that resource is to others. As a result of the inability to put a price on clean air, water, fish in the sea, etc., people are unlikely to consider the free consumption of those common good in their "costs". Furthermore, the problem of common goods is that they are "nonexcludable". If I install a machine that cleans water or air, it is virtually impossible to exclude someone from consuming the benefits of that effort for free. In addition, whether or not I consume or produce clean air, this generally does not affect its availability for other consumers. Such situations where markets generally are unable to provide the incentives for people or organizations to sustain the natural environment on which they depend are called "market failures" (Coase, 1960). A market failure is a situation where free market competition is unable to lead to an equilibrium that provides

the maximum level of welfare to society (Arrow & Debreu, 1954), in this particular case: a natural environment that is able to sustain the well-being of its inhabitants. Again, the reason why the natural environment elicits market failures is because for many environmental resources, markets simply do not exist (Pigou, 1920; Coase, 1960; Hardin, 1968). The three most important situations where this exist in the context of the natural environment are "externalities", "tragedy of the commons" and "inefficiency". What we will show, is that in each of these cases, there is no reward for those organizations that would voluntarily take the natural environment into account.

3.1.1 Externalities

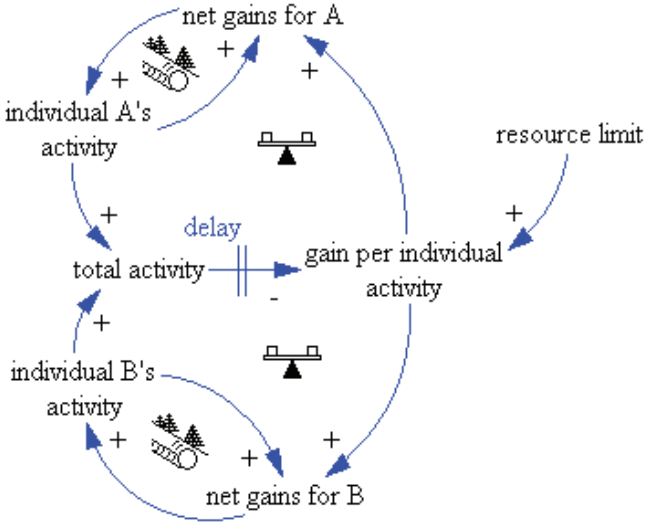
The first situation, externalities, occurs when the cost of a transaction is carried by someone that has not consented to or has played any role in the execution of that transaction (Coase, 1960; Pigou, 1920). In other words, when I pollute the environment, I am actually consuming a clean resource that has value as a clean resource for someone else. The problem however, is that I often don't know whether or how much I pollute because I don't not get any feedback from those affected by the pollution. For example, a company dumping polluted water in a river could deteriorate the quality of water downstream of the river, thereby killing the fish on which local fishing economy depends. Without external policing, however, such information would never reach the polluting company, and would just continue its polluting practices. Similarly, excess manuring may generate higher water-treatment costs off-stream due to toxic nitrogen-surpluses leaching from the manure into the ground water. Whereas this may give bad-willed polluters the incentive to produce externalities because they cannot be caught or sanctioned for producing them, externalities are not always the result of deliberate ignorance or bad-willed intentions: the polluting or welfare-destroying effects are simply not visible to its creator and he or she may thus not be aware of the externality. Furthermore, the effects of externalities are not always traceable to one specific actor: some emissions or consumption patterns only become harmful as a result of the culmination of the practices of a host of actors. In summary, a recurring feature in these situations is that the polluting firm receives no incentives from the market to internalize the costs inflicted on third parties.

> *"Economic systems make many polluting and wasteful goods seem alluringly inexpensive because they do not incorporate the full ecological costs of their production or use. These costs are passed on to future generations, transferred to nonusers of products as taxes or exported to less environmentally regulated countries." (Shrivastava, 1995: 941).*

3.1.2 The tragedy of the commons

The second situation, "the tragedy of the commons" (Hardin, 1968; Ostrom, 1990), refers to a situation where the short-term consumption of clean air, fish, pasture or any other common good, may extinguish the longer term existence of the natural resource. Without external constraints imposed or artificial markets created through quota trading or permits, economic agents lack the feedback mechanisms (i.e. discounted future costs reflected in the price) that signal the longer term peril of overconsuming the common good. As a result, they will tend to continue consuming the free common good until it is entirely gone.

Figure 4 The tragedy of the commons archetype (source: Wikipedia)



A typical example of the tragedy of the commons can be found in fisheries: by fishing too much, the regenerative capacity of fish is endangered in such a way that the population cannot be sustained. We use this example to introduce a very powerful tool to analyze whether a system has the right incentives in place to allow for long term success. Figure 4 shows the "system archetype" of the tragedy of the commons. A system archetype shows a known cause and effect system that drives behavior of a system. An arrow with a "+" sign indicates a positive stimulus, while "-" sign indicates a negative stimulus. Imagine that "A" in Figure 4 is a fisherman who finds a new fishing pond in a village. He starts fishing and sells his catch on the local market. Because he easily sells his fish ("net gains for A"), he receives a positive stimulus to increase his efforts in fishing ("individual A's activity"). As a result, this system acts like a snowball mechanism: the more he fishes, the more he gains. But of course, the fisherman's success does not go unnoticed and starts to attract other people ("B") to start fishing as well. They too experience the same incentive mechanism and so they too try to catch as much fish as possible. Their joint fishing activity ("total activity"), however, also results in diminishing returns: as the number of fish in the pond is limited ("resource limit"), the higher the total activity, the lower the gain per individual activity. The problem, however, is that this does not stimulate them to lower their fishing activity. Even though their revenues are decreasing, they are still better off fishing as much as possible. If fisherman "A" would voluntarily refrain from fishing as much as possible in order for the fish to be able to regenerate in a way that ensures the long term ability to fish from the pond, that would only give a higher incentive to fisherman "B" to fish more. As a result, both fishermen will intensify their fishing efforts, and generate the tragedy that there are no fish left in the pond. Using this system analysis, it is clearly visible how the incentive system naturally evolves to environmental deterioration and punishes environmental friendliness.

3.1.3 Inefficiencies

Finally, since there is no or little (perceived) cost for using common goods, there are no economic incentives to use them in a way that is socially efficient (Baumol & Oates, 1988). Because air, soil and water are (mostly) abundantly present, we do not have an incentive to voluntarily clean polluting discharges in it. In summary, firms that want to voluntarily refrain from causing externalities or social harms stemming from resource depletion face the peril of bearing the cost that careless businesses don't. At the same time, these latter businesses may benefit from the efforts from the former. Similar to the difference between those who pay and those who don't pay for a train ticket, the polluters free-ride the non-polluters' efforts. As a result, environmental strategies are often perceived as costly endeavors that do not create market positions that are favorable from a strategic point of view (Walley & Whitehead, 1994; Reinhardt, 1999).

> *"In a world where environmental externalities were the only departure from the assumptions of perfect competition (…) firms that volunteered to internalize these costs could not survive." (Reinhardt, 1999: 10)*

While the challenges that were described in this chapter help to understand why business organizations have found considerable difficulty in adopting environmental strategies, but have also been reluctant to look for opportunities related to it, it does not explain the recent growth that was demonstrated in the first chapter. By means of a review of the literature, supported by a number of case studies, the following chapter aims to provide an insight on how clean tech companies have been able to overcome these challenges and capture value while addressing the environment.

Although the domain on clean technology entrepreneurship is still in its infancy, a number of lessons have nevertheless been drawn over the years. In this chapter, we summarize these lessons and indicate how other companies could learn from their successes and failures.

4.1 Addressing environmentally conscious consumers

The first strategy to overcome environmental market failures is to focus on those customers that do not fit the stereotypical customer type on which market analysis is based, i.e. people that will only buy a service or product when the costs are lower than the value they are able to personally capture from it. For some people and organizations, however, conserving the natural environment is a moral imperative, provides social status benefits, or presents any form of benefit that they consider a value worth paying for. A first way for a company to overcome environmental market failure is therefore to appeal to the moral or social responsibility of these customers. In return for the additional efforts that the company does to internalize environmental effects, it aims to capture a price premium for its differentiation as a more environmentally friendly alternative (Reinhardt, 1998).

An interesting example of a clean tech company that deliberately overcame market failures by catering to environmentally conscious consumers is the marketing strategy of Ecover. Founded in 1979 by chemist Frans Bogaerts with the purpose of creating a more environmentally friendly detergent, Ecover was one of the first companies that sold detergents entirely based on natural products instead of petrochemicals and phosphates. In order to signal this deliberate eco-friendly orientation, Bogaerts named both the brand and his company “Ecover” (Gabel et al, 1995; Larson et al, 1999). Using a number of business contacts, Ecover set out to sell its products in very specific selling points: health food stores. Although health food stores did not have a history in selling detergents or cleansers, they catered primarily to a customer base of environmentalists that had gained both age and wealth since their interest in environmental issues emerged in the late 1960s. Not only did this customer base have an interest (and willingness to pay) in Ecover’s product features, they were also wary of traditional company detergents that had the image of causing allergies and environmental problems such as eutrophication. As such, health food stores presented a well protected niche that protected Ecover from competition from large firms like Procter & Gamble, Unilever, Henkel and the likes. Ecover quickly saw its demand increasing. Instead of relying on large marketing campaigns, they communicated in a very open way towards their customers, for example by issuing a manual in different languages explaining their key principles and how they differed from traditional detergent producers. Despite these lower advertising costs, Ecover’s retail prices were typically 20 to 30% higher than traditional detergents sold in supermarkets, mainly because of their renewable production and packaging of raw materials, and their fragmented distribution system. Although Ecover saw its sales increasing substantially between 1980 and 1990, the entire “green detergent” market represented only 1% of the total detergent market. In other words, it had been successful in its niche strategy, but had not been able to break out. When they subsequently moved into the supermarket space, they soon discovered the “market failure” space: customers were interested in more environmentally friendly products only when they were able to get the same quality at the same price. Customers complained that Ecover failed to make clothes “whiter than white”, mainly because Ecover refused

to use optical brighteners, an artificial way of making washed clothes look whiter. Furthermore, because other companies saw the success of green products, they jumped on the bandwagon, often with only marginal ecological improvements. Furthermore, a study came out in the mid-1990s that questioned the difference between “green” and “regular” products. As a result, the “green” product differentiation started to erode and had some retail chains even decide to remove “green detergent” from their shelves as a product category altogether. With its strong emphasis on integrity and open communication, and relying on two factories that are by themselves (in addition to the product that they produce) spearheading environmentally friendly production methods (built with 100% recyclable and biodegradable products, and several times more efficient in the use of energy and water), Ecover has been able to maintain a strong brand as a green detergent, but now with a lower price premium.

This case description highlights a number of aspects that have been suggested as important success factors for environmentally friendly product differentiation. For such strategies to have success, three factors have been proposed (Reinhardt, 1998):

1. the business must find, or create, a willingness among customers to pay for environmental quality;
2. the business must establish credible information about the environmental attributes of its products; and
3. its innovation must be defensible against imitation by competitors.

4.1.1 Willingness to pay

Even though customers may want to pay a price for their contribution for a better environment, it is evident that there are limits to the prices customers will nevertheless want to pay. Importantly, however, “the natural environment” is a broad continuum of issues that are not all valued in the same way and will also depend on personal characteristics. In a study on the value of ethical product features of bath soap, for example, some customer segments attributed a high value to “biodegradability” and “low levels of animal byproducts”, whereas for others “animal testing” was the most important ethical feature, and again others were not sensitive to any of these issues at all (Auger, Burke, Devinney, & Louviere, 2003). Interestingly, these customer segments varied in terms of such segmentation variables as education, income range and age. Typically, environmentally friendly customers tend to be higher educated, more affluent and slightly older customers (Bearse, Capozucca, Favret, & Lynch, 2009). The Ecover case is in line with these findings, since health food customers represented an older, more affluent and more environmentally sensitive consumer profile. The appropriateness of this market segment in the beginning years of Ecover when asking price premium was still necessary became especially clear when Ecover started catering to supermarket customers, who were clearly no longer satisfied to buy Ecover product merely on its environmentally friendliness.

Further adding to the necessity to well analyze market segments before marketing clean technologies based on environmentally friendliness is a study of green purchasing behavior among over 6000 shoppers in the US (see Figure 5), in which Bearse and colleagues found that the likelihood of environmental purchases also depended on the product type. Products that were more often consumed had clearly higher relative percentages of environmental product purchases. This finding

is also in line with the analysis by Reinhardt (1998) that the consumption patterns for environmentally friendly products will be different depending on whether the transaction takes place in industrial or consumer markets.

Furthermore, the willingness to pay seems to change depending on the number of product attributes that are simultaneously used to brand the product. In other words, companies may overcome the market failure of branding a product as contributing to resolving an environmental issue by capturing this feat under the broader umbrella of "quality". However, this foreshadows an important element in branding environmental products: merely focusing on the environmental benefits of a product will either quickly encounter the constraints of a small market niche, or will face the challenges of the environmental market failures as presented above.

Figure 5 % of shoppers purchasing green products (Bearse et al., 2009)

4.1.2 Supply credible information about the environmental benefits

As a second important success factor for branding based on environmental benefits is the supply of credible information. As the Ecover case clearly showed, once the legitimacy of the above normal efforts towards the environment were questioned, direct and indirect customer purchasing willingness were significantly diminished. By providing transparent information and consistency in their decision-making, however, they were able to maintain the level of credibility necessary to keep convincing customers of the credibility of the brand "Ecover" that was obviously conveying the message that this concerned an eco-friendly company.

Marketing exclusively on environmental product features will thus depend greatly on a company's ability to convince customers of the environmental benefits they are contributing to through their purchases. Companies have developed several approaches to this problem of credible information, including ecolabels, third-party certification and self-certification initiatives. As we will further argue, however, things become significantly more difficult when such initiatives do not exist and have to be developed. The Ecover case shows that such labels are not always favoring the success of the company.

In 1991, the European Environment Ministers jointly agreed on establishing an ecolabelling scheme for a broad range of products. During the negotiations that took place before setting the specific criteria for detergents, large detergent firms insisted on using only using packaging and energy consumption in the washing cycle in the criteria, whilst smaller companies (like Ecover) argued that differences between synthetic and natural ingredients in the detergent itself had to determine whether a product received an ecolabel or not (Gabel et al, 1995; Larson et al, 1999). Interestingly, while environmental movements were the primary advocates of the ecolabelling scheme, Ecover considered it a serious threat. Because adopting packaging and energy consumption during washing as the main criteria for a European ecolabel would enable large manufacturers to brand compact-powders with high levels of active ingredients that required low temperatures to brand otherwise toxic products as ecofriendly. Given that the only way Ecover was able to differentiate itself in the market was through its environmentally friendly image, this ecolabel could severely undercut its differentiation ability in the market. This shows how, besides providing credible information, the ability to justify price premiums will depend on the performance of a company relative to its competitors and how it is able to maintain it. This is the third and last condition to overcome environmental market failures by catering to environmentally conscious consumers.

4.1.3 Defense against imitation by competitors

A third and final factor determining the success of environmental product differentiation strategies is the ability of the firm to differentiate itself from competitors (Reinhardt, 1999). Most importantly, customers will need a clear perspective on why it is that they are paying a premium for the product or service they buy. While this is not unique for clean technologies per se, the problem for clean technologies is that other companies may try to brand themselves as environmentally friendly with only marginal environmental improvements, thereby both free-riding the efforts of trustworthy players in the market, but also eroding the credibility of the notion "environmentally friendliness". In addition, what is considered environmentally proactive now may become standard practice over

time, thus decreasing the willingness of consumers to pay a premium for a particular product. As a result, maintaining a credible and more than average effort towards the environment relative to standard practice in the industry will be necessary in order to justify the price premium to be paid by environmentally conscious customers.

In the Ecover case, the differentiation was originally achieved as a result of its environmentally friendly product features. After 10 years, however, Ecover decided to invest in the building of an entirely ecological factory. The objective had been to create a factory that was a closed-loop ecological system that was 100% recyclable and biodegradable and produced zero emissions. The opening of the factory in 1991 generated considerable press attention across the world and the company received several prizes and numerous visitors over the years as a result of its proactive approach towards the environment (Gabel et al, 1995; Larson et al, 1999). As a result of this strategy it was able to send a clear and consistent message around the world about the level of proactiveness towards the environment Ecover stood for, which was ahead of all of its competitors, even in other industries.

4.1.4 The limitations of the environmentally conscious market segment

In the previous analysis, it became clear that one way to overcome the market failures associated with the natural environment is to ignore the basic premise on which the analysis is built. Furthermore, the analysis also provides a number of important cues that enable a clean tech entrepreneur using such a strategy to be successful. Box 1 summarizes these strategic implications.

Box 1 Strategy 1: Catering to Environmentally Conscious Consumers

Market failure solution:

Focusing on those consumers that base their purchasing decisions on altruistic or moral motives that deviate from the standard economic rationale and are willing to pay a price premium for environmentally friendly products or services

How?

- Segment the market based on willingness to pay:
  - For what environmental feature are people willing to pay?
  - What are demographic features of market segments that demonstrate willingness to pay?
  - Where and how do these market segments tend to purchase?
- Prove that consumers will, through their purchases, contribute to environmental betterment
  - Ensure transparent and credible information about how the product or service resolves a significant environmental issue
  - Be significantly more proactive than standard practice so that the premium price is justified

The previous analysis, however, also shows that opportunities for clean technologies are only for a small portion driven by the market potential among environmentally friendly consumers. Given that the market share for such customers tends to remain under 5%, the opportunities for growth are severely constrained. Not that the remaining 95% of customers are not sensitive to or not aware of appeals for environmental improvement or conservation, but they are simply not willing to pay a premium for it. From our analysis of environmental market failures, however, this limited potential for the exclusive focus on environmental benefits as a value proposition should not come as a surprise. Even when they know that a voluntary contribution to environmental betterment is in their long term interest, in normal market conditions, people and organizations receive more incentives not to pay for such environmental betterment. In order to understand when clean technology opportunities may mainstream and conquer larger shares of the market (which would also justify why such actors as venture capitalists have an interest in them to begin with), other factors will become key. To put it briefly, in order for clean technologies to win the market, it will be necessary – like in any other type of market – to either play the game in a better way, or to change the rules of the game. Both these strategies are the focus of the next sections.

4.2 Playing a better game

The Ecover case was instrumental in learning how firms can address environmentally conscious consumers and use them as a niche to grow their business, but it also showed the conditions for success once it moved into supermarkets and tried to win customers in general. A recurring element in much consumer research is that people and organizations are interested in eco-friendly products, but only if they also fulfill all the other needs that other products provide: they need to be at least as cheap, as lightweight, as disposable or to have any other product feature that determines the comfort customers are used to. Preferably, however, the new clean technology even enables them to do things cheaper, quicker, more reliable or the like, and solves a problem for which previously no solution existed. In other words, if clean tech firms want to be successful beyond the eco-friendly niche, they will have to play by the general rules of the market.

Fortunately for clean tech entrepreneurs, “the world does not deliver market failures one at a time” (Reinhardt, 1999: 45): environmental market failures coexist with other market imperfections and latent inefficiencies in the market that provide opportunities to be exploited. Paying attention for the natural environment may in fact enable firms to see existing or new problems through a new lens, and as such come up with technologies that provide solutions for these challenges and contribute to environmental conservation or betterment at the same time.

4.2.1 Solving inefficiencies

As mentioned earlier, pollution of natural resources tends to originate from a lack of feedback information that indicates the scarcity of the natural resource or the value to third parties. However, any form of pollution, or waste production more generally, can be seen as a form of economic inefficiency. As Michael Porter and Claas van der Linde put it:

> *"Fundamentally, it [pollution] is a manifestation of economic waste and involves unnecessary, inefficient or incomplete utilization of resources, or resources not used to generate their highest value. In many cases, emissions are a sign of inefficiency and force a firm to perform non-value-creating activities such as handling, storage and disposal." (Porter & van der Linde, 1995b).*

In other words, even when disregarding the environmental benefits of pollution, waste streams and pollution represent an inefficient use of resources that are discharged into nature. It should be no surprise then that companies that the ability of companies to generate positive returns with environmental technologies is associated with engaging in "pollution prevention" rather than "pollution control" (end-of-pipe) solutions (Klassen & Whybark, 1999; Hart, 1995; Porter & van der Linde, 1995a). Clean technologies that are able to provide people and organizations with the means to make more efficient use of the resources that they consume will thus provide a cost-efficient measure that is environmentally beneficial at the same time. Recently, however, a number of companies have turned that same argument upside down and developed opportunities based on the premise that waste can actually be seen as a resource. If waste streams represent an inefficient use of resources, then there are some resources to be recovered from them as well. In summary, however, environmental market failures are overcome here by focusing not on the natural resource that is polluted, but on the inefficient use of resources discharged in it.

An excellent example of a company that enables pollution prevention is Ecophos. Founded in 1996 in Louvain-La-Neuve by Mohamed Takhim, the company developed a patent-protected process that enables a significantly more efficient production of phosphoric acid. The production of phosphoric acid, which is a product used as base material for animal feeds and fertilizers, consumes large amounts of phosphate rock and energy. With the Ecophos technology, even low grade phosphate rock can be used, as input and energy requirements are significantly reduced. Not only is there little remaining waste produced, the effluents are pure and also usable as inputs for other processes (CaCl2 and gypsum). In addition, the investment costs of building the technology is 40% to 60% lower than the traditional technologies. While Ecophos currently uses its patent technology to produce phosphates itself, it also builds, develops and licenses its technology for other companies such as PakAmerican fertilizers and Oswal requiring phosphate acid. As a clean technology, it is clear that Ecophos's phosphoric acid extraction method enables its customers to become more efficient in both economic and environmental senses.

Umicore's Precious Metals Refining business unit is a clear example of how clean technologies can harvest resources from existing waste streams in a way that both serves Umicore's bottom line and has a positive effect on the environment. In the mid 1990s, Umicore decided to integrate an innovative metal extraction technology in their metal refining plants in Hoboken, near Antwerp. Instead of depending on specific metal concentrates, the new technology used a "submerged lance technology" that provided Umicore with the flexibility to use a much broader source of base materials. As it was now able to treat dry or wet, fine or coarse or lumpy materials, Umicore realized that it could use a much broader source of materials for refining and that their infrastructure was in fact perfectly suited for recycling. Having a history in the extraction and refinery of precious metal ores, they also knew that precious metals were not only rare and costly, but also that the efficiency in extracting them from ore was rather low. Since precious metals are concentrated in the so called "technosphere" (computer circuit boards, catalysts, etc), recycling them could provide a large untapped source

of precious metals. The lithosphere can be considered a “mine above the ground”, as Christian Hagelüken, Senior Manager Business Development and Marketing at Umicore calls it (Hagelüken, 2006). Through this process, in 2006 Umicore was able to recover 2 billion dollar worth in precious metals, 300 million dollar in base metals, while also saving 1 million ton of CO2.if the same amount of precious metals would have been extracted from ore. Umicore is able to exploit this opportunity of resource recycling and decreasing pollution because it has found a technology to exploit the remaining resources in polluting waste streams (Vanbellen & Chintinne, 2007).

4.2.2 Solving power asymmetries

A second instance where markets produce situations that are inefficient in providing social optima is in the event of power asymmetries. When in a transaction one party holds power over the other, such as in a monopoly, this party will tend to undersupply and overprice goods and may also be resistant to changing inefficient practices. As a result, the benefits accrued by the monopolist outweigh the benefits accrued by society, which leaves an opportunity to break through the monopoly and provide more efficient solutions to those affected by the monopolist.

One of the most important examples of clean technologies serving to break monopolies or market power are clean energy technologies. As the world grows more dependent on energy and fossil fuels to generate it, it also becomes more and more dependent on regions that are able to provide these fossil fuels. Given the political risk involved in many of these regions, renewable energies like solar power, wind power and biofuels are seen as potential solutions that provide an independent source of energy. Recently, the Clean Tech group argued that one of the key drivers for the success of clean technologies is this willingness of countries to decrease their dependence on foreign fossil fuels. Again, the clean technologies do not provide a solution for environmental problems, but for the dependency on energy resources that cannot be controlled.

4.2.3 Solving information asymmetries

Another source of potential opportunities are asymmetric or incomplete levels of information as shared by people or organizations in a market. Actors with higher levels of information may have an incentive to abuse their power and – just like with power asymmetries – be slow with changing inefficient technologies or overprice goods that are sold. As such instances are suboptimal from a social point of view, opportunities exist for entrepreneurs to introduce these more efficient technologies (Kirzner, 1997).

In the context of the natural environment, it often happens that more efficient and economical technologies are available, but that customers are not aware of them or that producers are reluctant to provide them. An excellent example is the introduction of Thermolon by Greenpan as a more environmentally friendly and more healthy alternative to Teflon coated cooking pans. Over the past decades, Teflon covered pans had revolutionalized the cookware industry with pans that do not stick. At temperatures above 260 degrees, however, these pans were known to emit toxic fumes of PFOA (perfluorooctanoate) which provided a serious threat to human health. Greenpan, however, recently came on the market with a new anti-stick coating called Thermolon that did not emit these

gases at normal cooking temperature ranges. In addition, some of their pans are made entirely out of recycled aluminium, and are designed in a way that allows for easy disassembly and end-of-life recycling themselves. By providing a new alternative to Teflon covered pans, Greenpan made consumers more aware of the potential dangers of Teflon pans, thereby also reconceptualizing the concept of a "good pan".

4.2.4 Limitations of "playing a better game"

In all three examples as presented in this section, the clean technology companies were able to sell environmentally beneficial technologies not by focusing on the environmental benefits per se, but rather by framing the technology as a solution for which economic incentives exist in the market. The recurrence of this advice in much of the clean tech literature clearly indicates the importance of this message.

Box 2 - Strategy 2 - playing a better game

Market failure solution:

Focusing on how a clean technology can help resolve non-environmental problems (market failures), while resolving an environmental problem at the same time. The value captured is then created as with any other opportunity.

How?

- Analyze the clean technology and identify how it can be used to solve general problems that customers can have.
  - Market inefficiencies
  - Power dependencies or monopolies
  - Incomplete or asymmetric distribution of knowledge and information
- Apply marketing rules as one would do with any other product.

Yet there are many situations where even latent market opportunities are not able to overcome the hurdles of environmental market failures. For example, as nuclear power is currently generated with nuclear plants that are entirely depreciated, it is very difficult for clean energy technology companies to put their expensive innovations on the market. Or, how can hydrogen fuel cell powered companies buy hydrogen when there are no "gas" stations to buy hydrogen? Similarly, the EU ecolabel regulation scheme made it very difficult for Ecover to differentiate it as an ecofriendly product in the market. As we will argue below, such situations require that problems are dealt with at the level of the overarching system, and that often some level of external intervention is needed to further particular behaviors. As the Economist recently put it:

> *"According to McKinsey, around one-third of the required greenhouse-gas reductions will actually save money. Two thirds, however, will not. They can be achieved only if companies invest in more expensive, cleaner technologies. That will happen only if*

governments require them to do so, or tax dirty products and processes (through a carbon price) or subsidize cleaner ones." (The Economist, 2009:5)

How opportunities emerge from such systemic changes and external interventions, and what the role of entrepreneurs can be in shaping these opportunities is the focus of the next section.

4.3 Changing the rules of the game

One of the key assumptions of market economics is that markets will naturally evolve to states that are optimal from a societal point of view. In the previous analyses, we have shown that when the market conditions deviate from the assumptions which underlie this market economic analysis, market failures would be produced. In general, when such situations happen, governments are expected to intervene and correct the market failure through a series of policies (Weimer & Vining, 2004). Typically, such measures include legislation stipulating which products can be used or produced, formalized "licenses to produce", forbidding the use of polluting practices or even the production of certain products, market regulation through cap-and-trade systems, taxes and subsidies, compulsory reporting on toxic substances, and many more (Baumol & Oates, 1988). In addition to such governmental interventions, however, organizations in a particular industry can engage in a concerted action to jointly produce a system that changes the market in such a way that the old market equilibrium is replaced by a new one. Finally, social movements may act alongside, despite or instead of governmental interventions and act to enforce particular organizational behaviors.

Overall, however, the commonality across these three situations is that they act to change the rules by which "the game" itself is played, and to create new opportunities – incentives – that would otherwise have not existed. Whereas the opportunities hidden in market failures that require "playing a better game" may still (to a certain extent) be "found", changing the rules of the game requires opportunities really to be purposefully "made".

4.3.1 Governmental regulation and policies

Economists have generally suggested governmental intervention to address market failures. For example, the problem that freeriders cannot be excluded from the consumption of public goods is suggested to be resolved through the creation of property right regimes and the creation of a market for the trading of such property rights. In the European Union, such a property right regime has been created under the form of a cap-and-trade system for CO2. An overall CO2 emission volume was set by policy makers as the maximum amount (or cap) that could be emitted per year. Subsequently, this overall volume is divided among large CO2 emitters who are allowed to trade their emission rights on the European Union Emission Trading System. Organizations thus receive an incentive to decrease their CO2 production by becoming more efficient, because they can sell the emission rights they do not require. In a similar way, organizations that want to expand their production have an incentive to do so in a way that minimizes the production of additional CO2 because they would need to buy the right to do so on the emission rights trading market. As a result, all companies that are able to provide technologies that allow for a more energy-efficient production receive an additional argument

to sell their technologies, on top of the benefits from being more cost-efficient.

A similar CO2 reduction mechanism is the emission of Renewable Energy Certificates. In Belgium, every distributor of electricity is required to source at least 6% (since 2010 – 2% since 2004) of its energy from renewable energy sources. Electricity distributors can do this by either producing that energy themselves, or by buying green energy certificates on the spot market. Since green energy producers receive 350 euro per green energy certificate (equivalent of 1000 kWh produced) since 2010 (450 euro before 2010), and this guaranteed for 20 years, there is a clear incentive for both individuals and organizations to buy solar panels, wind mills or combined heat and gas combustion installations or any other clean energy technology. As a result, this market intervention has created new opportunities for clean technologies. In Belgium, for example, such governmental policies have allowed the growth of an entire industry of fast growing companies like Electrawinds, Photovoltec, Xylowatt, Vyncke, Power@sea, C-Power, Hansen or 4Energy Invest. All of them acknowledge that without governmental support, this growth would never have been possible.

In a similar way, the success of Umicore's recycling of precious metal was greatly fostered by the European Union Waste of Electrical and Electronic Equipment (WEEE) directive since 2003. This legislation stimulates the creation of collection schemes where consumers return their used electronic and electric waste free of charge with the purpose to increase the recycling and/or re-use of such products. As a result of this regulation, a steady supply of resource material for companies like Umicore becomes ensured. However, since the total amount of returned waste is only a limited portion of the total e-waste, meaning that a significant but undetermined amount of e-waste still ends up in landfills or is exported outside the European Union where safe and clean recycling is not guaranteed. Through its own communication and representative organizations such as the European Electronic Recyclers Association, it continues to support legislation and policies that foster a stricter follow-up of electronic waste-streams (Hagelüken, 2006). Again, such a position not only leads to a better environment, but also helps to carve out a bigger opportunity space where Umicore can continue to add value as a waste recycler.

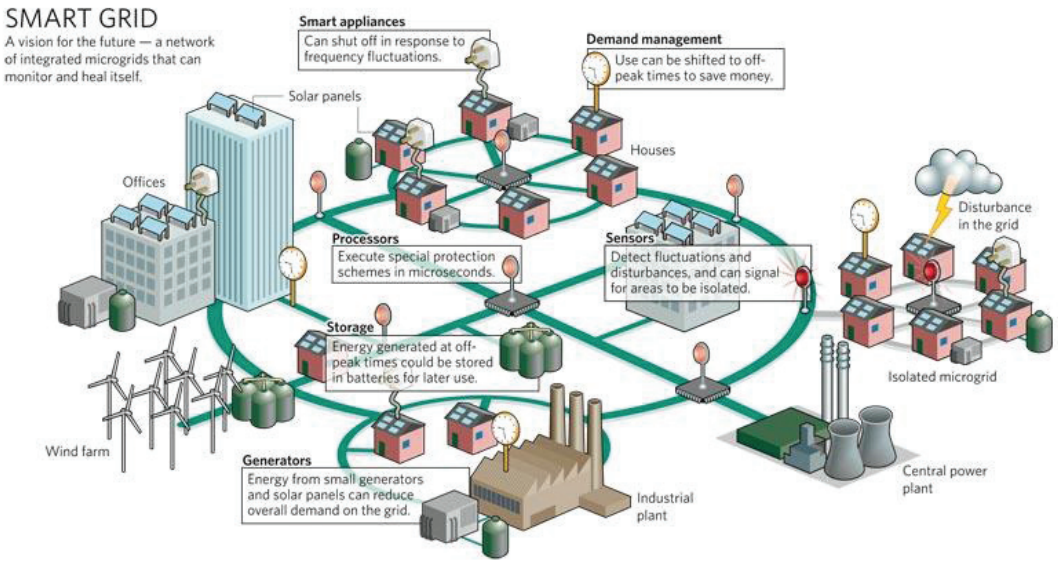
Although such an active business role in shaping governmental policies is often looked upon as inappropriate, it is a very important process in the context of addressing market failures and creating opportunities for clean technologies. While lobbying is mostly associated with some dark process where corporations settle deals with governments to the betterment of the corporations at the expense of society, the active involvement of clean tech businesses in shaping policies is particularly necessary (Dean & McMullen, 2007; Reinhardt, 1999). This type of business intervention in policy shaping has become known in the literature as "institutional entrepreneurship" or "political entrepreneurship" (DiMaggio, 1988; Maguire, Hardy, & Lawrence, 2004; Greenwood & Suddaby, 2006; Boettke & Coyne, 2007).

4.3.2 Systemic changes

Even though governments may set the stage for the development of new markets, a successful implementation of clean technologies and the eradication of market failures may sometimes require an entire new system to be created. In order for this to happen, clean technology companies need to work together with a network of actors to jointly create a market ecosystem that also allows to bring the technology to the market. At the same time, however, the need for such systemic innovations also creates new opportunities for businesses that are able to fill in the gaps between the clean technology and its successful implementation.

The introduction of local, small-scale energy production through solar panels and wind turbines, for example, has introduced several challenges to electricity distribution companies. While the electricity production of nuclear power or fuel (coal, gas, oil) combustion can be determined in advance and thus also be adjusted according to predicted demand, the energy production of solar panels and wind turbines is a lot less predictable. At the same time, electricity is wasted as a result of transport over long distances and because electricity is generated for which at some moments no demand exists. The main reason for these inefficiencies is that the current power grid was not built to cope with such high flexibility in supply and demand: electricity was produced in large power plants, transmitted in bulk to local networks, who then distributed power in one direction, the end consumer. In order to address these inefficiencies, considerable interest and investments currently go into the development of “smart grids”, that allow for a more dynamic adjustments of electricity consumption, distribution, production and storage. Figure 6 shows the complexity of different innovations that are needed for a change in more efficient and environmentally friendly energy distribution system. Such an innovation, however, would require not only the grid to be changed, but also electrical appliances, electricity pricing mechanisms, information and ICT management services and many more. To facilitate such innovations, concerted actions like the European Smartgrids Technology Platform, early stage experiments like the Dutch village Hoogkerk or the the establishment of a “Virtual Power Plant” at Groep Machiels as a joint experiment between VITO and the Dutch company PowerMatcher, that will manage a smart orchestration of supply and demand in the company. Although the development of such a new opportunity space is highly uncertain and depends entirely on the concerted action of a broad range of actors, early movers in such industries get a head start and learning experience with early adaptors to share the risk of the innovation process that is required. For companies like EnergyICT, GreenPeak and others engaged in smart metering, the developments of smart grids therefore depends on such a systemic change.

Figure 6 Smart grids as a systemic innovation for more clean energy systems (source: www.urbanecoist.com)



Systemic perspectives also highlight where opportunities for adding value remain. Filling those blanks is important since the success of the entire systemic change depends on it. For example, despite the policy support for clean energy technologies, solar panels and wind mills require considerable investments that have a return that for some people and organizations may either be too distant in the future or be uncertain given the short experience with the technology and the fast evolution of the industry. Companies like SunEdison or Enfinity, however, have made their entire business around developing, funding, installing and maintaining solar power installations for third parties. In essence, it pays land owners a rent for using their rooftops or land, and acquires the right to install and exploit solar panels in return. The electricity generated is subsequently sold for a fixed price to the land owner, or sold to the grid. In order reduce the risk of the considerable investments that are needed for SunEdison or Enfinity, they package the solar cell investments and resell them to banks or funds that get a steady and fixed income from the electricity sold. In return, the SunEdison or Enfinity ask a fee for developing, servicing and monitoring the installations. While SunEdison is now the biggest solar panel company in the US, Enfinity won the first ever public bid offer in China to install China's first solar energy park of 10 MWh.

In a similar way, a plethora companies have mushroomed over the years that support and supply clean technology companies as investors (e.g. Capricorn, GIMV, Stonefund, Dexia, KBC securities), key component manufacturers (Hansen Transmissions making gearboxes for wind turbines, Pauwels International providing transformers in wind turbines, specialized backsheet insulation film production by Bekaert, etc), advisory services (Laborelec, Triphase, TriEco) and the like.

The key competence for companies that are interested in the clean tech space, is to have a systems perspective and to acknowledge that there are both challenges and opportunities involved in removing market failures.

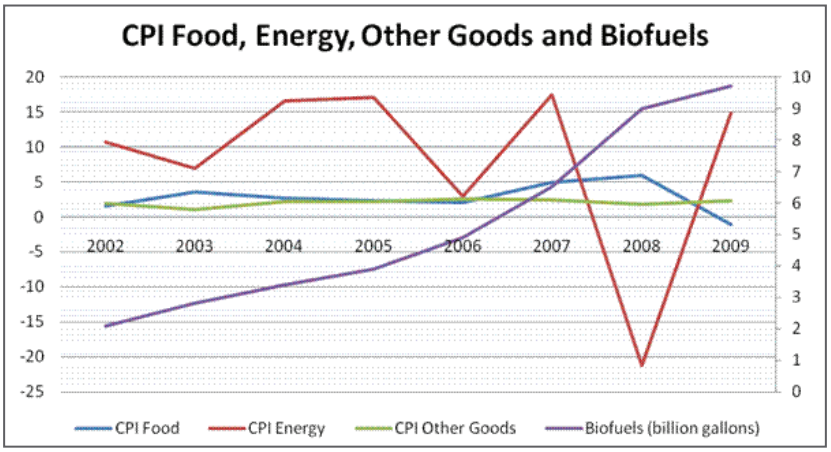
4.3.3 Social movements

A final mechanism that creates opportunities by overruling market failures is the existence of social movements that, by mobilizing commonly held resources, generate a semi-governmental power to enforce or stimulate the development of emerging markets (Wade, Swaminathan, & Saxon, 1998; Schneiberg & Bartley, 2001). When systemic changes are needed to foster the introduction of a technology, the new equilibrium represents an innovation that is characterized by typical liabilities of newness (Stinchcombe, 1965; Aldrich & Fiol, 1994). Furthermore, in the context of new markets such liabilities are even more outspoken, because starting organizations or technologies cannot connect with institutional structures that usually provide cognitive and socio-cultural legitimacy (Aldrich & Fiol, 1994; Sine, Haveman, & Tolbert, 2005). It is in such contexts that social movements like NGOs, trade unions, political parties or any other collaborative initiative can emphasize environmental problems, suggest potential solutions and mobilize their collective clout to promote or enforce them (Rao, Morrill, & Zald, 2000).

In the context of environmental technologies, it has been shown before that the growth of wind energy industries in the US was much larger in areas where environmental social movements were more active. In the Belgian context, a related and similar evolution can be seen in the development of user cooperatives that bundled their resources to jointly stimulate the adoption of wind energy power. Such cooperatives as Wase Wind, Ecopower and Groenkracht have all brought together people that were not affluent enough to stimulate the development of clean energy technologies in Belgium by themselves, but could reach a bigger clout by teaming up together. Such social movements can be important partners for clean technology ventures, as can be seen by the strategic partnership that Groenkracht has with Electrawinds. Electrawinds promises a fixed dividend of 6% for every stock (worth 125 euro) that an individual purchases from Groenkracht. Groenkracht then invests this capital in Electrawinds projects.

However, just as social movements are able to support and educate clean technology industries, they are also able to break them and dilute the opportunity that exists for a particular technology. An interesting example is the impact of the public debate about increasing food prices and the legitimacy of biofuels starting in 2006. While biofuels were positioned in particular by environmental social movements as one of the key solutions to global warming, rising food prices around 2006 made development NGOs question their appropriateness and legitimacy. The discussion became particularly strong after the publication of a report by Jean Ziegler, UN Special Rapporteur on the Right to Food, who called biofuels “a crime against humanity”. As Figure 7 shows, the fact that consumer prices increased together with a steady increase in biofuel production, it was assumed that biofuel production was responsible for the increase in food prices. It was argued that as a result of the increasing demand for biofuels, more land was dedicated to the production of plants for this purpose and less land to the production of food with increasing prices as a result. Although the validity of this causal argument was debated, it had a particularly strong impact on the Flemish biofuel industry, who had been investing very strongly in biofuel refineries and had a promising outlook to provide 3% of the fuels of De Lijn, the Flemish public transportation company. As a result of the debate, however, the Minister of Mobility at the time withdrew her decision she made three years earlier to introduce biofuels at De Lijn and decided to await more information on the sustainability of biofuels before committing to the purchasing of biofuels again. In order to maintain a credible environmentally friendly reputation, the Belgian biofuel industry therefore had to regain the legitimacy of all stakeholders involved.

Figure 7 - Consumer Price Indices for 4 product categories (source: US Bureau of Labor Statistics)



4.3.4 Limitations of changing the rules of the game

As a final strategy, changing the rules of the game helps to overcome market failures because it simply changes the transactions that are able to be produced. Box 3 summarizes the strategic advice that can be given for companies that want to engage in these kinds of strategies.

Without a doubt, changing the rules of the game is the most complex, cumbersome, unpredictable and time-consuming strategy of the three strategies that organizations may follow to overcome market failures associated with the natural environment. Systems and its incumbent players generally tend to resist change, as it challenges their survival or may induce costs that put them in a competitive disadvantageous position. As a result, incumbents will block entrepreneurial initiatives and policymaking that undermine their competitive position. In some situations, only external events like a severe oil or energy crisis, a big oil spill or toxic emission, or any other environmental damage that results in public outrage can act as an “environmental jolt” (Hoffman, 1999; Sine & David, 2003) that triggers institutional change. In other words, even though the exploitation of market failures and the recombination of resources to creatively destruct obsolete and inefficient industries is the heart of entrepreneurship, realizing such institutional change may require considerable effort and time. When it happens, however, the effects are truly systemic and heroic in nature.

Box 3 - Strategy 3: changing the rules of the game

Market failure solution:

The market failure is removed by changing the way the market is allowed or able to produce transactions.

How?

- Make a systemic analysis of the market failure and all the conditions that fail to provide environmental betterment.
- Identify gaps in the system that are holding back the resolution of the market failure.
  - Exploit opportunities as a result of systemic changes created by governmental intervention or social movements
  - Provide supporting services or products for clean technology companies or consumers that facilitate the adoption of clean technologies.
  - Identify partners and establish partnerships to engage in an orchestrated provision of an alternative system that provides incentives
    - Governmental policies
    - Social movements
  - Cocreate a new market space by educating governments (lobbying), consumers or partners about their potential role in establishing the systemic innovation.

With the present study, our goal was to get a better understanding of the importance of clean technologies, the challenges its development is facing and how entrepreneurs can develop strategies to deal with them. The main concept that underlay our analysis was that the success of clean technologies depends on their ability to overcome the market failures generally associated with natural resources. Technologies that have as their specific focus to increase the level of these natural resources will need to find solutions for the fact that markets generally do not reward such efforts. Based on a review of the literature and through the inclusions of a number of cases of Belgian clean tech companies, we provided 3 generic strategies that companies can follow to overcome these market failures:

1. Addressing environmentally conscious consumers

   Although market economics would predict that people would never pay for something that other people can get for free, a small proportion of the population is convinced that they can help to prevent or resolve environmental degradation through their environmentally friendly consumption patterns. Catering to such a customer base requires identifying a target population that is interested in the particular environmental issue the company wants to address and is willing to pay for it, credible information and a clear differentiation that customers perceive as reasonable to pay a premium for.

2. Playing a better game

   Because following the first strategy constrains the possibilities of capturing economic value, but also reducing environmental degradation, the second strategy focuses on how value can created for customers, while also resolving an environmental problem. Doing so requires firms to look at the environmental problem through a lens that recasts it into a non-environmental problem that customers want to see resolved and are thus willing to pay for, be it a inefficiencies, power asymmetries or information asymmetries.

3. Changing the rules of the game

   As a final and most radical strategy we identified, the introduction of clean technologies sometimes asks entire systems and markets to be redefined. Be it either through facilitating government intervention, technology ecosystem formation or cooperating with social movements, the goal of these strategies is to overcome market failures by reshaping the market itself .

Together these three strategies capture the advice that is shared by a number of marketing, public relations and investment firms that have developed specific capabilities. Trendwatching.com, for example, suggests the following strategy for clean tech companies.

> *"While the current good intentions of corporations and consumers are helpful, serious eco-results will depend on making products and processes more sustainable without consumers even noticing it, and, if necessary, not leaving much room for consumers and companies to opt for less sustainable alternatives. Which will often mean forceful, if not painful, government intervention, or some serious corporate guts, or brilliantly smart design and thinking, if not all of those combined."*
> *(Trendwatching.com)*

In a similar way, Box 4 summarizes a number of practical advises along the same lines from communications firm Weber Shandwick.

Box 4 - Clean tech communication tips (source: Weber Shandwick, 2009)

Think systems. One of the unique things about cleantech is that you can't effectively talk about what you're doing in a silo. It is all inter-related. If you do power storage, it relates to renewable energy and smart grid. If you do water, it's connected to energy. If you do biofuels, it impacts food, water and energy. Your point of view must be developed accordingly.

Market the solution, not the problem. There is enough fatigue out there already about the environmental problems we face. Be a face for the solution.

Be specific. Talking about "green jobs" or "renewable energy" is no longer enough and audiences are growing more sceptical about "greenwashing." Talk about "wind energy jobs" or "solar power." The more detail you provide the more believable you become.

Drive sales by focusing on your customers' strategic priorities. While it may be tempting to lead with the environmental benefits of your product or service, our research shows that compliance and ROI take precedence. Take time to research your customers and understand their primary motivations. Be more impactful by adapting your message and channels of communication accordingly.

Check the policy pulse. Perhaps more than any other space, cleantech requires that you have your finger on the pulse of policy. Whether you are in clean energy, water, smart grid, biofuels or transportation – national and international policy will play a major role. Ignore engagement with policy makers at your peril.

Go digital. Communications have moved online. Social media is the new currency. Find compelling content that can mobilise online communities and get traction for your brand. Ad spend and press releases are becoming less and less effective as the role of online search takes stories directly to individuals at the touch of a button. It can be cost effective, too.

When firms deliberate among the options of each of the three strategies for their firm, it is important to take both the external context as well as the internal capabilities of the firm into account. Research in the Netherlands has shown that the adoption of clean technologies in the construction industry strongly depended on the internal capabilities of the firms (Pinkse & Dommisse, 2009). Firms that had an active learning culture and based their competitive positioning on a strong internal technical capacity were keener to integrate energy-efficient technologies in their construction of residential buildings. In a similar way, it is important for firms interested in the clean tech space to see how their own capabilities fit with the strategies defined. This however, is an advice as old as strategy itself: making sure that your internal capabilities fit with the external conditions in which you are operating. But then again, that may very well be the key message of finding opportunities in clean technologies: even though clean technologies provide us with the necessary toolbox to tackle some of the most important challenges our society is faced with today, and as such deserve all support possible, this does not mean that they are exempt from the rules of the market.

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