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2. Preface

After a period of six months studying on the topics of energy, energy use, industrial areas, strategic niche management, mutual gains approach, transition management and so on, I proudly present my graduation thesis for the master track of Construction Management and Engineering at the Eindhoven University of Technology.

This graduation assignment is carried out at the well known 'Provinciehuis' of Noord-Brabant in 's-Hertogenbosch. This year's graduation atelier has the main topic of 'Eindhoven Energy neutral in 2040' where I focused my thesis on the contribution of the industrial sector to this ambition. My opinion is that major steps can be taken on the area of industries. At least 8 hours a day, at least 5 days a week, week after week, industries are working and operating delivering a substantial contribution to the main energy demand of the built environment. So this topic should offer lots of possibilities as well as interesting subjects to study.

More content of the topic will be found back in the following chapters and my intention for this chapter is to express my thanks to some helpful persons. At the first place I would like to thank my supervisors of the Province, Ad Raams, Chris Venderbos and Paul van Dijk. Thanks to them for providing me the right data, information and knowledge. Also for the discussions we have had which contributed my total view of the whole topic as well as specific issues. I would also like to thank my other colleagues at the 'Provinciehuis' for all useful tips and certainly not to forget the sociability and fun: Ad, Chris, Conny, Daniëlle, Hans, Martin, Paul, Peter and Yvette. Also not to forget Glenn and Jos for their nice contributions during the lunches.

Naturally I would like to thank prof. dr. ir. W.F. Schaefer and dr. ir. E.G.J. Blokhuis for their supervision and expert knowledge. I would also like to thank Rob van den Berg for his useful hints for interesting scientific papers.

Finally, the best for last, I would like to thank my family, friends and girlfriend for their unconditional support during the last (sometimes though) months. Though for me but sometimes also though for them. Thanks a lot!

For now, I hope you will enjoy reading this report,

Ruud Schoenmakers

3. Introduction

Currently there are lots of theories and predictions of the exhaustion of all oil stocks (resulting in the current price rises), climate change whether or not by human activities, the carbon problem and other environmental based issues. However, amongst other things based hereon the municipality of Eindhoven is aspiring to be an energy neutral municipality around the year 2035 to 2040. This means that the upcoming 30 years significant, wide scaled changes have to take place. This changes will occur on technological scale as well as on the management level.

A first arising question on above description is 'what does energy neutral means?' Does it mean that there is no energy use anymore? Or all needed energy has to be produced within the municipality borders of Eindhoven, etc. etc. To be clear in this aspect, at the beginning of this thesis, an assumption is made in the definition of the concept of energy neutral.

The main subject of this thesis is ‘energy neutral’. However, to obtain this ambition Trias Energetica is an important and useful tool which is actually based on two major actions: (1) make use of sustainable/renewable energy sources and (2) minimize your energy demand. This thesis will deal with the minimization of the energy demand on the level of industrial areas because this is seen as the first important step towards the energy neutral environment.

The structure of this thesis will be as follows. First the problem definition will be discussed, what is the problem nowadays? Why focus on the level of efficiency on industrial areas? Once the problem is described and defined, a research question will follow. To give a solid answer on the main question sub questions are defined, this way a structured approach will be reached.
Following on the problem definition a theoretical framework is set up. This framework contains the subjects of Industrial Symbiosis which represents the exchange of residual flows (water, heat, waste streams, etc.) at industrial areas. This could be a method to increase the efficiency on area level. However, to make an approach like industrial symbiosis successful and widely supported a transition has to take place. Second in the theoretical framework the subject of Transition Management will be discussed. What has to happen, which knobs have to be turned on or off to initiate a transition in the energy sector? Third I will focus on Strategic Niche Management, an approach which provides possibilities and creates protected areas wherein innovations can develop and grow without being pushed over by the dominating regime. At last the Mutual Gains Approach will be discussed. Mutual Gains Approach is a method which has the main goal to create mutual profits. By creating mutual supported ambitions, all involved parties will support actions to fulfil these ambitions because of the mutual advantages.
For the practical approach in this thesis current situations within an existing industrial area is studied. The industrial area of Moerdijk is used as a so-called Proeftuin for the Province of Noord-Brabant with respect to sustainable development. Also DWA (a consulting firm) carried out a research on the residual flows in existing companies settled on the industrial area of Moerdijk as well as the opportunities to link these residual flows. Interviews are carried out and literature containing representative interviews are also studied.

Once all data is collected, it will be processed and analyzed to verify if all questions in this thesis can be answered correctly and well funded. When this analysis is done, a chapter with conclusions and recommendations will follow. The conclusion part will exist of the answers on the sub questions and the recommendations part will give advice for the development or the trip to an energy neutral environment on the background of industrial areas. Also recommendations will be given for further investigations, due to this investigation new questions have emerged with regard to the main topic.

4. Problem definition

4.1.Introduction

The purpose of this thesis is to contribute in a major investigation into energy-neutral environment. This contribution will be in the sense of a focus on the industrial sector and point at the industrial areas. As described in the introduction Trias Energetica plays an important role in the preservation of our environment, trias energetica is an important instrument in the development of more sustainability regarding the energy aspect. The two main streams in this trias energetica are the use of renewable energy sources and reducing your energy demand. An important step in reducing your energy demand is the focus on efficiency. When the efficiency increases, demand will be reduced.
The energy use at industrial areas appears to be significant when compared with this use at urban areas. Research by among others DWA shows that there are significant amounts of energy getting lost at companies in the form of by products. The settled companies have troubles with getting rid of these residual flows, for these companies this flows are not useful anymore. As a result hereon, these flows end up in the air or water, which results in extra costs for this companies for example due to their duty to cool down these flows.
Steps could be set on a higher level, area based. The increase of efficiency could take place at the level of industrial areas. Companies who cannot get rid of their energy surplus should map the possibilities of delivering these residual flows in the sense of energy, to (for instance) their neighbouring companies. There are opportunities for these companies in the sense of cost reduction. Also this method can deliver a substantial contribution to Trias Energetica and finally also in the trip to an energy neutral environment.
However despite all possibilities and a confirmation by DWA a major transition stays away. There are lots of technologies for sustainable energy (re-)claiming, the society is talking about it and more and more this society is expecting companies to make use of these technologies. However a real transition seems to stay out, a certain turning point isn't yet in sight. What has to be done, which knobs have to be turned on or off and who has the duty to undertake these actions?

4.2.Problem definition and research question

Problem definition:
Despite all effort a transition towards the use of sustainable techniques and methods seems to stay away. There is a movement in the development but a real turning point is currently not in sight.

Research question:
Which steps have to be taken to approach the turning point of an energy transition, and who is the right party or are the right parties to initiate here in?

Subquestions

Above question will be investigated and the answers/outcomes should arise by answering the sub questions drawn up with regard to the theories and techniques regarding the subject. The sub questions to be answered are the following:

- How can Industrial Symbiosis/ecology contribute to an energy transition?
- Who is 'problem' owner?
- Who are the actors and how do/can they influence?
- What is nowadays the position of companies towards energy neutral developments?
- What are the preconditions for companies to join in a symbiosis network and how are they influenced?
- What could be the role of the Province of Noord-Brabant here in? How can they deliver a desirable contribution in initiating a certain transition?
- What are possible process techniques to initiate a transition?

5. Methodological Approach

5.1.Introduction

In this chapter the sub questions and their approach to acquire answers hereon will be spoken. Per sub question a procedure will be explained as well as the motivation to apply this procedure. Also the boundaries of this thesis will be explained and motivated. The second part of this approach describes the boundaries of the research.

5.2.Approach per sub question

Subquestion 1: How *can Industrial Symbiosis/ecology contribute to an energy transition?*

By analysis of the theoretical background as well as practical approaches in the sense of the casestudies Kalundborg and Moerdijk, relationships and starting points will be mapped. Also practical translations will be made.

Subquestion 2: *Who is problem owner?*

For answering this sub question information is gained using literature as well as questioning experts on this level and interviewing companies.
First there has to be found out what the real problem is. This real problem is the fact that techniques to use sustainable energy sources are not breaking trough while they can deliver a significant contribution towards an energy neutral environment. What is the reason why the private sector isn't implementing this techniques widespread?

Subquestion 3: *Who are the actors and what is their influence?*

Actually this is a twofold question, Who are the actors and how do or can they influence?
To explore who the actors are a literature study is carried out based on facts on the industrial area (re-)development as well as the Proeftuin Moerdijk. Besides the literature, experts are consulted who had or have their share in the development of several concerning projects and other developments on this topic.

Subquestion 4: *What is nowadays the position of companies towards energy neutral developments?*

The position of companies towards energy neutral developments will partly be extracted from literature. The other part of the data will be gained by executing a questionnaire at different companies settled at the industrial area of Moerdijk.

Subquestion 5: *What are the preconditions for companies to join in a symbiosis based network and how are they influenced?*

This question can only be answered by input from these companies. A proper selection has to be made in which companies will be interviewed. Most of the larger companies are feeling a social pressure in the sense of their social responsibilities (CSR), a pressure which is nowadays less at smaller companies but may be influencing this companies. This means that for the larger companies the threshold is less than for smaller companies, so large companies could be more willing to join. Thereby the larger companies provide a full-time function for environmental employees where in the larger companies a person who has a lot of interest in environmental developments has the responsibility for taking care of environmental aspects. The factors which influence the preconditions (which forms a part of the willingness) will be extracted from the questionnaires which will be send as well as expert meetings.

Subquestion 6: *What could be the role of the Province of Noord-Brabant here in? How can they deliver a desirable contribution in initiating a certain transition?*

By approaching scientific literature, expert talks and questionnaires, an answer on this question will be determined. The government in the sense of the Province of Noord-Brabant has not the objective to enforce the private sector into tight corners. It is important to invest in sustainable relationships between government and private sector. Maybe in this way answers can be found for this question.

Subquestion 7: *What are possible process techniques to initiate a transition?*

Several process techniques are available which can deliver a positive contribution towards a process. In this case the process can be or is the transition towards a energy neutral environment. Which steps have to be taken or which approach is helpful to stimulate this process?
Methods/theories which will be investigated are Strategic Niche Management, Transition management and at last the Mutual Gains Approach. It is certainly not sure that just one of these methods is the best or only one, it could be possible that a combination of those is helpful, or one method influenced by details from other methods, a wide scale of directions could be possible.

5.3.Boundaries

Technological:

This thesis focuses on the technology of exchanging residual flows based on Industrial Symbiosis. The subject 'energy neutral environment' is very broad, too broad to investigate at once. To build a clear view, it is smart to focus on smaller subjects which all deliver a contribution to the main topic. My idea is that saving energy by creating more efficiency is one of the first steps in creating an energy neutral environment. When the demand decreases, the supply will automatically decrease which results in the need of less renewable energy sources.

Geographical:

The main CME study is focusing on the topic of 'Eindhoven energy neutral in 2040', however this thesis will investigate methods, approaches and techniques which are primarily not area bounded. However a sharpening is made by focussing on the industrial area of Moerdijk which, in the view of the 'proeftuinen' project of Noord-Brabant is seen as a best case. Expert talks pointed out that on the level of industrial areas the energy demand is significant higher in comparison with the rest of the built environment. Industrial areas have a great energy demand for their production processes as well as their main demand in the sense of office light, computers, etc. In my opinion there is a lot to save or win at the level of industrial areas as a geographical boundary.

System:

Regarding the current and upcoming restructuring projects at abandoned and/or neglected industrial areas, this thesis will focus on these as well as other existing areas because this restructuring projects can form an opportunity for implementing new systems. Also the erection of new areas will decrease. In the case of new areas, they will be developed taking substantial sustainable techniques more and more into account. Most of the time existing areas are traditionally supplied in their energy demand and suffer with a substantial energy surplus.

Concluding

This thesis will focus on existing industrial areas. Industrial areas because the great energy demand in this zones as well as their 'non-useful' residual energies. Existing areas because there is a governmental initiative of minimizing the development of new industrial areas and the restructuring of existing areas. Furthermore there is an opportunity on the level of the restructuring of existing (abandoned) industrial areas. The opportunity is that there is a reason or motivation to make changes in the nowadays traditional methods of energy supply at the areas.

6. Theoretical framework

6.1.Introduction

By studying different scientific papers as well as related official websites regarding the current energy problems and issues, a literature study is carried out to form a theoretical framework.
This chapter will start with the current Dutch situation on the level of industrial areas, the mismatch between supply and demand and the plans to restructure old (abandoned) industrial areas. Secondly investigation is done on the field of sustainability, what is sustainability, how can it be obtained and what are interfaces with the road to an energy neutral environment? This investigation has lead to the focus on energy efficiency. Energy efficiency creates a decrease in energy demand, when less energy is needed less energy has to be produced which results in better circumstances for sustainable energy production. Energy efficiency is assumed to be one of the first steps in creating a more sustainable or energy neutral environment. On the field of efficiency at the industrial sector an interesting method is Industrial Symbiosis (also called industrial ecology). This industrial symbiosis is based on the exchange of residual flows and waste streams. This method is described by literature studies as well as the description of the interesting case of Kalundborg in Danmark. Kalundborg is an industrial area which started with symbiosis based activities in 1961 and since then developed towards an area rich in residual flow connections. When this symbiosis is discussed, the systematic view for the implementation of symbiosis is drawn, based on techniques of system dynamics.
Industrial symbiosis is a method which's success is connected to the level of participants. To increase the level of participants a certain transition has to take place, a transition of the energy system. The subject of transition management is also discussed in this theoretical framework. Transition management could be a helpful tool to map which actions have to be undertaken to mobilize a community in their participation in a dominating regime (in this case the traditional energy regime). Several methods or models are available to initiate, stimulate or contribute a transition. In this case the method of Mutual Gains Approach is seen as a useful manner for supporting in a certain transition. Industrial symbiosis will result in mutual efficiency and so mutual advantages. However to create a successful symbiosis based network collective support is needed. Also to initiate a transition collectiveness is crucial. Mutual Gains Approach is based on shared interests and based on collective approaches. MGA is described in this framework as useful method in the transition towards the implementation of industrial symbiosis.
Finally Strategic Niche Management will be discussed. Strategic Niche Management (SNM) is a successful instrument for the development of innovations. Most of the time innovations or new techniques are initially not strong or developed enough for beating a dominant regime. This regime is proven to be working and reliable. When there is no strict need for a new technique in a certain sector, innovations have to be very strong to survive. SNM is a method wherein niches will be created where in this innovation can develop and grow (i.e. due to experiments) until it is strong enough to compete the dominating regime. Industrial symbiosis is a technique which is interesting to implement making use of SNM. This way companies can get convinced about the reliability of this technique and shall be willing to implement it too.

6.2.Development of industrial areas

The last decades the Dutch government stimulated the development of workplaces, created chances for companies. The government stressed on the development of industrial zones. In the *Nota ruimte* (VROM e.a. 2004) as well as in the *Nota Pieken in de Delta* (EZ 2004a) the objectives were set that spatial difficulties for the economical development have to be taken away as much as possible to increase the offer of attractive business locations. (Gordijn et. al. 2007).
In the last decades (1987 – 2005) an average amount of 1130 hectare land for industrial areas has been given out. This development resulted in a growth of business area especially in comparison with the amount of living space (respectively 12,9% and 8% in the same time period 1993 – 2000). Nowadays questions are asked at this area-development in the sense of the degradation of public space as well as a threatening overabundance (if there isn't an overabundance already) keeping in mind an upcoming decrease in business land demand. (Gordijn et. al. 2007).

Regarding the threatening overabundance, it is known that new business/industrial zones are more attractive then the current available. A company prefers a custom made company building, it is difficult to find an already existing building which fulfils all its wishes. '*Having enough grantable plots in stock is seen as a responsibility of the municipalities to guarantee a sustainable economic growth.*' (Blokhuis and Schaefer, 2007). Because of this thought, many municipalities try their best to stimulate the granting of industrial plots and, as cheap as possible. *'As a result, approximately 50% of the building land in the Netherlands is reserved for industrial activities, whereas these industrial activities use less than 20% of the built land.'* (Blokhuis and Schaefer, 2007). *T*hereby, because of no real central instance which controls the release of new business plots, and the very low prices makes it more attractive to construct a new custom made building rather then renovate the old one. This results in aging and exodus of already existing areas which then results in situations of unattractive messed up industrial areas. So a mismatch between demand and offer occurs.

However, nowadays the government as well as a number of private companies set up instances which have the objective to stimulate the provincial economy (provincial view, not municipality). One of those instances in example is the BOM (Brabantse Ontwikkelings Maatschappij) which main objective is “creating chances by reinforcing economical growth- as well as innovation power.” To reach this objective, this company has five core tasks where one of this tasks is the realisation of the restructuring of industrial zones in the province of Noord-Brabant. The purpose of this restructuring process is to realize a punctual or efficient use of business space to create a proper land use, a better distribution of land (regarding private and business space and finally a good and economical attractive business climate. (www.bom.nl)

6.3.Sustainable energy

6.3.1. Introduction

Energy neutral, climate neutral, carbon neutral, etc. Those terms could be seen as hot-item nowadays. Maybe in the same line with a few years ago when the term Sustainability was a sort of hype. However it can be seen that all these terms have the same objective, 'saving the planet'.

Saving the planet, or to become oil independent or 'oil-magnate' independent. In this thesis the subject of climate change and carbon-problems will not be carried out extensively, a lot scientific evidences as well as contradictions are drawn up the last years and I am not convinced being the person who proves what the real climate problem is nowadays and its absolute solution here on. Though the creation of an energy neutral environment is a great challenge, there are lots of possibilities in claiming energy an alternative way then using oil or other exhaustible sources, **why isn't this already happening**?

With the purpose to stimulate a transition towards a sustainable environment, the government has drawn up the so called 'Trias-Energetica' (Energy efficiency, sustainable energy and efficient/smart use of fossil fuels). This Trias Energetica is based on the Trias Ecologica, a roadmap to sustainability on a broader scale then just energy. The major part of this Trias Ecologica is to limit the use of finite sources (water, energy, raw materials, etc.)

The three aspects in this Trias Energetica are:

1. Minimize your energy demand;

The first action to take is saving energy. This is possible by better insulation or adapting the user's behavior. Also optimizing the efficiency of all processes can contribute to a minimization of energy demand.

2. Making use of sustainable/renewable energy (like solar or wind energy);

Second action is to make use of sustainable/renewable energy sources. Solar cells or wind energy are well known examples of these sources.

3. Making the use of fossil energy as clean and efficient as possible.

Third action is to stop using fossil fuels. When this is not a possibility limit the use and use it as smart and efficient as possible. Fossil fuels are those sources which are finite like for instance oil and coal. This action corresponds with the minimization of the energy demand, by making fossil fuel systems more efficient, less fossil fuel is needed. (www.vrom.nl)
Due to the cohesion between action 1 and 3 and the focus of this thesis on the saving of energy and improvement of the efficiency on industrial areas, this part will focus on the minimization of energy demand and the use of sustainable/renewable energy.

The main objectives of the Trias Energetica; the use of renewable energy sources as well as the decrease of your energy demand, will now be discussed.

6.3.2. Renewable energy sources

Currently the knowledge of renewable energy sources is developing bit by bit. Investigations are done on natural forces like wind, solar and water energy as well as bio sources. Bio sources means the use of biomass as fuel, bio-gas and bio-fuels like palm oil, anaerobic digestion and so on. However this bio-fuel developments in the sense of palm oil are currently taken in doubt regarding the threat for the food demand (Breure et al. 2007). In despite of the everlasting food scarcity, one is claiming agricultural land to cultivate vegetation not for food but for the development of bio fuels. This will enlarge the contradictions between the western (prosperous) world and the developing countries as well as enlarging the climate problems in the sense of deforestation (deforestation for biofuels). Another method to produce bio-fuel is anaerobic digestion, by using manure which will be heated and stirred where after it produces bio gas to stoke. Also landfills produce a gas where can be stoked on.
Other examples of sustainable energy claiming is the method of solar energy. More and more situations are known wherein the consumer can be its own little energy provider. (www.milieucentraal.nl)
Tough these methods of energy supply are still not broad applied nor is there a new standard.

Although nowadays there are a lot methods of claiming sustainable energy, there is still no standard on this area. Many small scale techniques are available for approaching a level of being energy neutral but none of this techniques are able to knock down the current traditional methods of claiming energy; a certain regime is dominant.
Most of the time those small sustainable techniques are not able to break trough. Mostly, new techniques are rather radical in comparison with the traditional method which can result in distrust as well as the traditional methods are often proven to work properly and safe.

The reason why this new techniques are still not widely applied, can be assigned to the fact that these techniques are often radical or right angled on the usual traditions. New techniques have to get strong enough to 'beat' the old traditional system or regime. To reach such a situation, Strategic Niche Management can be applied. A niche can be seen as a protected space wherein the new technology can develop and grow. The protected space can be created by in example providing subsidies or measures on legal aspects. (Raven, 2005)
The new technology can grow and develop in the niche until it has developed so much that the technology niche can turnover in a market niche.(Raven, 2005)

6.3.3. Minimizing energy demand: Efficiency

Energy efficiency is a very important factor to reduce environmental harm. There is a direct relationship between energy efficiency and energy use, the higher the efficiency the less energy demand/use. Less energy use means less fossil fuel demand so less environmental harm.

Energy efficiency on the level of companies/industries is assumed to be carried out well especially in cases of process industries were the average energy demand is quite high. Entrepreneurs are continuously searching and exploring to improve their processes, as much production per dollar input. One item hereon will be their energy use. The objective of the entrepreneur is optimizing processes to lower all costs, energy is one of the main costs. Based hereon the assumption is made that energy efficiency issues are always running at company level, saving energy means more profit for the entrepreneur. However, despite the individual efficiency will be proper, the companies suffer with an energy surplus.

DWA, a consulting firm in the energy sector, carried out an extensive research focussing on the energy use and energy flows which occur on industrial areas. DWA shows in their report that lots of energy disappears into the air, water or as other forms of waste. Companies suffer with a surplus of energy where they cannot get rid of looking on individual company base.

Increasing energy efficiency should be obtained on area level, companies could collude and focus on energy efficiency collectively. One of the widely spoken methods of creating more energy efficiency on company-group level is the application of industrial symbiosis or ecology. Symbiosis in the sense of the biologic phenomenon means *"the living together of unlike organisms". (wilkinson, 2001)* A comparison between an ecological and an industrial ecosystem can be seen as a starting point by the development of this integrated approximation. (Gallopoulos, 1990) The main point is to realize closed physic loops of energy, water and residual flows (i.e. heat). Thereby, there are three character properties which should be imitated:

- *Energy requirements should be minimized, as well as waste generation and the consumption of scarce resources;*
- *Industrial wastes and discarded products should be used as input to industrial processes '...in a way analogous to the cycling of nutrients by various organisms in an ecological foodweb'*
- *The systems should be diverse and resilient in order to absorb and recover from unexpected shocks.* (Baas & Boons, 1997)

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6.3.4. Production and transport

In the last part of the 19th century, the electricity supply could be seen as a decentralized situation. Small scaled electricity production plants were situated nearby its customers. During the years the electricity demand as well as the (amount of) energy producers grew. This resulted in a growing network for the energy supply, fed by large centralized production plants. Two reasons hereon where that (1) it was cheaper/more profitable to produce electricity at large scale and (2) due to technological developments it became possible to

transport electricity over larger distances. (Lowe et al, 1996)
Until the mid 1980's this electricity supply was mainly centralized. Due to an increasing attention to energy saving and sustainability, more and more decentralized production of electricity took place in the form of wind energy, incinerators, and CHP devices (micro WKK). These decentralized production has a contribution of 30% to the total electricity production in the Netherlands. To compare, in 1979 this contribution was 11%.(SEP, 1999) This means a certain transition IS taking place, however the result is 19% in a time period of 30 years.

Of course, this decentralization is also a result of the liberalization of the energy market. Due to the technological developments nowadays it is possible to produce heat and electricity on dwelling scale using a micro CHP/co-generator. On this way lots of parties can/will get involved in the energy market because they are producing their own energy. When these individuals produce too much energy for their selves, they can sell it back tot the provider, tough this provider is not giving the same price as the customer has to pay in case of energy demand by the customer. Till 5000 kWh the provider will level the energy bill, though when one exceeds this 5000kWh lower prices will be given. In contradiction, in Germany the government decided that energy suppliers have to offer the same buying price as the selling price which results in a higher attractiveness of these technologies.

Since the release (liberalization) of several markets, the government has lost its grip on it. Though, when civilians mingle into the energy market, the government will be able to get back a sort of grip on the electricity market in the sense of taxes or other financial methods. However this is not appreciated by everybody. (Financieel dagblad 25-05-2010)

The thought is that by decentralization of environmental responsibilities tough implementation problems can be solved. (Burger, 2001) By decentralization, innovations can be applied on small scale but widespread. When an innovation is applied on a large scale, many users are dependent on it which can result in major problems when the innovation fails, there is no way back. When implementing this innovation small scaled, risks and consequences will be more synoptic and stability is easier to obtain. Experiments on small scale can have the same results as large scale but less (negative) effect, in the sense of damage as well as reputation.

6.4.Industrial symbiosis

6.4.1. Introduction

"In contradistinction with other biological organisms, we as human beings have the possibility of pro-active thinking in the sense of 'forward thinking' and anticipating. This can also deliver a very useful contribution in industrial Symbiosis, for instance in the form of collective anticipating." (Konz & vd Thillart, 2002)

Factories and other industries have a great energy demand, maybe the energy needed for regular activities (like heating offices, light, etc.) can be neglected when comparing with the production/processing activities, but in comparison to households these regular activities should not be underestimated. Also entrepreneurs will try their best to make their production process as efficient as possible with the goal to reduce energy demand and thus money → benefit. The assumption is made that it is rather difficult to reduce the energy demand focusing on the individual companies. The entrepreneurs should be motivated by the direct effect of energy saving in the sense of a lower energy bill at the end of the month.
Though, in despite of all individual entrepreneurial actions made to increase efficiency, the companies suffer with great energy surpluses where they not easily can get rid of. DWA investigated these situations and showed that major profits can be reached when approaching this problem collectively. It is the level up, at industrial areas where efficiency gains can be obtained. Though, this process is not going automatically, companies do not take initiate actions on area level by their selves, the core business is a more important issue.

So industrial areas or industries can deliver its contribution to the Trias Energetica between two parts, energy efficiency on area level, industrial symbiosis (Konz & vd Thillart, 2005) and the use of sustainable energy. On area level the efficiency will rise and when looking at companies individually one company is saving on the energy bill by selling its waste streams and the other company is buying 'second hand' resources which should be seen as sustainable.

When approaching the energy issue on area level, the concept of Industrial ecology could be rather interesting and useful. Industrial Ecology, a concept introduced by Frosch and Gallopoulos in 1989, means in practical way the exchange of each others by products and/or waste streams with a purpose to increase area efficiency. Industrial Ecology, also called Industrial Symbiosis is also investigated by Konz & van den Thillart who drew up the following definition:

> ***"Industriële symbiose op bedrijventerreinen:***
> *Een proces van samenwerking op lokaal niveau tussen bedrijven onderling en met de overheid, gericht op het efficiënter inrichten en afstemmen van verschillende (industriële) activiteiten, met als doel duurzaam ondernemen mogelijk te maken en efficiënt om te gaan met energie, materialen, ruimte, logistiek en biodiversiteit."* (Konz & van den Thillart 2002)

Translated into English this means:

"Industrial symbiosis on industrial areas:

A process of local co-operation between companies mutually as well as companies together with governmental instances, focusing on a more efficient way of categorizing and fine tuning of several (industrial) activities, with the objective to create more space for sustainable enterprises, and an efficient use of energy, materials, space, logistics and biodiversity. (Konz & vd Thillart, 2002)

6.4.2. Kalundborg Denmark

A best practice is found in Kalundborg Denmark. This industrial area is seen as the best practice on the level of EIP's (Eco Industrial Parks) by many scientific papers/scientists.

Situation

In 2006 the municipality counted for about 50.000 inhabitants on a surface of 733,9 square km's and it contains a major industrial area. The industrial area of Kalundborg started with symbiosis based techniques in 1961 when an Oil Refinery company started using surface water from the Tissø Lake for it's processes, to save the limited available level of groundwater.
The approach was that the municipality took the responsibility for the construction and realization of the needed pipeline while the oil company was responsible for the financial part of this project. (Christensen (1999) in United Nations Environment Programme). An interesting early symbiosis based co-operation. Since this co-operation a number of successful co-operations started increasing the level of symbiosis which finally resulted in a complex web of inter-company connections. (Figure 1)

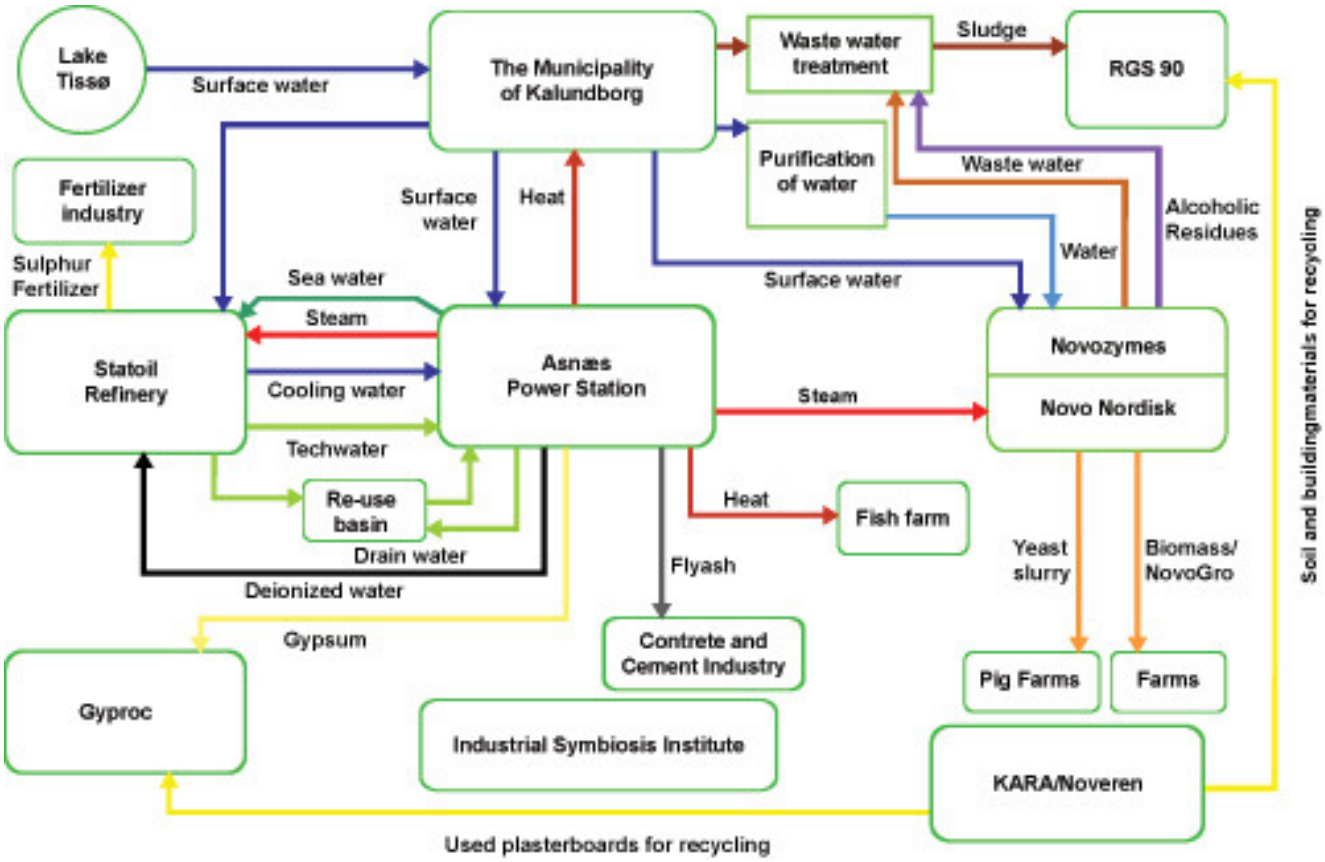


Figure 1 The industrial ecosystem at Kalundborg, Denmark

This situation has occurred not in a short time, to reach this network of by-products and waste sharing a time period of about 25 years has passed. This situation is by many scientists seen as a best practice and a widespread example of industrial symbiosis.
In 1990 a group of American scientists and businessmen went to Denmark and took the responsibility of spreading the concept of industrial ecology. (Rovers, 2008) "*One of its members had a student writing a doctoral thesis on Kalundborg. This study (Gertler 1995), which was also published on the internet, appears to have been crucial in spreading the Kalundborg story. It was also instrumental in corroborating the idea of industrial ecology and showing that it could, indeed, be more than wishful thinking and conceptual desk research* (Rovers, 2008)

The study also accentuates the evolutionary character of the Symbiosis and accentuates the complex interaction between technical and social forces in origin and development: "*Economic efficiency as a motivation for the various actors taking part in the symbiosis; the environmental regulatory regime's role as facilitator for innovative solutions; and, finally, the locally embedded network of agents for sharing ideas, information, and solutions to common problems*" (Rovers, 2008)

Above quote mentions three industrial motivations for industrial symbiosis:

- Economic efficiency;
- Environmental regulatory regime (Milieuwetgeving);
- A Network of agents for sharing ideas, information and solutions.

The economic efficiency is a factor which stimulates companies into a more efficient environment, the proper actions they take will be noticed by direct savings on the energy bills. In the case that somebody is not willing to get more sustainable on energy level he/she will not save money. The environmental regulatory regime is a mean which could take care for reaching the tipping point earlier.

In despite of the possible negative image of a regulatory regime (forcing parties to change in behaviour), this regime is seen as an important motivator in changing 'energy-behaviour'. "*Most problems that have been solved through exchange activities have come up as an effect of implementation of national emission legislation or initiatives to save energy and water (Rovers, 2008)*

The flexibility of the legislation was or is a rather important factor in stimulating the Industrial Symbiosis. This legislation is not based on fixed emission values but flexible and based on the negotiation process between (local) authorities and entrepreneurs. The local governmental instances have the responsibility on the execution as well as the control on the environmental legislation (Rovers, 2008). This means that the execution of this legislation can be case dependent which results in a closer connection between companies and government in the sense of negotiating and on that way creating more mutual respect and finally mutual gains.

6.4.3. Approach

The Kalundborg project is seen as one of the most successful EIP practices. However this project emerged over a period of about 25 years which evolved from a number of bilateral relationships (Heeres et al. 2004). One of the most crucial steps in setting up or developing an EIP is to stimulate inter company relationships. Although, in the literature one thinks the formation of a "*business network, based on improving both environmental and business performance, as an essential first step in the creation of an eco-industrial complex*"(Heeres et al. 2004)
Another success factor for EIP's is the pro-active participation of the following stakeholders:

- *"Public sector stakeholders from local, regional and national government agencies;*
- *Representatives of local companies and potential future tenants in the EIP;*
- *Leaders in the industrial and financial community;*
- *Local chamber of commerce;*
- *Labour representatives;*
- *Educational institutions*
- *Practitioners with the full completement of capabilities needed in the project: architecture, engineering, ecology, environmental management and education and training; and*
- *community and environmental organizations*."(Heeres et al. 2004)

When all stakeholders participate in the project, sufficient information has to be exchanged. The goal of this information exchange is to efficiently map the problems, opportunities and

other aspects which have their influence on the project. The exchange of information could be a crucial point for stakeholders not to join. Some information (for instance energy demand/use) is competition sensitive and companies could be not willing to publish it. A possible solution is to make strict agreements of the use of this information. In the case of Moerdijk, the Havenschap (comparable to a park manager) owns sensitive information and the only way to share this information happens in consultation with the company which is related to the information. Due to the trust in this Havenschap, companies are willing to deliberate sensitive data.

Heeres et al. Also appoints five possible barriers for exchange relationships:

1. "*Technical (an exchange is technical unfeasible);*
2. *Economic (an exchange might be economically unsound or economically risky from a company perspective);*
3. *Informational (the right people do not have the needed information at the right time);*
4. *Organizational (the intended exchange might not fit in the current corporate organizational structure);*
5. *Regulatory/legal (caused by the jungle of environmental laws and regulations).* (Heeres et al, 2004)

However, across from the above mentioned barriers Heeres et al. appoints two aspects where on the Dutch EIP projects are so successful. "*Firstly, the active participation of companies to the project is important. A majority of the companies located in the project area are willing to invest money and other resources in the development of an EIP.*" And "*Secondly, the presence of an entrepreneurs'/employers' association in the industrial park is relevant. This association proves to be an effective platform to educate and inform companies of the potential benefits that can be achieved through the establishment of an EIP. The association also functions as a much needed communication platform between the companies themselves and provides company management and staff with important "social" contacts (see Kalundborg).*" (Heeres et al, 2004)

The Heeres et al. Paper also describes success-factors in the sense of already existing exchange situations. Also the development of '*pollution prevention projects with a utility sharing character*' can be seen as a good start of exchanging projects, these projects are perceived as "*low risk projects with a potentially substantial economic and environmental benefit*".

Both projects will create a certain level of trust in initiatives of exchanging projects. This trust is crucial in this sense that exchanging projects are based on mutual trust. Mutual trust as a fundamental ingredient to a thoroughgoing co-operation.

6.5.Systematic view

Experience has showed that the erection of an industrial symbiosis system is a complex process influenced by several factors. This total process is too complex to map in mind. A method for visualizing and analyzing this complex processes is the use of System Dynamics techniques. The basis of this method begins with simplified causal loop diagrams.

The picture below shows three aspects connected with arrows which are provided by a plus sign. The plus sign on an arrow means that both connected aspects grow or decline the same way, so when A increases B will also increase. For instance, the more chickens at a farm, the more eggs there will be produced. The opposite of the plus sign is the minus sign, when this sign is used, the aspects will in- or decrease vice versa, so for example, the chickens can cross the street and will perish, this means that the more road crossings the less chickens there will be left.

Three major aspects in Industrial Symbiosis are Willingness, Stability and level of Participants. These three aspects have influence on the Symbiosis as well as on each other. As can be seen in picture 1 the willingness is influenced by the stability, the higher the level of stability in the system the higher the willingness of the companies. When there is more willingness there will be automatically more participants in the system. When the level of participants is high, the effect when one party tumbles down will be lower when the company is one out of 100 rather then 1 out of 10. So more participants means more stability.

This loop is a positive feedback loop, which however has to start positive somewhere to increase. When there is willingness, automatically there will be more participants which results in more stability, and the circle is round again. However when there is no stability, willingness will decrease which will result in less participants. (Sterman, 2000)

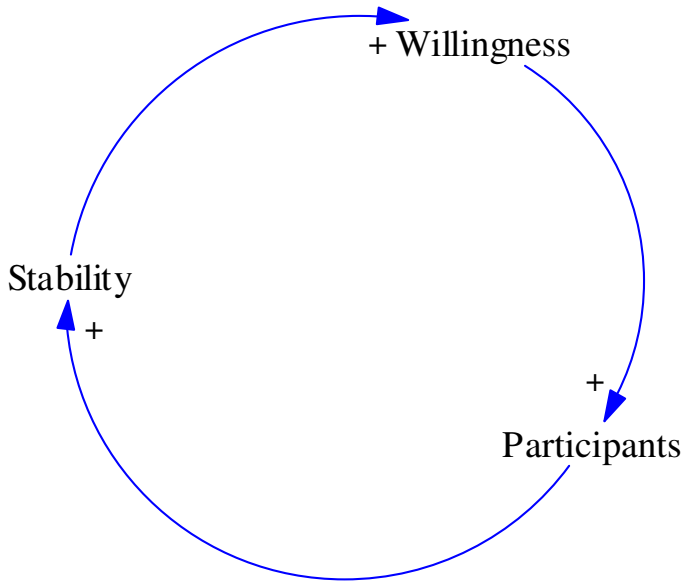
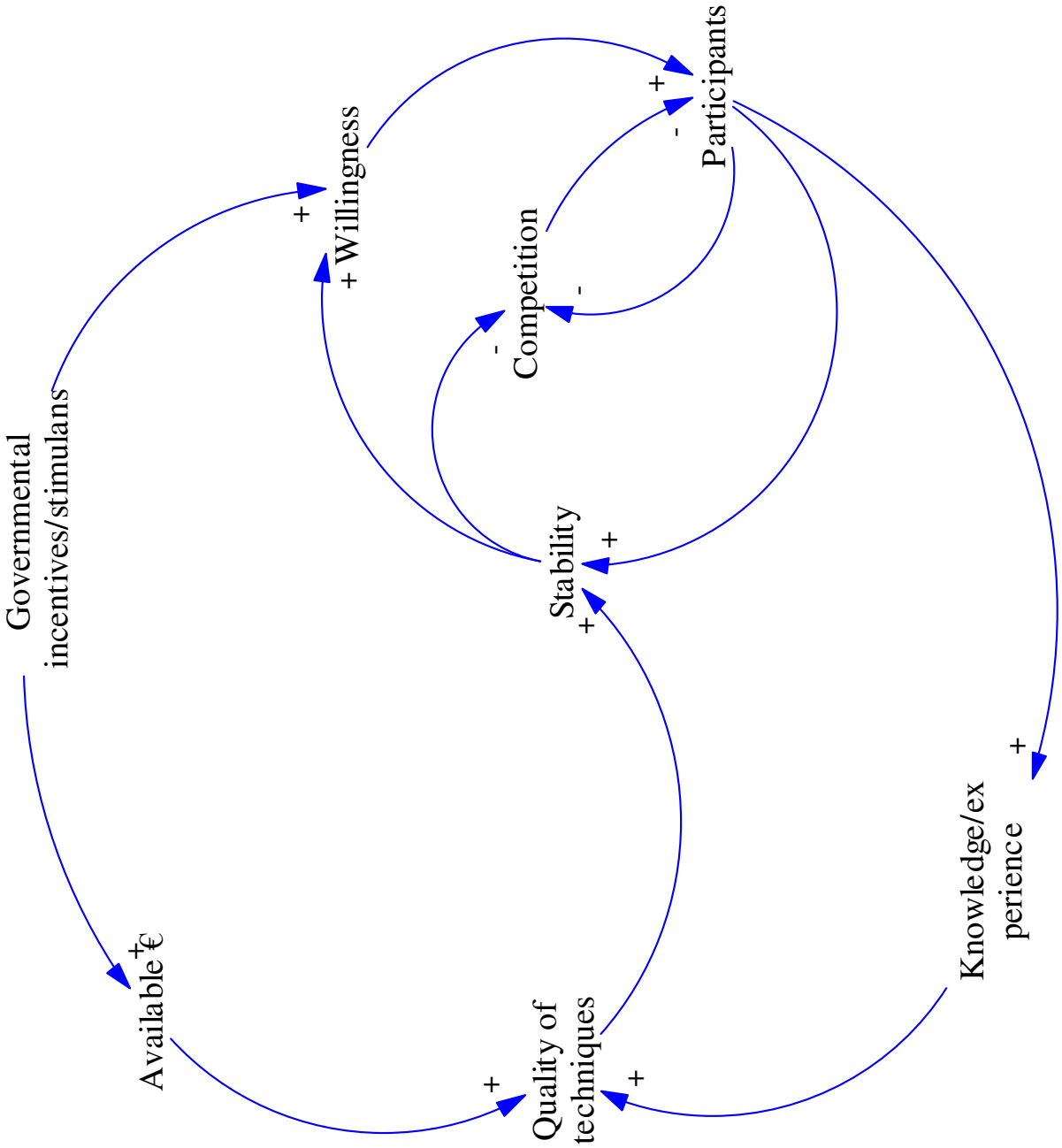


Figure 2 Primary systematic view of a symbiosis process


Governmental incentives/stimulans
+ Willingness
+
Participants
+
-
Competition
-
-
Stability
+
+
Available €
+
Quality of techniques
+
+
Knowledge/experience
+

However these three aspects can also be influenced by other issues, for instance the stability of the system is not only dependent of the number of participants but also the quality of techniques. On this way the reinforcing loop can be stemmed. These factors can also be visualized in a loop diagram and can be made as complex as needed. By making a complete diagram, the boundaries of a project can be determined.
Beneath a complete diagram is made wherein all important aspects which indirectly influence the willingness are shown.

Governmental incentives/stimulans

The government, in the form of municipalities, the province and the state have the objective to stimulate in sustainable developments. This stimulant is being carried out by initiating projects and sharing or spreading knowledge to those who have a demand. The Proeftuin Moerdijk is a project initiated by the province of Noord-Brabant. The province initiates a sustainability project and tries to positively activate all actors which are crucial for a successful project. By initiating a project, spending time and knowledge on it, the government tries to activate the right actors, however when this activation process gets difficult or when there is no or less interest at actors side, the government can offer subsidies to make the project or techniques more interesting which can result in more Willingness to join a certain project.
A mission is to create that much willingness so that governmental support can be decreased and the new technique is integrated that way that the right actors can carry it.

Available €

Financial means available is partly dependent on the governmental incentives as mentioned above. But also the users of a symbiosis network will or have to deliver a financial contribution to the developments. When more parties are involved, more money will be available. However more participants also means higher costs, so this aspect will make this loop a bit more balancing.
The available money for a system can be spent on investigation of the area of sustainable energy techniques as well as the execution of these techniques in the sense of the more money available, the better/higher quality parts can be used. Both of these factors will result in a higher quality of the total system.

Quality of techniques

The quality is influenced by two factors, namely Knowledge/experience as well as available financial goods. The more money available the better the techniques can be figured out because of more personnel available for investigation as well as the availability of better (more expensive) investigation tools and methods. Also better components can be used/applied when there is more money available.

Knowledge and experience can take care for optimalization and improvement of the techniques. The quality of techniques is connected to the stability of the system, when one can deliver proper quality, the system will be more stable and supply can be guaranteed better.

Knowledge and experience

Knowledge and experience is a crucial factor in the offer of a stable system. This knowledge and experience is influenced by the available money, the more money, the more room for investigations but also more room for initiating test projects were a lot of experience can be absorbed due to experiments. When the level of knowledge and experience is high, a higher quality can be reached.

Stability

This factor may be the most important one for a successful project and finally transformation. The current energy supply in the Netherlands is rather stable and consists of a good quality of delivery which is affordable for every citizen. Actually, instead of the climate and carbon-problems, there is no crucial reason to change in energy supply. Actually the natural gas stock in Groningen, the Netherlands is assumed to be a more clean way of energy supply rather than oil.

If there is a new way of energy supply it has to be better and cheaper in comparison with the situation nowadays. If one of these factors fails, the new system has no change at all.

Competition

The competition aspect has to be interpreted as follows. The bigger an industrial area, the more chance on same categorized companies. When this occurs, the level of competition will grow. Same categorized companies or competitors will not easily share their rest products in the sense that they are helping their competitors. So the more competition, the less participants. But when this level of same categorized companies is much bigger, the competitive thought will decrease, in a network of total 10 companies and 3 same categorized companies the willingness to participate will be less then in a situation of 100 companies and 30 competitors. Actually the ratio is more or less the same but the total amount of participants provides more stability. Also the psychological distance between the competitors will increase.

6.6.Actors

An important issue wherein the development of sustainability in the energy sector stagnates could be the scarce involvement of important stakeholders. Logically, when all stakeholders are positive and interested in the development of an energy neutral environment, the involvement is high and development hereon will expand which results in a positive contribution to a transition. However this situation will hardly occur at an initiation phase.
Below a power interest grid is drawn (Figure 3) which illustrates the actor behaviour in most of the sustainable energy cases.

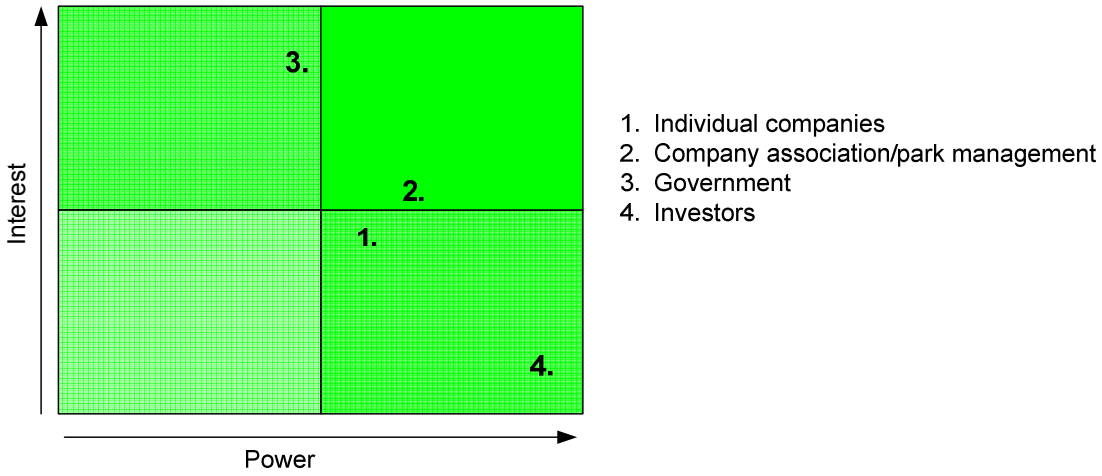


Figure 3 Power interest grid concerning the actors

This power interest grid describes the stakeholders which have their share or influence in a possible transition. Nowadays in the Netherlands, governmental instances have a great interest in the development of an energy neutral environment. The power of the government is their ability of permitting projects and another important instrument is their ability of granting of subsidies or introducing tax-arrangements which could make it possible to make sustainable projects more attractive. However this subsidy source is not inexhaustible. Subsidies have to be granted carefully to obtain successful initiatives.
Power in the sense of financial resources can be found at the individual companies as well as the investors. However these parties still have a lack of interest in the development of sustainable techniques. The most called reason of this lack is a lack of trust in techniques as well as uncertainties about payback times or costs at all, investors often prefer payback periods for about 5 years or less (3 years), while the payback time of sustainable systems is most of the time more longer or the certainty of a short payback time is missing. Due to less experience one is frightened to invest.
Many industrial areas have a company association and/or park manager, an association which takes care of general company interests and could form an intermediary for the private as well as public sector. The power of this association will be higher then an individual company because of their ability to mediate between company and government. Also their interest will be higher in the sense of positive publicity, which increases the attractiveness of the area.

An objective in this situation is to increase the interest of the companies to invest in developments towards an energy neutral environment. Another objective is to increase the power of governmental instances. However, the most sustainable (in the sense of successful) manner of a certain transition can be reached/obtained when all actors are willing to corporate.

6.7.Transition

Aside from the oil scarce threat, the majority of the Dutch population doesn't matter the origin of the energy he or she uses. The use of sustainable energy is surviving nowadays mainly due to subsidies. Every year the government has a certain budget available to stimulate initiatives for sustainable energy. However, these budgets are, just like fossil fuels not inexhaustible which can result in a backslide of sustainable energy because a lot of techniques are still rather expensive as well as the manageable part where in the level of expertise is not that much in comparison with traditional methods of energy claiming. So there are two parts, the technological part which is called 'hard innovations' and the manageable part, consisting of fundamental ideas, rules and organization forms which is called soft innovations. (Rotmans, 2003).

The change towards sustainable energy and an energy neutral environment can be seen as social innovation which then can be assumed (in the theory of Rotmans) as a social transformation or transition. '*A transition is a structural social change which is a result of each other amplifying and affecting developments on the level of economy, culture, technology, institutes and nature & environment.*'(Rotmans, 2005)

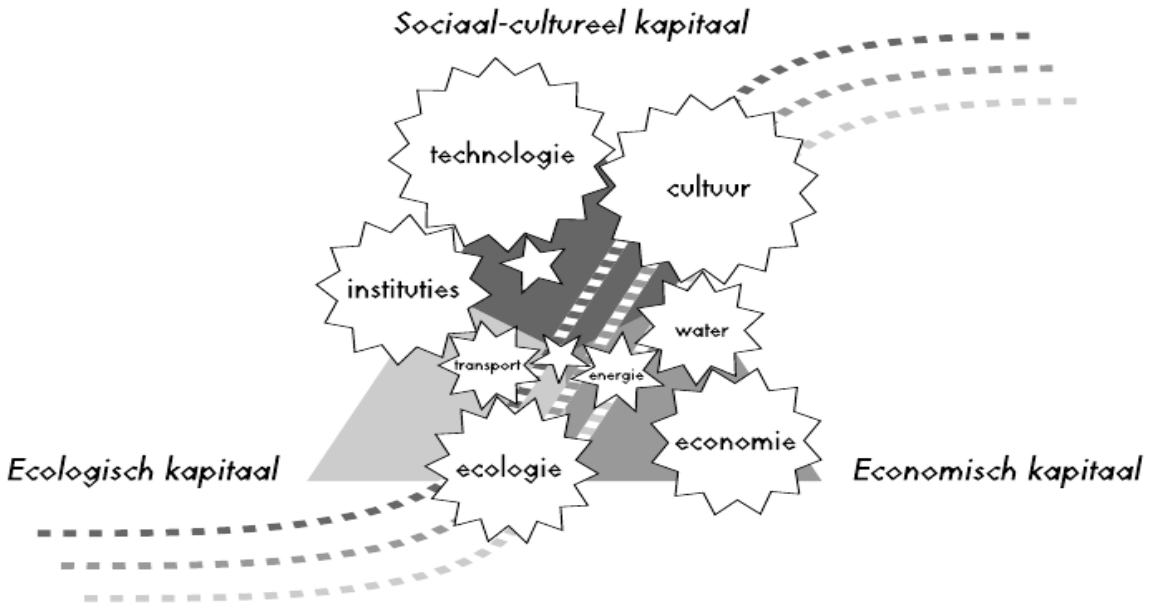


Figure 4 Transition like social wheels amplifying each other (Rotmans, 2005)

Following Rotmans´ transitions can be seen as structural changes which take a lot of time, at least one generation (25-50 years). (Rotmans, 2005) The first initiatives on the field of sustainable energy by manure fermentation (mest vergisting) were set up in 1973. (Raven, 2005). Assuming that these initiatives were the beginning of a transition, a period of about 37 years has passed, which should mean that we're almost there. However still a lot work has to be done to make sustainable energy the standard. Maybe the transition has not started

yet which can mean that one is trying to implement new techniques on a traditional way, which will not work properly when it will be carried out the traditional Dutch manner. Rotmans: '*The more we try to carry it out traditionally, the more persistent the problems will be which results in a closing loop of Unsustainability.*' '*Transitions need their time because existing boundaries, barriers, relationships, in short terms, the existing structure and planning has to be cracked*. (Rotmans, 2005).

Rotmans made a figuratively picture how the system of transition looks like, based on eight terms which can be found in the wheels which form a certain coil effect (figure 1). '*This coil-effect will only work when innovations on different social levels come together and practice an amplifying effect on each other.*' In this coil effect it is important that one can speak about a system, a system is a junction of parts subjects/parts which affect each other in a certain direction, for example: the economic sector, a business part, city or region or social domain or theme. So a covered issue where on above mentioned sectors are focusing themselves on.(Raven, 2005)

The transition towards an energy neutral environment can be seen as a 'system innovation'. The transition into an energy neutral environment strongly depends on an advantageous innovation climate; however this climate is not sufficient to stimulate this system innovation:

'*System innovations are exceptional market- and system-fail sensitive: this innovations are performing on a long time scale, are surrounded by major uncertainties, have their affect on many areas (technological, economical, social cultural and institutional), they focus not only on a latent market demand but also on the development of public goods where isn't a good market for yet' [0]. 'System innovations are sensitive for market and system failures so they explicit have to focus hereon' [15].*

In the case of transitions and system-innovations there are market- as well as system-failures, as already spoken above. These market-failures can be seen as a market system which is not functioning optimally because the market is not willing to invest on innovation and R&D. System failures are the flaws in social systems: economical (by a weak economical infrastructure and the lack of investment capital), the political-governance system (institutional obstructions, lack of innovative arrangements and networks which are too strong or too small), or the innovation system (like path dependents, technological fixations and a lack of adaptation power of the innovation system. (Rotmans, 2005)

Market is not willing to invest on innovation and R&D

The current Dutch energy supply fulfils all wishes of its customers. The current system is stable and the supply is guaranteed, the level of failure is minimal. Thereby the current energy supply is affordable and certainly not too expensive. Actually there are no motivations to switch. Thereby, an investment on sustainable energy systems is an investment where the payback time is not that short to be very interesting for companies. Governmental incentives have to stimulate and convince the market that sustainable energy on the long term is rather interesting. In the case of Moerdijk some companies got convinced of sustainable techniques. The province amongst other parties initiated the ´Proeftuinen´ project and several companies took it over and got rather enthusiastic about the possibilities and started looking for more options of sustainable techniques as well as optimizing their efficiency, individual as well as collective.

An important aspect on this ´ failure mechanism´ is that market parties have to get convinced about the advantages of sustainable techniques and efficiency, once they are convinced, this parties will become ambassadors for their sector.

Another aspect concerning the above described is the governmental involvement in public R&D. For the case of Noord-Brabant, the market is investing in the so-called 'private R&D' 45% of the Dutch private R&D takes place in Noord-Brabant. Though, Noord-Brabant seems to fall far behind on the level of public R&D and the objective to invest 1% of the G.N.P. in public R&D. This objective is based on the Lisbon convention which says that 3% of a land's G.N.P. has to be invested in R&D, 2% private and 1% public. In contradiction, Germany is fulfilling this goal which results in the fact that this country is one of the leading countries in sustainable developments.

Weak economical infrastructure and the lack of investment capital.

This mechanism is actually not dependent on techniques or interest. However the cheaper the systems, the less investment capital is needed to implement sustainable systems. Thereby due to a weak economical infrastructure and/or the lack of investment capital, the willingness to invest is often also missing, especially in individual cases, nobody is willing to be the first in row to invest. Collective investments should break through this threshold. However when there is no money available it will be very difficult to invest.

Political governance system

The political governance system can considerably influence upcoming developments. Currently the market has no major demand for a new energy system, the current one is certainly not malfunctioning and is rather affordable, so no need. However sustainable energy techniques will on the long term be very interesting. The task of the government should be to stimulate these new techniques. Of course the government is stimulating nowadays a lot, but with all liberalizations the government lost its grip on a lot sectors because all these sectors are market controlled.

Innovation system

The innovation system will not form an obstacle in the transition towards a sustainable or

energy neutral environment. Techniques are rather developing, steps have to be made on manageable level. How to implement, so above obstacles are more important than the innovation system. As said earlier in this report, the innovations are running, but there has to be a boost from the market sector, on this way there will become more money/investment capital available for R&D.

Jacobsson and Johnson studied on the field of the implementation or transition towards sustainable energy and showed that a process of diffusion of a set of sustainable energy sources is beginning to take place. That was an indication for Jacobsson and Johnson '*that we are entering into an early stage of transformation of the energy sector.*'(Jacobsson & Johnson, 2000) However the authors set up a table were in the examples are stated of factors leading to a new technology being repelled (Figure 5). This table of market failures is applicable on the field of the new/upcoming energy technology.

Actors and markets
Poorly articulated demand
Established technology characterised by increasing returns
Local search Processes
Market control by incumbents
Networks
Poor connectivity
Wrong guidance with respect to future markets
Institutions
Legislative failures
Failures in the educational system
Skewed capital market
Underdeveloped organisational and political power of new entrants

Figure 5 *Examples of factors leading to a new technology being repelled [Jacobssan and Johnson, 2000]*

Because of the fact that the new sustainable energy techniques are at the beginning of a diffusion its market is still rather small. An example of Sweden from Jacobsson and Johnson is their following quote: '*Again, in the case of solar collectors in Sweden, there is an absence of increasing returns in many fields. The firms are so small that there is little feedback from sales to R&D. Information is not diffused properly in the market. There is a lack of complementary industries, particularly in terms of knowledgeable plumbers who may inform customers, install the collectors and take responsibility for the installation (thus reducing uncertainty among potential customers).(Jacobsson & Johnson, 2000)*

Thus what is missing as an important ingredient of a transition is a growing network of ambassadors. Market control by dominant incumbents could be a factor which holds the development of ambassadors for a new technology. This market control results in a non-free or market dependent choice by customers. '*Take, for instance, the case of the rise of nuclear power in Sweden. As Kaiser (1992) notes, in the mid 1960s, a major threat to the diffusion of nuclear power was co-generation plants based on district heating. As a dominant actor, Vattenfall (the Swedish State Power Board) solved this problem by influencing the operating of many co-generation plants.' (Jacobsson & Johnson, 2000)* This As Kaiser explains: '*Municipal energy companies that built cogeneration plants were 'punished' with unfavorable terms. Their cost of standby power was high, while the price paid for power delivered to Vattenfall was low. In contrast, companies that did not undertake to build co generation plants were offered favorable (but secret) power contracts with very low prices. As a result, the number of towns that actually built co generation plants stagnated during the 1960s. Thereby the door was opened for nuclear power and the power hierarchy with the electricity system remained intact.* (Kaiser, 1992)

An interesting visualization of possible situations which will occur before a transition is the circle of blame. The challenge in initiating a transition is to turn over the circle of blame into a circle of engagement. But at which part does the circle has to be broke? (figure 6 and 7)

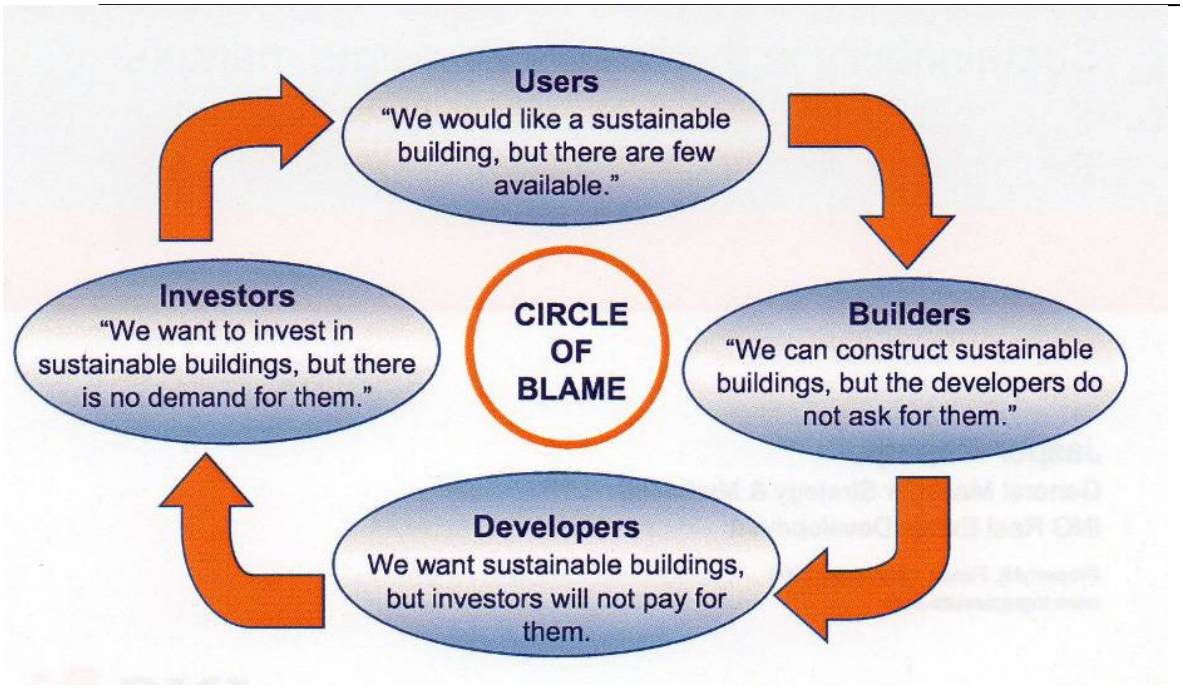


Figure 6 Circle of blame (Mulder, 2010)

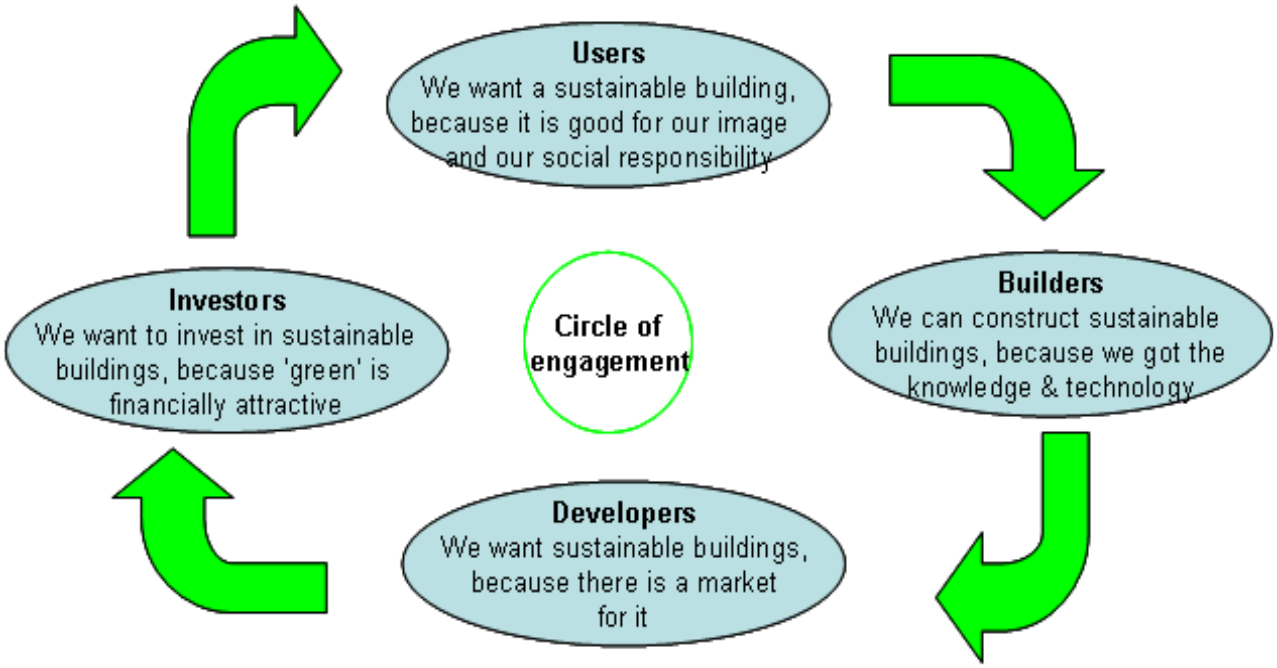


Figure 7 Circle of engagement (Mulder, 2010)

6.8.Mutual Gains Approach

Mutual Gains Approach (from now MGA) is a process method with the objective to create solutions or make use of opportunities which result in mutual gains/advantages. This method is based on thinking in shared benefits (belangen) and ambitions rather than individual standpoints and ambitions. Benefits tell the motivation of somebody's position, a standpoint only shows the position of a party. When the motivation of a standpoint is clear, there is space to negotiate, positions can be seen from other perspectives, more parties can deliver a contribution in the sense of knowledge towards a certain problem. This co-thinking creates more possibilities and above all mutual respect which then results in well thought out solutions which should be broad supported.
When negotiating, one has to be aware that there is enough space to explore each others benefits and create possible ideas. Another important aspect when starting the negotiation phase is to invite as much stakeholders as possible, everybody who is significantly influenced by the result has to join this process, when this is not done the process isn't mutual anymore. At last the related parties have to get enough possibilities to negotiate with their disciples to avoid blow offs at the end of the process.

Background and advantages
This MGA is developed at the Harvard University America and has major relationships with sustainable land development/integral designing.
Due to the collective searching for solutions and benefits, the opportunity or chance of a successful implementation should be much bigger because of a wide supported approach. In case of a tight co-operation between different parties [1] next projects or co-operations will be much easier as initially. The different parties have the objective to enlarge the scope of their 'problem' the larger the scope, the more (positive) affect the project will have. The purpose is to enlarge the pie and then divide it, the larger the pie, the more pie for every stakeholder or actor (the more benefits will be fulfilled).
Mrs. van der Linden mentions five requirements which have to be fulfilled for a successful application of the MGA:

1. Parties have to be agreed for openness: insight information, policy process and role division;
2. Parties (particularly government) have to be prepared to share responsibilities;
3. A constructive relationship is essential;
4. The question or problem has to be suitable for a MGA; one has to concern about it, it has to be manageable (scale, scope, time, financial, etc.), the problem may not be too urgent but also not to much masterminded.
5. There is an expectation (out of the entrepreneurs) that the process is leading to value creation.

[1] (one can think about entrepreneurs, governmental instances as well as environmental organizations, parties which initially have opposite objectives)

To fulfil a good Mutual Gains Approach, the following seven steps have to be taken:

1. **Exploration**
   The first step in the process is to explore the exact problem, who are problem owner, who are the stakeholders, what is the urgency of the problem and is it promising?
   This phase has to create a feeling with the problem, what is mainly happening? To create force analysis can be drawn up which structures this process.

2. **Interviewing stakeholders**
   All stakeholders have to be interviewed by a neutral person, preferably a person who is supported by every stakeholder. It is very important to create mutual trust. This interviewer will describe the playing rules concerning MGA. Thereby the interviewer will ask some depth questions in the sense of deep motives of the party regarding the specific problem. When asking some depth questions, the parties will think about the problem seriously, when this happens several parties will contact each other to talk about their 'problem' and the way they think about it.
   Some questions for the interview can be: 'what is the problem', 'what are the opportunities' and 'what are possible threats?'

3. **Set up a starting memorandum**
   When all interviews are done, a main report will be drawn up containing:
   - Information about MGA and its playing rules;
   - The problem;
   - Which parties are involved? (very important not to forget a party!);
   - The interests/benefits;
   - Possible obstacles, threats but also solutions, etc;

   When this concept report is finished, all parties involved can verify it and adjust where needed. This is a sort of deepening in the process. When the report is updated it will again be send to all parties to verify where after it becomes a final report. This final report is a debate piece which should be supported by every party where in the exact problem is articulated.

4. **Draw up benefit matrix**
   From this moment all parties have to come together physically in a meeting or workshop. At this meeting the following aspects will be handled: acquaintance, playing rules and process appointments, discussion about objective and progress, did we approach all parties influenced? Which party do we miss? Is something missing on the agenda/diary? And does everybody agree the schema and approach?
   During this first meeting a benefit matrix will be drawn up. The major issues will be appointed and arranged based on level of importance. At last a priority list will be drawn up containing tasks which are most important to focus on with the objective to fulfil a successful project.

5. Enlarging the pie and creating solutions

At earlier stages one has not spoke about possible solutions for the main problem. The first 4 stages are based on the clarification of the real problem (facts), the involved parties and its benefits. The goal also is that above mentioned clarification etc. is well supported by every involved party.

In the fifth phase the goal is to generate several solutions. In fact, this step is the core of MGA: to enlarge the pie, generating as much as possible solutions and options without valuating them, just the possible solutions. When all possible solutions are drawn up a valuation can take place, how do the solutions fulfil the main goals, objectives and benefits.

6. Sharing the pie and negotiating

Once everybody is convinced that the pie is big enough, the pie can be shared/divided. Negotiation has to take place regarding all options, the first solution/option can fulfil for a major part in a demand but less in another. Again bilateral talking can take place and a person can be appointed who analyses all options and come with a main solutions which fulfils as much as possible in all demands and benefits. This person also verifies if all solutions are spoken and if they are sustainable and long term proof.

This step has to lead to a covenant where in the solutions and approach are mentioned and clarified and finally has to be signed by all involved parties.

7. The day after and monitoring

The last step in this process is about the monitoring of the appointments. The following issues have to be taken into account in a document:

- What to do when an extra party likes to join?
- What when the facts will change?
- When in case of a costs surpass?
- How to communicate to the followers?
- What to do when it gets problematic?
- Who is responsible for the external communication with which message?
- What is the status of this agreement?
- Which milestones will be secured?
- How do we measure the progress?
- Etc.

All these questions have to be secured in a sort of document to finish and close the past six steps. Once every party owns this document the change on mistakes should be minimized.

In contradiction with above mentioned 7 steps drawn up by Rudy van Stratum (www.stratumstrategie.nl and Nuiver et al, 2008) Evers and Susskind assume five steps for achieving consent:

1. Taking the lead;
2. Granting/allocating responsibilities and roles;
3. Starting with a mutual search process;
4. Achieving consensus/consent;
5. Achieving people to fulfil their promises.

In figure 8 a scheme is drawn which shows all above mentioned steps.

Figure 8 Five steps towards consensus (Evers & Susskind, 2006)

The first step is ‘taking the lead’; initiating the MGA process. From this moment the initiator (in the case of Moerdijk this could be Noord-Brabant) has the mission to get the right persons/parties with the right expectations around the table. To achieve this, the initiator has to keep in mind to take into account the specific problem (which is then as specific as an initiators objective/ambition). To attain this, the initiator has to ask himself the question: “Which parties are crucial to acquire all interests (belangen)?”

Analyzing the specific situation shows which parties represent certain social subjects and which subjects have a major priority for everybody. This analysis results in a (conflict) assessment which is the first part of the initiation phase.
It is the assessor's duty to draw up an interest matrix which finally results in a list of important stakeholders that have to be invited to the upcoming MGA.
The following picture 9 illustrates the steps which have to be taken to attain a good result in the sense of mapping all stakeholders which have to be concerned in the Mutual Gains Approach.

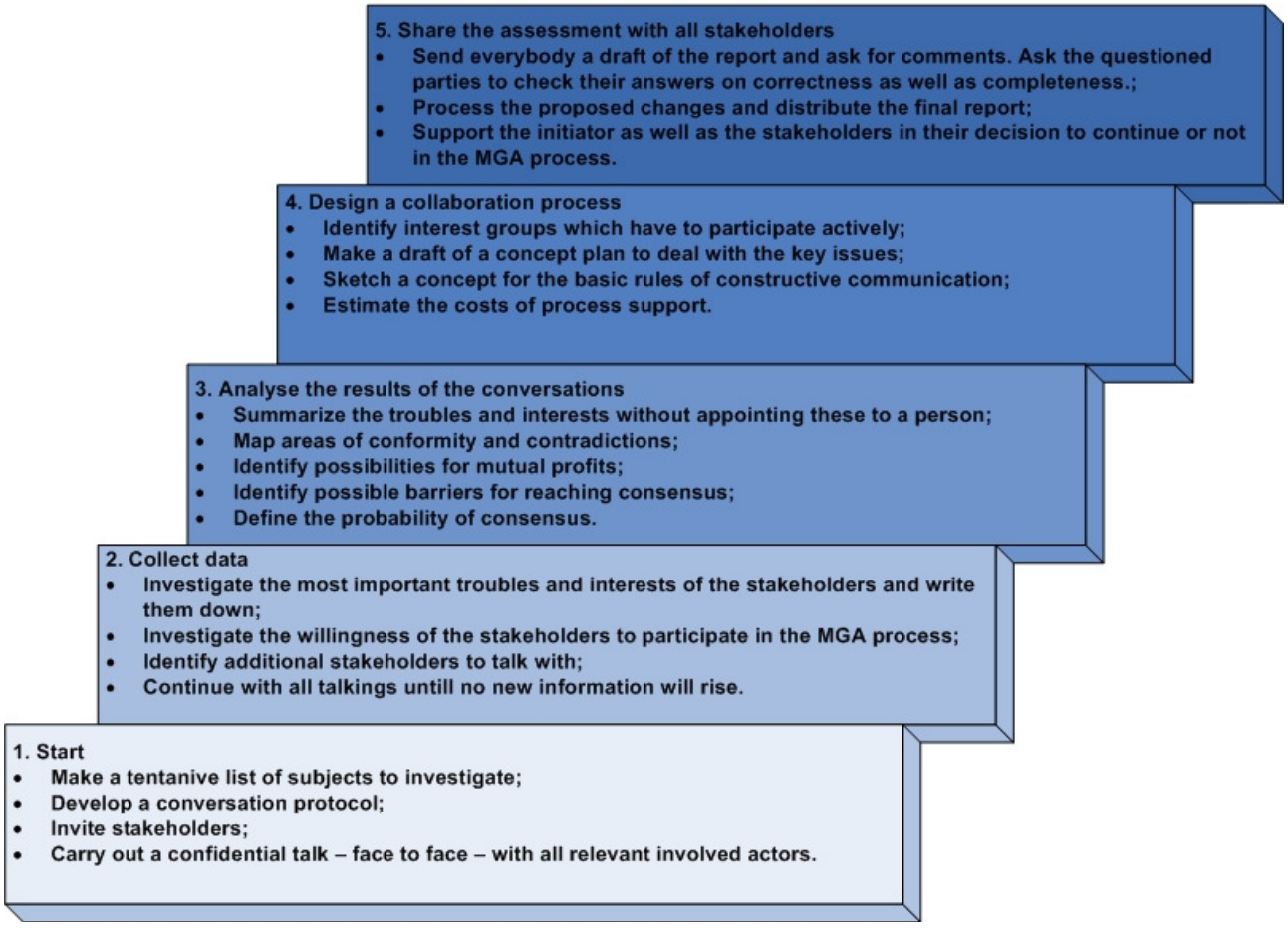


Figure 9 The assessment (Evers & Susskind, 2006)

The second phase in the MGA is the Granting/allocating of responsibilities and roles**.** Clear agreements have to be made about the whole process in the sense of communication, playing rules, everybody's tasks, etc. In this step it is rather important to create a solid fundament which is stable during the whole process. A kind statement of Susskind is: "Going slow to go fast'.

The third step: Starting the mutual search process, looking for common solutions. The opponent of this process is the Yes-No debate. Traditionally one party has an idea which forms a solution for a certain (most of the time his) problem. The next step is putting together a lot stakeholders and start a discussion where after a decision will be made which

has to options go or no go. Applying the MGA the solution has the objective to fulfil in everybody's interests, so mutual advantages. This approach has the objective to develop packages, proposals and ideas which have a more positive effect for all parties instead of the advantage when choosing one solution for one party. (Figure 10)

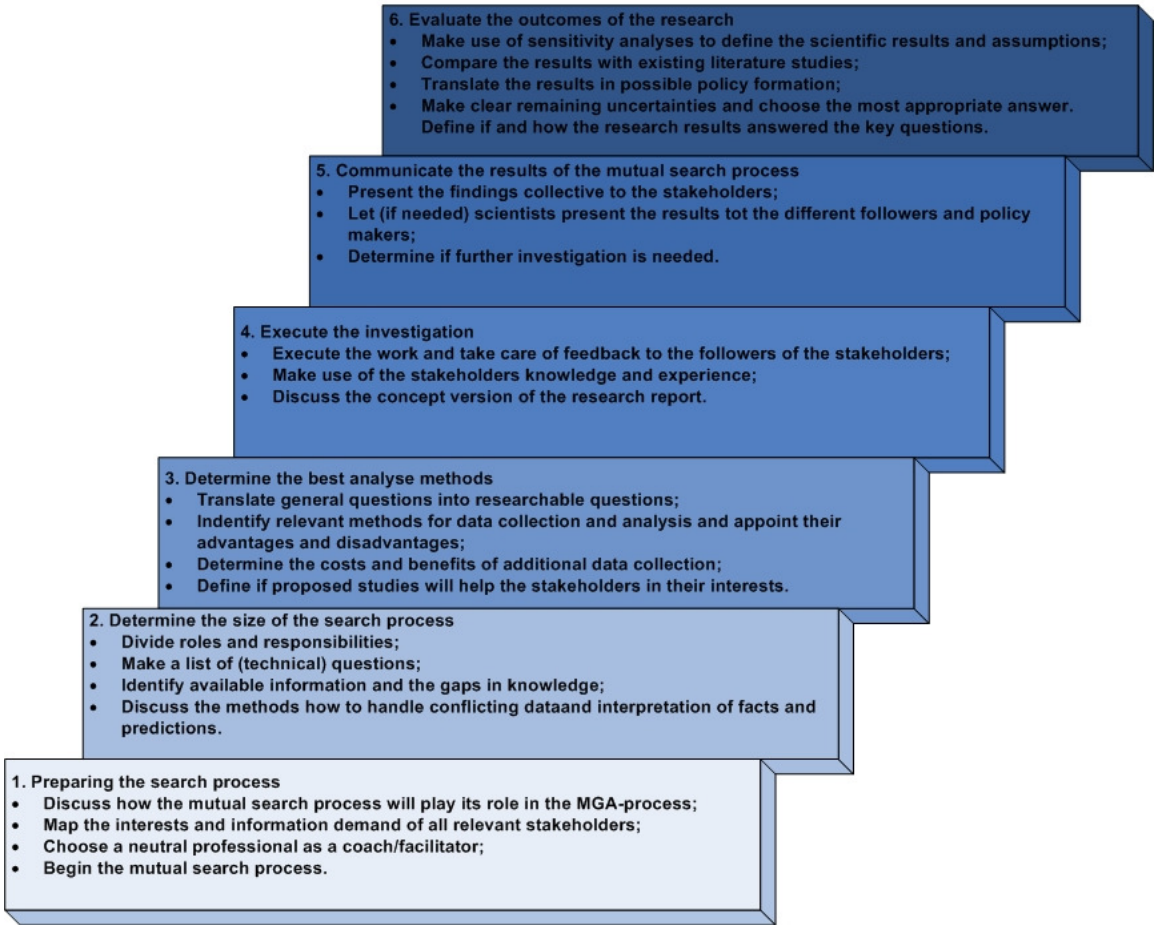


Figure 10 Joint fact finding (Evers & Susskind, 2006)

At phase 4 consensus has to be reached. This consensus has actually be called consent, it is very important that every party supports the decision made by the group. To avoid problems at a later stadium it is sometimes better to reject an apparently good solution and continue the search process to a better one instead of making the 'wrong' choice which results in dissatisfaction at one (or more) parties.

Phase 5 is the preparation for the implementation of the solution. Clear appointments have to be made on the manner how to implement the decided actions as well as ensuring that everybody fulfils its agreements. Thereby one has to manage how to handle when facts will change. For instance 'how can we ensure our plans and agreements with the government when a governmental period ends and other political parties will reign?' 'How to act when new parties enter the system? Etc.

In above described phases, none of them is more important then the other. The difference in comparison with traditional decision making is the separation of generating solutions and the judgement of these solutions. When all interests are mapped as well as the possible solutions, it is much easier to connect solutions to interests. When this is done, one can judge these solutions based on factual information.
Another difference in comparison with the traditional method is phase 5, where all parties think about, decide and agree how to continue and take care for this continuity of the process, make the process sustainable in the sense that agreements will be fulfilled and continued.
When everything is figured out a so called ambition map (ambitiekaart) can be drawn up. This map shows all mutual ambitions which will be pursued to reach mutual advantages and enlarge the pie. This ambition map is shown in figure 11 as a visual map. A large version as well as the textual ambition map can be found back in the Appendix A

Figure 11 Visual ambition map

6.9.Strategic Niche Management

A transition begins with the birth of a new innovation. Initially most new innovations (technical but also social innovations) will not be strong enough to compete against dominating regimes. What happens is that the innovation can develop on different aspects in a niche. A niche is a protected small defined area wherein new innovations can develop. This way an innovation in a niche can boost a transition. The objective of SNM is to set up niches wherein technologies/innovations can develop itself. SNM is a very interesting method regarding the research question, because the transition has a technical innovative side but also a very important social innovative side. SNM offers opportunities for these innovations.

SNM is an instrument to steer the first phase in the transition process. When talking in evolutionary terms SNM means achieving the protection of vulnerable innovations against early failures (by stimulating variation) and on the other hand the gently exposure on the inevitable market pressure. On this manner new techniques can be crammed for beating the prevailing regime. (bruggink, 2005)

"Observation has shown that many sustainable technologies are often unable to break through. Central in SNM to the idea that new technologies are developed against the background of a dominant regime, ie the set of (formal and informal) rules governing the behaviour of actors steers (not dictates). To develop new technologies, it is necessary to create protected areas (technological niches) where in actors can experiment with techniques and rules which differ from the dominant regime. For example, protection can be achieved by subsidies or exemptions from regulations. Technology niches can be created by social experiments, such as demonstration and pilot projects. As players learn the technology and social embedding to improve, protection can be reduced and may eventually create a market niche. SNM claims that creating technological niches is not a guarantee, but a necessary step in the overall innovation process." (Raven, 2005)

Kemp et al (2005) set up the goals of SNM:

- Crucial adaptations/changes can be applied in the technology and regulations to get a technology successful;
- Learn in different areas like: technical and economical feasibility, the environmental impact and the support of the population on different projects;
- The stimulants of further developments, the promotion of development of complementary technologies and skills;
- To form unity/creating support between the different actors with respect to a certain technology.

Based on their definition of SNM (Kemp et. al.1998):

"SNM is the creation, development and controlled phase-out of protected spaces for the development and use of promising technologies by means of experimentation, with the aim

of learning about the desirability of the new technology and enhancing the further development and the rate of application of the new technology."(Raven, 2005)

Three processes for technology niches

When developing a niche, three processes are rather important, namely:

1. **The connection of expectations;**
   When expectations and promises are auspicious, actors are more willing to invest in new technologies or innovations.(Raven, 2005) Expectations on a new technology are rather important for developing a niche, you have to gain support on the technology. This expectations will be more powerful when they become **shared** (by more actors), **valid** (supported by investigation and experiments) and when they are **specific** (focused on a technology).(Raven, 2005)

2. **The learning processes;**
   In fact SNM is a process wherein new technologies are implemented in an existing situation with real actors. However in fact this is an experiment. On a small scale a new technology is being applied and the actors in this situation will give feedback on this technology. On this way everybody related to the technology will learn about this. Rob Raven (2005) says: The ideal situation is that experiments produce results, actors will learn about this results and will apply adaptations/adjustments here on. (Raven, 2005)

3. **The creation of a network of actors.**
   In a niche several different actors will be present like producers, users, governmental instances and maybe civilians or groups. These actors are rather important for the feedback on new innovations as well as the creation of expectations. When a niche starts, the level of actors will be low and instable. However, when a niche develops positively this level of actors will rise and get more stable.

Also these processes can be seen as a positive loop. The more successful the technology, the more actors will support, when there is more support, there will be a higher learning factor which results in better performances in the technology, etc. This loop is also set up by Geels and Raven (2006) and is shown in figure 12.

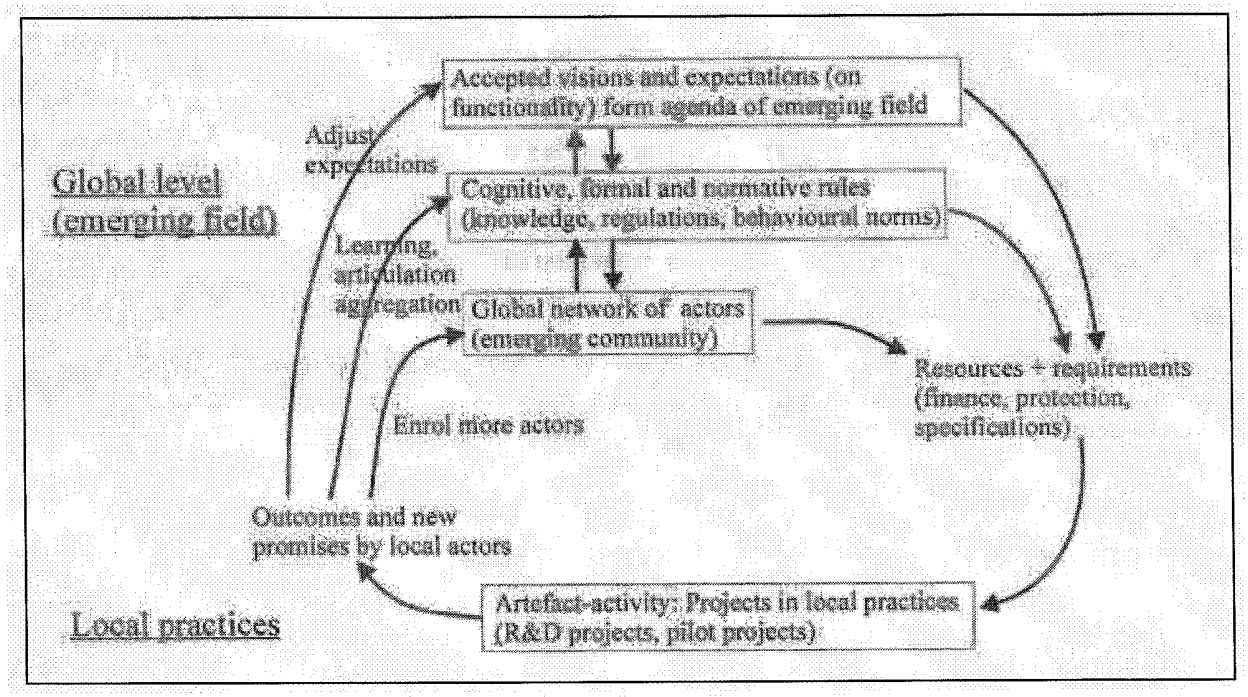


Figure 12 Dynamical interactions in a niche (Geels and Raven, 2006)

In the case of an energy transition, the niche of sustainable energy develops on the background of a rather stable energy regime. (Raven is talking about an instable electricity regime, however the energy regime as a whole can be seen as rather stable). According to Raven (2005) instability of a prevailing regime can result in bigger niches on three manners:

1. Due to the instability the expectations of the new technology will become higher which will result in more experiments, set up by the actors;
2. Instability can stimulate actors to participate in niche development because the view of the technology as a promising one;
3. Regime actors can participate in a niche development while they see this technology as a 'problemsolver'.

Instability of a regime is of course not the only condition for a successful niche, the niche itself and its processes has also to be qualitatively good. Raven has made a matrix where in a visualisation is made of the relationship between regime stability and the quality of a niche development. (figure 13)

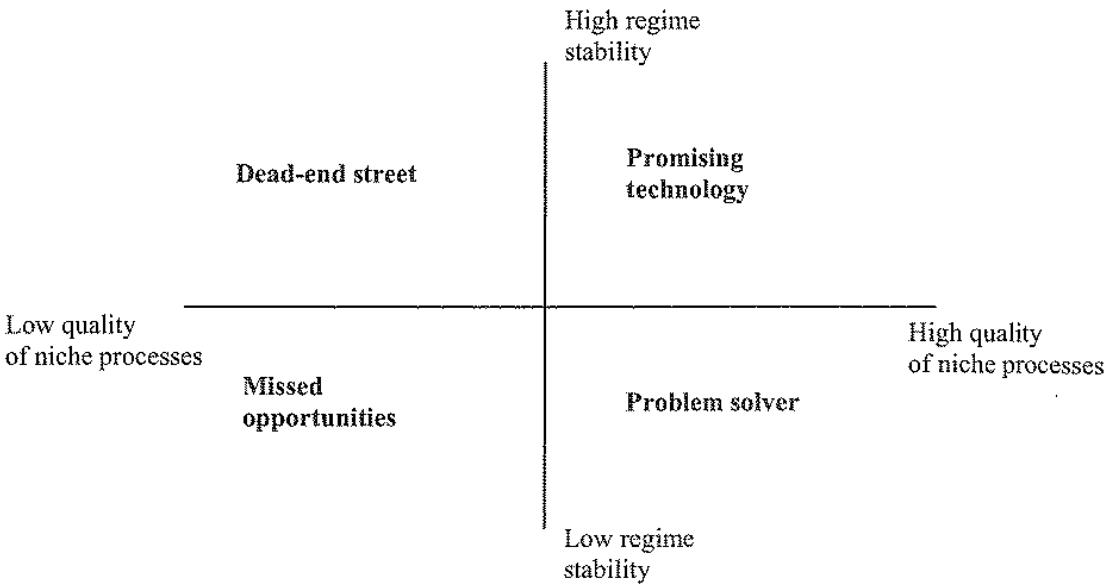


Figure 13 Relationship between regime stability and niche quality (Raven, 2005)

Regarding the governmental role Raven (2005) concludes that to reach a successful niche development at least a few elements of process and network management are needed. *"Without the stimulant of experiments, the possibility of thoroughgoing learning, the creation of new social networks and active participation of governmental instances, the chance on successful niche development is small."* Again this is not the one and only key to a successful niche development. Bottom up market based strategy is also needed for realizing a situation where it is financial attractive to participate.

6.10. Concluding

Consulting scientific literature, as well as conversations with the provincial experts and developments which can be picked up in the society and news sources, a conclusion can be made that the development of renewable energy sources is going rather slow in comparison with the effort which one is putting in. A result of transition into an energy neutral environment stays at low level, notwithstanding that the topic is discussed rather often in the society. The idea that sustainable energy is only interesting when subsidies and grants are given away or projects are initiated is rather frightening because this could be a sign that the techniques are still **not strong enough** to survive upon the **current regime** of traditional energy claiming. However it can also mean that private parties or companies are not yet willing or interested to pick up developments. Motivations for not being interested can be the **current financial situation**, first there is no investment capital available and second, when there is investment capital available, one is not willing or **afraid** to invest in a new technique where useful information, experiences and knowledge is rather difficult to find. Thereby, why switch to another energy system when the **current system fulfils all demands**? The current system or regime, is reliable, stable and affordable.

The theoretical framework discussed a number of topics, like the developments on the level of industrial areas, the mismatch between supply and demand. Governmental initiatives in braking development of new areas and restructuring existing (abandoned) ones.
Secondly the aspect of sustainability is spoken. Sustainability is a very wide interpreted subject, however to structure this subject. SenterNovem (recently it is called AgentschapNL) introduced the **Trias Energetica**, three steps to take in the road to a more sustainable environment. This trias energetica can fulfil an important role in the road to an energy neutral environment by two major aspects: (1) Making use of **renewable energy** sources and (2) **decreasing your energy demand**. Decreasing your energy demand can be obtained by focussing on energy efficiency.

When looking at the energy use in the built environment it is clear (experts talks also pointed this out) that energy use at company level is far the highest. Lots of energy use means that, when creating more efficiency the demand as well will decrease. DWA investigated these energy uses in the situation of **Moerdijk** and concluded that companies have lots of energy residues where they cannot get rid of. The report shows the possibilities for residual flows and the exchange of it, as well as specific feasible project ideas. So efficiency on the company level could be well done when focusing on their primary processes in the sense of low energy use. But in despite of the energy efficient processes, lots of energy disappears in the sense of heat, steam and water. However, the level up, at **industrial area** view there are possibilities to improve efficiency. The residual energy flows could be exchanged applying **Industrial Symbiosis** (or Industrial Ecology). This Symbiosis is based on the exchange of each other by products with the objective to increase efficiency and deliver a substantial contribution on the level of sustainability.

Though, in despite of these opportunities (techniques as well as figures which prove the possibilities), **nothing happens**, no actions are undertaken. A certain **transition** which is needed for implementing such a method is staying away.

An interesting example which is seen by many scientists as a (or the) best case in industrial symbiosis is Kalundborg Denmark. This industrial area started the symbiosis based approaches in the early 60's and expended since then bit by bit an evolutionary way towards, what it now is. This is a sign that implementing such a symbiosis based technology will not occur from one day to another. It is based on the evolution of a number of **bilateral relationships**, the stimulation of **intercompany relationships** and also the formation or the presence of a **business network**. Thereby pro-active participation of different stakeholders is crucial as well as starting small scaled initiating less risk projects. This way, **mutual trust** can be created which is a crucial factor in the initiation of symbiosis based projects.

The implementation of new energy regime is seen as a transition based on a technical as well as a social innovation process. Transitions are seen by Rotmans as structural changes which take a lot of time, at least one generation (20-25 years). A transition can be seen as a system of social **wheels amplifying each other.** However in the case of this thesis, the question is **which wheels** have to turn faster or slower to stimulate this transition? Aspects which slow down the transition are for example the lack of need for a new system, the market provided by a reliable proven energy system, why change? Also the small scale of the sustainable techniques nowadays results in a **lack of ambassadors** to promote the use of it. This results in major **uncertainties** for techniques. Because the ambassadors are missing, there is **less feedback from sales to R&D**. This situation can be simplified shown by the circle of blame which should be turned around in the circle of engagement.
Industrial symbiosis as well as the transition towards this symbiosis is based on relationships between all actors. In the case of good, well funded **relationships** and mutual knowledge, a transition towards industrial symbiosis will be stimulated. An interesting approach to stimulate this transition into industrial symbiosis is the method of **Mutual Gains Approach** (MGA). This approach is based on thinking in **shared benefits** instead of solely standpoints. When all benefits are clear a mutual ambition can be drawn up which should be broad supported. The goal of a **mutual ambition** is to enlarge the pie which will be divided when it is large enough. Because every actor delivers its contribution to the same pie, everybody's benefit will be affected which results in collective profit.

The last topic discussed in the theoretical framework is **Strategic Niche Management** (SNM). This SNM is a method which creates **opportunities for innovations** to grow on the background of **prevailing regimes**. A niche can be seen as a protected area wherein a new technology or innovation can grow. Protection can be carried out by governmental instances in supporting the new technology in the sense of supporting knowledge, connecting actors, subsidies or other financial means. The niche creates possibilities for these techniques to grow and develop (by small scaled implementation and/or experiments). Due to this protected area the techniques can develop to be strong enough to take away **uncertainties** and survive the world of a prevailing regime.

7. Data collection

To create a general view with the purpose to answer the research questions a literature study is carried out which resulted in usable broad information. At the same time general developments are being watched in the sense of news, newspaper articles, literature regarding sustainable topics, etc. A focus is carried out on the industrial area of Moerdijk, what are aspects which could be unrolled over more industrial areas instead of Moerdijk, what are broad applicable actions to be made and what are specific Moerdijk issues?
However there is a need for sharpening the topic in the sense of a practical approach. Several scientific papers described practical situations in the sense of case studies or other ways of field research. Though, there is a need for information to sharpen the current view against the background of developments in the Province of Noord-Brabant. What is nowadays the standpoint for the companies? Are they benevolent or not? What are their motivations for their standpoints? An investigation is done on the level of collecting already existing data, which studies are available focussing on the Moerdijk or western Brabant?
DWA, a consulting firm carried out an investigation on the area of residual flows in western Brabant including Moerdijk. This investigation as well as an extensive interview carried out by Daan Rovers (2008) provides useful information and a clear view for the Noord-Brabant situation and its possibilities.

The Province of Noord-Brabant is the initiator of the project 'Proeftuin Duurzame Verbindingen Moerdijk' (experimental garden for sustainable connections Moerdijk). The objective of the Province is to stimulate companies in making steps towards a more sustainable industrial area, for instance by realizing symbiosis based connections/networks. The DWA report shows on a clear way the possibilities for the realization of symbiosis based networks, strengthened by figures based on the energy use of the companies at Moerdijk. However notwithstanding this elaboration of all possibilities, the settled companies did not move towards initiatives in visiting each other to talk about possibilities or other actions. Companies were interested but that's it, necessary actions stayed away.
Ever after the initiative of the Province of inviting several parties in a discussion about these opportunities the ball started rolling, the companies got enthusiastic and even came with own ideas based on their mutual problems, also the sharing of energy use data seemed to be less problematic then before.
As a completion on the DWA report and the interviews of Daan Rovers, extra questionnaires were carried out to map developments since the DWA investigation and separate as well as later the initiatives of the Province in connecting or activating the different parties. This questionnaire has the objective to verify developments and relationships between companies and government.

7.1.Moerdijk

7.1.1. Main characteristics

The seaport/industrial area of Moerdijk is the area where this thesis is focusing on in the sense of a best practice. In the literature Moerdijk is a widely spoken area with a lot of successes and can be seen as one of the model projects in the sense of industrial ecology.
The area the seaport is about 2600 hectare and contains for about 400 companies with more then 6000 employees. A number of this 400 companies are so-called mailbox-companies which means that there is an address but the real company with its employees is actually missing at Moerdijk.

Most of these companies are united in an association called the BIM which means Bedrijfsvereniging Industrieterrein Moerdijk (Company association Industrial area of Moerdijk). This association has the objective to connect companies, create networks and the sharing of knowledge and experiences.

The industrial area is divided into several themes where in companies with the same character are settled. Different themes which can be found on this area are: Seaport, Distriboulevard, tradepark, Servicepoint, ecopark and industrial park. On this way all companies concerning the same themes are settled more close to each other which provides opportunities for sharing more related knowledge and experiences.

Another important party on the area is the Havenschap Moerdijk. This party delivers its contribution to the business to business contacts between new companies and the already settled ones. This party also takes care about the facility issues on the area as well as park management aspects. Due to the work of this Havenschap, the settled companies don't have to care about issues which are not directly related to the primary businesses but do have influence. The companies are in a way relieved and can spend their time on the core business. The Havenschap also takes care about the settlement regime on the park. On this way an attractive business climate is realized.

Another relevant party is BIM (Bedrijvenkring Industrieterrein Moerdijk) a company association. BIM can act as a representative for the settled companies at Moerdijk as well as an intermediate in cases of communication between the companies and government or other parties. An interesting development of BIM regarding the sustainable actions is the 'Koploper' initiative. This initiative is to stimulate companies to undertake actions towards social innovations like for instance corporate social responsibility. This is a effective method to create ambassadors for these developments.

7.1.2. Proeftuinen

The management agreement (bestuursakkoord) of the Provincial Executive of Noord-Brabant is called 'Vertrouwen in Brabant' (Trust in Brabant). This agreement contains several projects where the ecological project is called Schoon Brabant. This project is focusing on sustainability in the three aspects of People, Planet and Profit which is translated in Living, working and relaxing. These three themes are carried out by means of the so called 'Proeftuinen' and the Proeftuin on the level of working is called Proeftuin Duurzame Verbindingen Moerdijk which is logically focusing on the industrial area of Moerdijk.

The industrial area of Moerdijk has the ambition to be leading in sustainability. In the framework of the master plan 'Sustainable Port- and industrial Area (2007-2010) the sustainability of the area is taken to a higher level. The province's proeftuin project is lifting this ambitions towards a higher level by initiating projects and bringing together different parties.

A goal of the Proeftuin is to show that it is possible to create physical areas which contribute to a clean, healthy and sustainable environment. The role of the province in these developments are the following:

- Connecting different parties (stakeholders or actors);
- To stimulate innovation;
- To advance the process;
- The creation of conditions and;
- To take away thresholds.

To enforce the ambitions and involvement of all stakeholders in April 2009 the intention agreement 'Duurzame Verbindingen Moerdijk' (Sustainable Connections Moerdijk) is signed by the following parties:

- Havenschap Moerdijk; (Harbor of Moerdijk)
- Rijkswaterstaat Zuid-Holland;
- Waterschap Brabantse Delta; (Water authority of Brabant)
- Bedrijvenkring Industrieterrein Moerdijk (BIM); (Representative party for all companies at Moerdijk);
- The Muncipality of Moerdijk;
- The Province of Noord-Brabant.

The intention agreement contains appointments as well as expectation towards each other in the sense of where the parties stand for, what are the individual objectives, what can they offer, etc. Other important aspects which are include in this agreement are the way to communicate, appointments about how to communicate, etc. Appendix B

The great advantage of such an intention agreement is a change in the power interest grid, by setting up an intention agreement, all expectations and objectives towards each other as well as company objectives can be tuned off on each other. Instead of different stakeholders with objective conflicts will fight each other, they now have to cooperate which results in less tensions between the stakeholders.

7.2.Residual energy facts

DWA, an energy and advice company set up an investigation on the flows of residual products which could be useful for other parties. The area which is investigated is the area of West Brabant for the municipalities Moerdijk, Roosendaal, Bergen op Zoom, Halderberge and Steenbergen. In this thesis with the view on Moerdijk, the focus will lay on the industrial area of Moerdijk.

However, important conclusions of this investigation (December 2008) were that there are several interesting (also financial interesting) possibilities for the exchange of residual flows in the sense of heath, steam and hot water with payback times which vary from 4 until 8 years. This shows that companies, despite of their own efficiency, create lots of residual energy which is non-useful for them.
At the area of Moerdijk more investigations are carried out as well as still running which map more interesting and executable connections based on residual flows. However these reports contain sensitive energy consumption information which makes them confidential and so not possible to implement it in this report. In the appendix C the possible broad savings are shown on a satellite view of Moerdijk.

Of course, a lot of companies have been visited by DWA personnel, questionnaires have been taken, etc. Interesting is that companies appreciate the initiative of the province, (connecting residual flows) and initiate own ideas as well as they make their cooperation's more intensive. The practical approach figured out that continuity for the investigation is rather necessary. When an idea or concept for a connection looks feasible, the companies feel the need to take it over and work it out where in self determination is a rather important right where the companies have the need for.
Final major conclusions are that DWA found out 26 pieces of residual flow connections which have a saving potential of 7PJ. As a reference, the total energy demand of the investigated companies is for about 42PJ. 7PJ equals $2187{,}5*10^{6}$ m^3 natural gas a year. Finally the residual heat potential equals 15% from the total energy use of the investigated companies. (Appendix D)

Above mentioned figures can be found back in the total DWA report and shows that there are enough possibilities for symbiosis. Furthermore important conclusions of this investigation are the following.

- In the West-Brabant region there is a big amount of companies active settled on industrial areas; at this locations several connections for exchanging energy are already established.
- Apart from above connections, there is a big potential for connections of residual flows;
- There is a big amount of companies which use natural gas for heating offices etc. This can be avoided by making use of residual heat;
- An amount of companies is using electricity to cool down places, this can also be avoided by using residual heat for cooling by absorption;

- The investigation delivers a lot of relevant information;
- The energy use of the area is for about 42PJ, which is for about 11% of the energy use of Noord-Brabant (400PJ). A major part (28PJ) consists of the use of gas by big companies with their own electricity supply;
- The energy use of the other investigated companies consists for 43%(average) of gas use.
- On the area of Moerdijk a lot of rest heat is available, however this area is far removed from urban areas. Major distances have to be passed trough;
- It was a major effort to obtain the right data and information for mapping all residual flows. A substantial part of the data can be obtained at municipalities, environmental organisations as well as the province for the supply of permits. However there is no central instance which can provide all needed energy data.

Thereby companies are hardly willing to share their energy data, this data is seen as confidential and will only be showed when real energy sharing projects will start, even then a few people will be able to observe these figures.
However companies are willing to join in exchanging projects, there are substantial potencies of sharing residual flows. However naturally the trade and industry have to be respected in their activities and thoughts. Therefore an investigation has been carried out by interviewing those parties, by mr. Rovers BSc. 2008, with the following outcomes amongst other things:

> *'Major motive for the companies at Moerdijk to join residual flow connections are economical advantages. Environmental considerations become secondary. Some of the companies indicated that they set up a connection to stimulate cooperation with other companies. Other motives for exchanging are sustainable production, improvement of the relationships with their environment, lower scale of production input as well as an environmental more friendly image.'* (Rovers, 2008)

Furthermore a list of conditions for joining and realisation of an exchanging network is drawn up with input from the interviews taken by mister Rovers BSc. Conditions based on economical, organizational and spatial issues.

- Closeness of suppliers and purchasers as well as the infrastructure;
- Economical profitability, payback time, energy prices as well as grant arrangements;
- Correct timing;
- A good common economic situation;
- Not too much mutual dependence;
- No interest differences;
- Guarantee of continuity, quality and scale size;
- More contacts with other companies to create more mutual knowledge;
- Easier/more comprehensible laws and regulations;
- The correct treat of approval procedures;
- Proper contacts with (semi-)governmental instances;
- Enough personnel available for design and realization;
- First internal, then external measures;
- Clear appointments;
- The maintenance has to be arranged properly;

- There is a social as well as a legal pressure for a more environmental friendly production process;
- Limited risks and uncertainties by mutual trust;
- An active and persistence participation level by the concerned parties.

All underlined requirements can be a threshold for getting fully dependent of 'your neighbours'. When 100% of the demanded energy or heat will be produced by a colleague company instead of a dedicated energy plant, there will be complete **dependency**. Once the producing factory is going bankrupt, what will happen with the company who gets its heat from the bankrupt one? In fact the staying company can go back to it's traditional energy plant but real problems occur when this company adapted its product price down because of its very low energy bill. Results can be that its products will become that expensive which can result in major customer losses…

No interest differences, can be linked on mutual dependency, once company A is dependent on company B, this company B has a dominant position towards A. Most of the time the companies will be best friends but once this 'friendship' is over or anybody else is taking over the company, things can change radically.

Guarantee of continuity, quality and scale size. These three aspects can be different at each connection that will be made in between two or three companies. Continuity has some interfaces with the mutual dependency. When the production process of company B is not stable enough, company A (receiver) is not able to plan its processes on the supply stream of B which will result in less willingness. Above mentioned aspects can be declined by raising **mutual trust** and **clear appointments**. However this mutual trust is difficult, clear appointments can be recorded in a contractual piece, trust is something which is personal and has to grow.

Design, realization and maintenance is a very important aspect which has directly influence on the continuity and quality of the system. For a proper system enough financial goods are needed whereby the question will be 'who is going to pay for it' or 'who ARE going to pay for it'. In above conditions and conclusions one can see that economical advantages are a substantial motive for joining in exchanging projects which can mean that companies are not willing to pay too much for a system. The intention agreement signed on April 2009 says that the harbour of Moerdijk (which exploits) the area, is willing to make space available for installing infrastructure. Furthermore there are no appointments made about financial aspects concerning the erection of exchanging systems.

7.3.Interviews

In 2008 Daan Rovers interviewed 21 companies as well as three persons who are closely related to sustainable developments and industrial ecology, respectively Herman de Boon (program manager BioPark Terneuzen) and ing. Jacco Rentrop MSc. (Havenschap Moerdijk). (appendix E and F)

The objective of the interviews was to investigate the motivations/incentives to set up symbiosis systems. Other objectives are to determine the economical, organizational and spatial requirements which are important to realize symbiosis systems within Moerdijk. (Rovers, 2008)

Outcomes
One objective was to determine motivations to participate in symbiosis projects. The interviews with the 21 companies brought out that the most important motivation for energy exchanging was the financial aspect. Environmental issues are totally subordinate. Other motives which came up where:

- To obtain a sustainable production process;
- A more environmental friendly product;
- A better relationship with surrounding urban areas;
- Better/more cooperation with surrounding companies;
- To minimize the product input radius.

Above mentioned motivations where appointed a few times, some motives where mentioned just by one respondent. However because there were just 21 respondents which are rather connected to the sustainable developments, these answers are also seen as valuable and are included in this report.

On the level of economical, organisational and spatial issues outcomes were that the relative large distance between the companies is seen as problematic. However when (traditional) energy prices will rise this issue will decrease in weight, the higher the energy prices the larger the distances can be between offering and demanding companies. This energy price issue is an issue which returns very often. Further mutual dependence and continuity is seen as a very important factor of success. A backup supply could guarantee the continuity of an exchanging system, however a number of entrepreneurs is afraid that the costs of this back up supply will tackle the total payback time. (Rovers, 2008)

The (economical) profitability is an issue which is also seen as important. As mentioned above, the financial aspect is the most important motivation to participate in a symbiosis network. When the profitability is attractive, more parties will be interested in participating. The economic motivation differs from “it is fine when the system covers its costs” to “I want to make money with such a system”.(Rovers, 2008)

At the organizational aspect the respondents think the settlement policy is an important tool to stimulate symbiosis. Some of these respondents think that this issue started too late in

Moerdijk. However this is a useful issue at the restructuring processes of existing industrial areas.
Another useful outcome of the interview is that some respondents told the grant/subsidy regulations takes too much time and energy and not decisive enough for potential connections. There was one respondent who said it should be better to influence the regular financial/economical factors rather than grant methods. (Rovers, 2008)

Another aspect which could be seen as a point of improvement for the government is the opinion that legislation in a general way is not that problematic, the relationship between government and companies is seen as rather good but also desirable. However at the level of environmental permits (milieuvergunningen) the cooperation remains weak. Some companies are willing to expand their activities on the level of symbiosis but are "*counteracted by the permit provider*" (Rovers, 2008)

The interviews also clarifies that most of the (little) companies don't have enough personnel available to focus on these developments were the bigger companies have a certain QHSE (KAM) manager employed. And on financial area, small companies are most of the time not strong enough to invest major amounts where in the bigger companies do have this possibility. The smaller companies have their profit/benefit in grants or subsidies. (Rovers, 2008)
Since the municipality of Moerdijk consists of a major amount of small companies, this could be an aspect where profit can be made by for instance set up a team which takes care for the activities related to symbiosis what a QHSE manager should do.

Success as well as problem factors:
Success:

- A company association (ondernemersvereniging) which looks after the interests of the companies and also can be seen as an external communication channel;
- A clear vision of this association (and so also the companies) for the neighbourhood. Mutual interests.

Problem:

- The relative large distances between companies; this makes connections rather expensive. Rising energy (traditional) prices influence this price/distance relationship;
- The entrepreneurs don't have that good mutually connections;
- Mutual dependence is a factor which should not be too big;
- A back up facility is needed but can tackle the payback time.

Two other interviews are analysed which are the interviews with the Mr. de Boon (Biopark Terneuzen) and ing. Rentrop MSc. (Havenschap Moerdijk).

Biopark Terneuzen

Biopark Terneuzen can be compared with Moerdijk in the sense that this is also an industrial area (in the province of Zeeland) which is focussing on industrial ecology. Mr de Boon is program manager at Biopark Terneuzen.

The BioPark idea started in 2006 and initiated by the so-called program of 'Transforum' which has the objective to connect scientists, knowledge institutions, government, social organizations as well as the business sector to stimulate sustainable developments. The program of BioPark Terneuzen is a public private partnership where in the government covers 50% of the resources and the private sector the other part. This way a fair and sustainable connection can be made between government and private sector.
In the situation of Terneuzen, the motivation to share energy flows and by products was the demand of the one and a possible supply of the other. On this way waste streams could get valuable which made the private sector listen carefully.

Mr. de Boon his idea about the governmental role in this project is that the governmental instances have to make things possible instead of taking care of… (*zorgen 'dat' ipv zorgen 'voor')* '*The government should not regulate everything that tight that nothing isn't possible anymore and also has to answer questions within a year instead of after a year."*
Besides, mister de Boon's idea about the attitude towards this project of the province of Zeeland and the municipality of Terneuzen both are rather positively.
At last mister de Boon alerts that it is important to watch the risks carefully to avoid problems in a later stadium. When this problems occur, some parties could give up and leave the 'team' which results in a collapse of the project. A factor which is essential to avoid this risks is to create mutual gains situations (win-win).

Havenschap Moerdijk

Jacco Rentrop (Havenschap Moerdijk) again names the problem of legislation, particularly on the level of environmental laws as well as land use policies (bestemmingsplannen). "*These aspects ensure that connections are not realized that easy"* However this is an aspect which is not that hot regarding the company interviews. A sure thing is that when this legislation is called as problematic, the legislation on environmental permits (milieuvergunningen) is problematic.

Rentrop tells that the Havenschap has a key-role in the developments towards symbiosis developments. This key role expresses itself in the sense of the facilitating role. Also the Havenschap is owner of the area. Furthermore the Havenschap has a settlement policy (vestigingsbeleid) which means that this Havenschap has the ability to steer on the grouping of companies and maintain the theme idea of the area.

A question is asked if there is a list published where all energy flows of the companies are mapped. There is a certain list, however because of the competition level on the area between several companies, this list is in ownership of the Havenschap and confidential. When a company has a wish to join or participate in a symbiosis project, this company can approach the the Havenschap and mention its idea or demand. The Havenschap will contact possible companies which can contribute to this wish and when these companies are willing,

the Havenschap will set up the connection between the companies (connection in the sense of talkings) where after the project can start.

Main outcomes of the interview with Jacco Rentrop are:

- The challenge of symbiosis is not the technical side but the governance part. Risks have to be covered;
- Legal challenges/problems at the level of Environmental laws (wet milieubeheer) as well as zoning plans. These factors cause an unattractiveness of symbiosis;
- The payback time and the relative big distances between companies make it more difficult to exchange;
- The Havenschap fulfils a key role in the symbiosis as well as other sustainable developments. Because the Havenschap owns the land and has a role as facilitator;
- To publish energy use figures of companies is no option because of the level of competition on the area is too high, these figures are stored at the Havenschap, companies which want to participate can ask the Havenschap which will contact the right company to ask permission to share its data;
- One of the most important motivations for joining a symbiosis network is the financial trigger.

7.4.Questionnaire

To map the developments at the industrial sector in Moerdijk regarding the DWA investigation and the Provinces initiatives a questionnaire is carried out. The questionnaire, which has interfaces with Rovers' interviews focused on the motivation to participate in an exchange project, conditions connected to participation in the project and their vision on the relationship between the companies and the government in the sense of the province of Noord-Brabant. After the DWA study the Province initiated the Proeftuinen project which is a totally separated project regarding DWA. However since the initiative of the Province, the companies at Moerdijk started moving and got interested in the possibilities, also the fear for sharing energy data decreased. This questionnaire focuses on the developments since the Province's initiative and can be seen as a sort of verification of DWA findings and Province expectations. The questions can be found in the appendix G.

The questionnaire does not contradict the questionnaire carried out by Rovers (2008). On the level of motivations to participate in an exchange project, environment, CSR and responsibility for our offspring are motivations which play parts but are not important in comparison to the financial motivation. Economics prove to be the main incentive to participate in an exchange project. The question if clients/customers require energy neutral/sustainable processes scored rather low, there is yet no great customer demand for Industrial Ecology.
On the level of companies requirements in participating a set of requirements from the Rovers report were used. The questioned parties were asked to give these requirements a score from 1 to 5 (totally not important – very important). Outcomes were that there may not be a cost rise, however the energy price may be the same as traditional but lower should be nice. The supply continuity must be 100%, a back up supply is important. The asked companies are willing to invest time as well as money in possible projects. However the payback time of a system must be to the utmost 5 years. 10 years is too much and the theorem: "payback time doesn't matter, I'm working on a sustainable manner, that is the most important" is rejected immediately.
Furthermore a direct mutual dependence is not desirable and private relationships do have its influence at the negotiation table. The last outcomes are that a supply contract of at least 10years is desirable but not crucial; indeed there is a requirement which secures supply continuity. And profit should not flow down/away.

Further the companies are asked what their idea is about the province before they joined the project. Some answers:

- *"The official (ambtelijke) mill will throw up lots of barriers";*
- *"Before the project started my vision was that the Province was more or less an initiator who had the wish to promote sustainable development from political considerations. Gradually this changed into a partnership where in the province did not avoid participation in process responsibilities."*

These ideas about the Province changed during the project positively, due to a positive contribution of the Province. The average view towards the Province is positive in the sense of their stimulating role. Some recommendations towards Noord-Brabant are done:

- *"First do the pre-work before presenting things outwards. This to avoid that the apparent time of the project will be too much.*
- *"When solid investigation is done in the sense of possibilities, clear appointments with companies have to be made regarding input and results. Another important aspect is to notify that projects will be continued in next governmental periods.*

8. Conclusion

Despite all efforts a transition towards a energy neutral environment seems to stay away. Several actions are undertaken in the sense of the use of sustainable energy sources or techniques to claim renewable energy. However, a sort of tipping point which will cause major support in a transition seems to stay out. The main question is '*Which steps have to be taken to approach the turning point of an energy transition, and who is the right party or are the right parties to initiate here in?*'
To answer this question a number of sub questions is set up which should structure the problem and generate a clear view of a solution direction. To answer these questions a theoretic framework is made as well as a practical approach in the sense of data collection focusing on a best case at the industrial area of Moerdijk, Noord-Brabant.
In this chapter the research question will be answered by answering the subquestions based on the different topics discussed in this thesis. These answers will generate a clear view to form a number of recommendations.

Subquestion 1: What is Industrial Ecology or Symbiosis?
Ecology is a well known concept in the biology sector and means amongst other things the investigation of the interaction between organisms. Symbiosis means the together living of two life forms.
Industrial ecology or symbiosis focuses on the interaction between industries in the sense of exchanging residual flows which are for one company valued as waste or non-useful and for the other company as a valuable input material (i.e. energy). In industrial ecology/symbiosis the ambition is to close the cycles as much as possible. (Rovers, 2008).

In fact, techniques for the application of this symbiosis are not that difficult nowadays, the major challenge for implementing these systems lies on the level of bringing together the demanding and producing parties. Interviews pointed out that inter company relationships on area level aren't that good at all (in the sense of limited contacts). It is important to be informed about the present industries and map the energy flows of an area and its industries. However because of competition on industrial areas as well as lack of an initiating party not every company is willing to share its energy 'data'. It is smart to establish a sort of umbrella instance which builds a good and sustainable relationship with the settled companies. On that way the energy patterns could be mapped.

Subquestion 2: Who is problem owner?
The nowadays 'energy-problem' is a problem which is recognized by a substantial number of parties, also the sense of actions into sustainable developments is a sort of confirmed. However despite of the recognition and confirmations, real actions are staying out. The question 'Who is problem owner?' is difficult to answer in the sense of appointing one party who has the duty to carry out all the work. A better approach for this issue is to trace who is the best party to take initiatives which result in a transition.

In the case of Industrial Symbiosis (at the level of Moerdijk) the Province, BIM as well as the Havenschap are the right parties who could be able to initiate in actions which stimulate the transition. This methods is proven to convince the companies to join conversations/meetings

in creating opportunities for symbiosis. When the companies react positive and some projects are started, the province should be able to retreat bit by bit.

Subquestion 3: Who are the actors and how do/can they influence?

In fact every situation has its own actors in these projects. However in almost all cases these actors are well presented: Municipality, Province, settled companies and maybe energy companies. However in the case of Moerdijk the actors can be mapped more specific (extracted from the Statement of Intent):

- Province of Noord-Brabant;
- Municipality of Moerdijk;
- Havenschap Moerdijk;
- BIM (Bedrijvenkring Industrieterrein Moerdijk);
- Rijkswaterstaat Zuid Holland;
- Waterboard Brabantse Delta.

However the companies are represented by the BIM, they can also individually be seen as actors in this project because they may have interests which may not be shared by the BIM.

These actors all have its own objectives or ambitions. To map these objectives, ambitions and maybe pre conditions, a Statement of Intent is drawn up and signed by all above mentioned parties. This way provides a situation which minimizes unforeseen problems regarding powerful opponents. Thereby when these parties will meet each other periodically, their ideas and demands can be tuned on each other which will have a positive influence on the process.

Subquestion 4: What is nowadays the position of companies towards industry ecological developments?

To answer this question, literature review is done as well as the consult of experts, existing interviews as well as an executed questionnaire.

The most important motivation for companies to participate in a symbiosis based network is the financial aspect. Interviews and questionnaires pointed out that environmental aspects are totally subordinate with regard to the financial aspect.

Furthermore barriers for symbiosis are the uncertainty of payback time, projects have to be paid back within 5 years. Because of less experience in this field a good anticipation on this field is hard to make. This is an issue which can discourage companies. A manner to avoid this can be seen in financial governmental support in the sense of guarantee means (garantstelling). However the outcomes of the Moerdijk interviews did not reveal that companies have a major distrust in these developments. Reason of this ‘missing distrust’ can be the success of the ‘Proeftuin’ project of Noord-Brabant. The ambition was to start successful, not big, this way companies can experience successful projects which will result in more trust and even more candidates. At last the rising energy prices (traditional) will make it more interesting for companies to find out other methods of claiming energy.

Subquestion 5: What are the preconditions for companies to join in a symbiosis network and how are they influenced?

This question is investigated by literature reviews as well as interviews and a questionnaire. The interviews mapped the issues, by sending a questionnaire the interview is validated. Preconditions which are set by companies on Moerdijk are the following:

- *Supplying and demanding parties have to be settled in each others neighborhood;*

  However techniques are advanced nowadays, distances between companies are limited. Though, when energy prices rise, the distance between companies can rise either. The higher the (traditional) energy price, the more interesting sustainable techniques.

- *Economic profitability, payback time…these factors are connected with the (traditional) energy prices;*

  As mentioned above, rising (traditional) energy prices influence the attractiveness of sustainable techniques, in the sense of symbiosis. Economics still are the most important motivation for companies to participate in a symbiosis network. Environmental issues are subordinate.

- *Correct timing (do not initiate a symbiosis project in economical hard times);*

  Setting up an industrial symbiosis system means also investing. When economic hard times occur, it is not interesting for companies to invest in this kind of techniques. Also when a company's energy system isn't worn for the present, this company will not decide to switch. The same story on area level, but the moment of erecting a new area or restructuring an existing area could be the perfect starting point to introduce symbiosis.

- *Too much mutual dependence has to be avoided;*

  It is inappropriate when companies are mutual dependent so much that in case of process interruption at one company (supplier) that the connected companies suffer and in worst case these connected companies also fall.

- *Interest differences cannot be afforded;*

  There must be a mutual interest. Some companies think the exchange has to be break even and other companies prefer to make money/earn on a connection. Clear appointments have to be made to avoid this kind of financial problems or escalations.

- *Continuity has to be guaranteed, supply certainty;*

  To realize substantial savings, the exchange flows have to be substantial as well. For attractiveness of this connections continuity has to be guaranteed. Also in comparison

with the idea that there is an affordable and reliable (traditional) system a symbiosis network has to be as reliable as the traditional system.

- *Easier and more comprehensible laws and regulations;*

  Literature describes the laws and regulations as problematic in the set up of an symbiosis network and sustainable developments at all. However the interviews and questionnaire did not appoint this as problematic. In the cases that is was problematic, problems occur at environmental permit level (milieuvergunningen) which is the responsibility of the province. (Rovers, 2008).

- *Neighborhood knowledge;*

  This aspect is not a precondition but more or less a motivation to participate in a symbiosis project. The interviews appointed that mutual contacts are not that good as assumed. Some companies like to participate in a symbiosis network to get more knowledge about their neighborhood.

- *Proper contacts with (semi-)governmental instances;*

  A good relationship with (semi-)governmental instances is desirable. Without co-operation of these instances a lot is hardly possible (permits, knowledge, mediation, grants). A good relationship will stimulate the process.

- *Enough personnel available for design and realization as well as proper agreements hereon;*

  The industrial area of Moerdijk consists of many small companies/industries. Most of these companies don't even employ a QHSE (KAM) manager. However symbiosis systems need their construction and maintenance, a proper team for this is desirable. Also clear appointments have to be made to obtain a smooth maintenance process.

- *Limited risks and uncertainties by mutual trust;*

  Mutual trust is a fundamental aspect in the process of exchanging residual flows. When trust is missing, full support will also stay away.

- *An active and persistence participation level by the concerned parties.*

  The last aspect as issues for an industrial symbiosis network is the demand of involvement and persistence participation of all concerned parties. When every concerned party supports the plans the process will be more successful.

Subquestion 6: What could be the role of the Province of Noord-Brabant here in? How can they deliver a desirable contribution in initiating a certain transition?

Literature reviews pointed out that barriers which occurred at governmental level are the difficulties in the sense of permit supply. Furthermore companies think a good contact between government and company is desirable, governmental instances have to give building permits, can give subsidies, are in some cases land owner, etc.
The way the government can deliver a substantial and desirable contribution in the development of sustainable techniques focusing on symbiosis systems, is (1): Obtain consistency on the level of legislation as well as governance aspects. The government has three layers, Municipality, Province and the State. These layers should obtain this consistency, a municipality can obtain certain ambitions which are perpendicular to Provincial plans or State plans. These situations can result in distrust from companies towards the governments. Thereby the European Union may also not be forget.

Secondly (2) the governments can facilitate in innovation (public R&D) and collaboration. As mister de Boon said: '*The government should make things possible instead of taking care of…"* This way stimulates companies to initiate in social and/or technological innovations.

Subquestion 7: What are possible process techniques to initiate a transition?

This thesis describes two process techniques which could deliver a useful contribution to the energy transition. One, Strategic Niche Management (SNM) and two Mutual Gains Approach (MGA). SNM means the creation of a niche where in a new technique or an innovation can develop and grow until this technique is strong enough to compete the dominating regime. '*Strategic niche management is an instrument to steer a transition in its first phase."* (Hermkens, 2006) The niche is a protected environment where in the innovation or new technique gets the possibilities to grow and develop. In fact it can be seen as an area where in experiments can be carried out to raise the new technique so far that it gets strong enough to survive the regimes first punches. SNM is a method which is useful when the accent of an initiative lies on the level of success instead of project size.
Mutual Gains Approach (MGA) is a strategy with the objective to create solutions which result in mutual gains. The focus lays on making the pie as large as possible, due to input of all stakeholders. A MGA is based on the input of all stakeholders which have mutual trust, and are willing to take co-responsibility. (de Graaf, 2007). When the pie is big enough and pleased all interests as much as possible, it can be shared/divided to all stakeholders. Instead of focusing on a stakeholder his standpoint MGA focuses on the interests of a stakeholder. In a MGA it is crucial to have all stakeholders around the table, when this takes place, the conversation part can begin where in the important factor is to create mutual trust and then ambitions, ambitions which are supported by all stakeholders. When all stakeholders agree this ambitions, they will support the implementation of it. The chance of success is rather big and next projects will also run better with less barriers. Seven important steps in a MGA are listed on the next page and is explained more extensively in this thesis.

1. **Exploration;**
2. **Interviewing stakeholders;**
3. **Set up a starting memorandum;**
4. **Draw up benefit matrix;**
5. **Enlarging the pie and creating solutions;**
6. **Sharing the pie and negotiating.**
7. **The day after and monitoring**

The projects with reference to the Proeftuin Duurzame Verbindingen Moerdijk are partly based on the techniques of Mutual Gains Approach, focusing on mutual advantages. Spending time and effort on the preparation phase of a project, by intensively mapping the benefits of all stakeholders and creating mutual supported ambitions (enlarging the pie) will result in broad supported actions which avoids problems in the sense of harmed stakeholders. An ideal MGA results in total support of all stakeholders.

Though, the proeftuinen project in Moerdijk is also very suitable for applying the Strategic Niche Management approach. By means of the Proeftuin, the Province can create a protected area (niche) to implement the symbiosis techniques. By a small scaled approach, the projects can get an experimental character, where cases are likely to fail, one can directly intervene and undertake actions or changes in the approach. When applying small scaled projects, the chance of success is much higher, when projects are successful more support and interest in the new technique will occur which then results in more actors interested and finally more as well as larger projects which should stimulate a transition.

9. Recommendations

This chapter will handle the recommendations which raised during the investigations. The recommendations are sorted in different categories. A distinction is made in the different phases of a project as well as recommendations for further investigations in the development of the industrial contribution towards an energy neutral built environment.

Scope

- **The focus should be done on industrial areas because their major energy use and the opportunities in exchanging surplus energy.**
- Existing industrial areas which will be restructured offer great opportunities for local energy transition. Implementing industrial symbiosis is rather timing sensitive. Companies who have just started up or just changed/updated their energy system will not be willing to participate in such projects for the next years. When an industrial area will be restructured, a time course (natuurlijk moment) arises to initiate the implementation of an innovation. Respond hereon, the restructuring of industrial areas is a hot topic nowadays on the political agenda, which means that actions will be undertaken on these areas.
- By regional alignment and settlement policies, industrial areas which have to be restructured can be classified optimally and effectively to pursue ideal circumstances in the sense of energy supply and demand, focus on efficiency. The province which focuses on a regional level can deliver a significant contribution hereon.

Preparation or initiation phase.

- Focus on a good collaboration level. Everybody is willing to save energy consumption but has its own conditions and interests. Make these conditions negotiable and discuss them. The investigation showed that companies are not unwilling to invest or spend time on the development of for instance Industrial Symbiosis. The financial aspect seems to be an important motivation of their interest; environmental aspects are more subordinate, though CSR is upcoming more and more. However, Respect this thought and mark this financial aspect as an instrument to promote sustainable developments.
- When initiating a project don't save time on the mapping of the actors, also future actors. Be pro-active in this search and keep in mind that you are not the only person who is willing to initiate a (sustainable, environmental or other) project, look after other initiators and get in contact so talk about each others plans and maybe interfaces or contradictions.
- The Havenschap can play a crucial role in promoting symbiosis relationships. This instance has the position to connect the companies. When this Havenschap promotes relationships more active, companies will easier participate.
- When initiating, make your scope as large as possible and do not forget European developments, provincial initiatives are most of the time subordinate to decisions of higher authority (National government, European Union). This prevents situations occur like the Natura 2000 'issue'. When these developments are mapped in time,

plans could be tuned off on each other.

- Mutual contacts on industrial areas are minimal; the mutual knowledge of each others companies seems to be minimal while this is a fundamental aspect in industrial symbiosis. Intensify mutual contacts. Associations like the Havenschap can stimulate mutual contacts. For instance by organizing 'business days' or other activities where companies can meet each other. In fact these activities look rather simple, the effect on mutual knowledge should be substantial.
- Focus on developments on the level of Corporate Social Responsibility. The government can play an important desirable role in the sense of taking care of possibilities for companies to initiate innovations, social as well as technological.
- Encourage the companies who are willing to invest in sustainable developments, for instance by means of the 'Koploper' idea. Create ambassadors.

When actors are being approached.

- Keep in mind the objectives *'How large does the pie have to be?'* When is the mutual ambition fulfilled?
- Choose a directing party, most of the time this role is carried out by the Province. The province is a party which is often seen as neutral. However conversations will be in the character of round table talking, it is smart to appoint a directing party in the sense of leading discussions, managing administrative tasks, external communication, etc. The advantage of the Province as the directing party is their regional operation scope, the Province can generate a regional vision.
- Focus on the success of projects, not project scale. Successes in small scaled projects are more valuable large scaled failures. Scale size expansion is a result of success!

When the project is running

- Be careful when publishing developments or starting points to avoid that people start thinking the developments take lots of time. Publish aspects which are worth mentioning. It is important to publish possibilities and its positive effects. Of course negative effects should not be kept secret but focus on efficient communication. Avoid a view towards the government that their projects take lots of time and effort.

Initiatives for new investigation

- Take care for the exchange of emission limits, possibilities for compensation of these emission limits should be investigated.
  Some companies have imposed emission limits. In the case of industrial symbiosis company A can deliver a positive contribution to the emission limits of company B. However it can occur that a direct emission decrease stays away but indirect company B delivers its contribution. Because companies are treated individually, the positive effect of company A on B will not be taken into account for B's emission targets. This can result in the refusal of a possible permit request which will not stimulate companies to participate in symbiosis. To avoid this problem it should be interesting when there is a sort of umbrella effect. For instance the Havenschap becomes a major company which contains all smaller companies on the area. The emission targets will be drawn up at Havenschap level which should make it possible to compensate emission profits. So company A takes care for emission decrease and

company B has also benefits because A already achieved its emission goals.

- Investigate possibilities for obtaining interesting energy prices as well as transparency in exchanging contracts. When expanding the projects it is also crucial to keep the MGA thought alive and pursue it. It could be smart to attract utility companies, these companies have knowledge and experience in energy systems as well as connections and networks. Also these companies can deliver a substantial contribution in continuity of systems, avoiding mutual dependences and providing back-up systems. However since the financial aspect is an important motivation for companies to participate in a symbiosis project, the energy price has to be kept in mind. Solid appointments are crucial when attracting utility companies.
  It should be worthy an investigation on the set up of a utility centre or energy company which could be directed by a utility company but owned by the companies who make use of this centre (in the sense of majority of shareholders). This way the companies can have their grip on developments within their energy supplier, continuity is better to guarantee, mutual dependences will be minimized or null and a back up utility is easier to realize. And a rather important aspect, the shareholders can get their wanted transparency; the questionnaire pointed out that profit in no case should flow down.

10.References

Blokhuis, E.G.J., Schaefer, W.F. (2007) *A sustainable approach for industrial area redevelopment in the Netherlands*, Eindhoven - University of Technology, the Netherlands

Boons, F.A.A. Baas, L.W. (1997) *The organisation of industrial ecology: the importance of co-ordination*

Breure, B. Grin, J. Kerkhof, M. Lissandrello, E. Stam, T. Woudenberg, E. (2007) *De probleemanalyse verdiept, een verdere uitwerking van het Startdocument, Programma Leren voor duurzame ontwikkeling* - Provincie Noord-Holland

Burger, H. (2001) *Gemeentelijk energie- en klimaatbeleid in een geliberaliseerde energiemarkt*

Christesen, I., Gabric, A., Herat, S., Krrishnamohan, K., Scott, J.A. (1999), *What is needed to encourage adoption of industrial ecology?,* 2nd Asia Pacific Cleaner Production Roundtable

DWA Installatie en Advies (2008) *Inventarisatie reststromen West-Brabant*, commissioned by the Province of Noord-Brabant

Evers, F. Susskind, L. (2006) *Het kan wel! Bestuurlijk onderhandelen voor een duurzaam resultaat,* MGMC Haarlem

Frosch, R.A. (1990) Gallopoulos, *managing planet earth*

Geels, F. Raven, R. (2006) *Non-linearity and Expectations in Niche-Development Trajectories: Ups and Downs in Dutch Biogas Development (1973-2003)*, Eindhoven - University of Technology, the Netherlands

Gordijn, H. Renes, G. Traa, M. (2007) *Naar een optimaler ruimtegebruik door bedrijventerreinen. Een verkenning van enkele beleidsopties*, Ruimtelijk Planbureau, Den-Haag

Graaf, H.J. (2007) *Een win-win aanpak voor het oplossen van maatschappelijke vraagstukken,* Centrum voor milieuwetenschappen Leiden

Heeres, R.R. Vermeulen, W.J.V. de Walle, F.B. (2004) *Eco industrial park initiatives in the USA and the Netherlands: First Lessons*, Journal of Cleaner production 12, 985 - 995, Utrecht University, the Netherlands

Hermkens, J.J.P.P. (2006) *Een inventarisatie, selectie en aanbevelingen tot beleid door middel van Strategisch Niche Management*, Eindhoven – University of Technology, the Netherlands

J.J.C. Bruggink (2005) *The Next 50 years: Four European energy futures*, Energy research Centre for the Netherlands

Jacobsson, S., Johnson, A. (2000) *The diffusion of renewable energy technology: an analytical framework and key issues for research*

Kaiser, A. (1992*) Redirecting power: Swedish nuclear power policies in historical perspective*

Konz, W. van den Thillart, C. (2002) *Industriele symbiose op bedrijventerreinen*, Eindhoven - University of Technology, the Netherlands

Lowe, E.A., moran, S.R., Holmes, D.B. (1996) *Eco-Industrial Parks: A handbook for local development teams*

Ministerie Buitenlandse zaken, (2004) *Pieken in de Delta*

Mulder, G. (2010) *Pego Pilots - Bedrijven terreinen*, TNO, Creatieve Energie

Raven, R. (2005) *Strategic Niche Management for Biomass, a comparative study on the experimental introduction of bioenergy technologies in the Netherlands and Denmark*, Eindhoven - University of Technology, the Netherlands

Rotmans, J. (2003) *Transitiemanagement: sleutel voor een duurzame samenleving*

Rotmans, J. (2005) *Maatschappelijke innovatie, tussen droom en werkelijkheid staat complexiteit*

Rovers, D. (2008) *Een studie naar de economische, organisatorische en ruimtelijke voorwaarden rondom reststroom-koppelingen: Casus Moerdijk*, Tilburg - University of Tilburg, the Netherlands

Samenwerkende Elektriciteits-productiebedrijven (SEP), (1999) *Elektriciteit in Nederland*

Scheepers, M. (2008) *De toekomstige elektriciteitsinfrastructuur van Nederland*

Sterman, J. (2000) *Business Dynamics: Systems Thinking and Modeling for a Complex World*, Irwin/McGraw-Hill

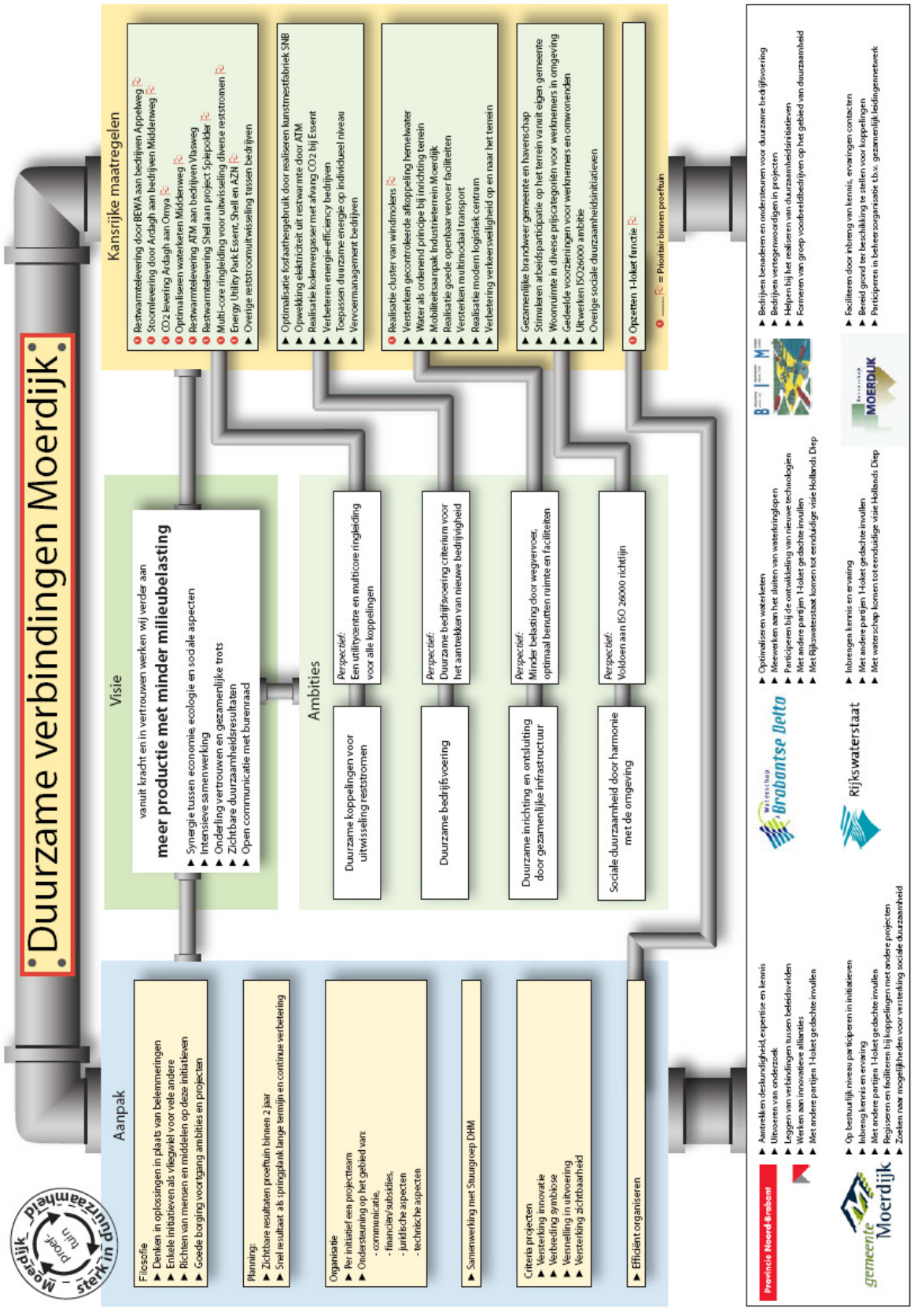
Wilkinson, D.M. (2001) At cross purposes

Internet sources

- www.bom.nl
- www.brabant.nl
- www.duurzameverbindingenmoerdijk.nl
- www.google.nl/scholar
- www.milieucentraal.nl
- www.sciencedirect.com
- www.stratumstrategie.nl
- www.vrom.nl

11.Appendix

11.1. Ambition Maps textual and visual



Duurzame verbindingen Moerdijk

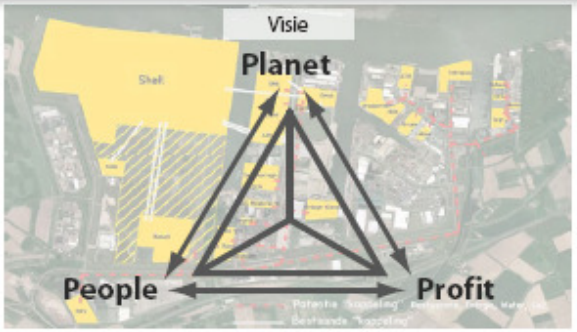
Aanpak

Denken in oplossingen

Springplank lange termijn

2008 - 2011

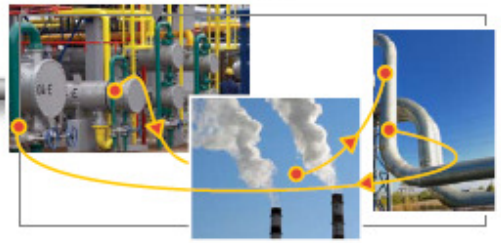
Daadkracht



Ambities

Duurzame koppelingen voor uitwisseling reststromen	*Perspectief:* Een utilitycentra en multicore ringleiding voor alle koppelingen
Duurzame bedrijfsvoering	*Perspectief:* Duurzame bedrijfsvoering criterium voor het aantrekken van nieuwe bedrijvigheid
Duurzame inrichting en ontsluiting door gezamenlijke infrastructuur	*Perspectief:* Minder belasting door wegverkeer, optimaal benutten ruimte en faciliteiten
Sociale duurzaamheid door harmonie met de omgeving	*Perspectief:* Voldoen aan ISO 26000 richtlijn

Maatregelen



Eén loket

Provincie Noord-Brabant

Waterschap Brabantse Delta

gemeente Moerdijk

Rijkswaterstaat

MOERDIJK

The industrial contribution towards an energy neutral environment

An investigation on how to initiate a transition

TU/e

Provincie Noord-Brabant

11.2. Intention Agreement Proeftuinen Duurzame verbindingen Moerdijk

Proeftuin Schoon Bedrijventerrein -Haven- en industrieterrein Moerdijk

Intentieovereenkomst "Duurzame Verbindingen Moerdijk"

2 april 2009

Rijkswaterstaat

Waterschap Brabantse Delta

gemeente Moerdijk

havenschap MOERDIJK

Provincie Noord-Brabant

Intentieovereenkomst Proeftuin Schoon Bedrijventerrein Moerdijk

PARTIJEN:

1. De Provincie Noord-Brabant, krachtens artikel 176 van de Provinciewet rechtsgeldig vertegenwoordigd door gedeputeerde O. Hoes, daartoe gemachtigd door de Commissaris van de Koningin bij besluit van 24 maart 2009 en handelend ter uitvoering van het besluit d.d. 24 maart 2009 van Gedeputeerde Staten van Noord-Brabant
2. Bedrijvenkring Industrieterrein Moerdijk (BIM), vertegenwoordigd door haar voorzitter, de heer mr. ing . J.E.J.M. Peters
3. Havenschap Moerdijk, vertegenwoordigd door haar plv. directeur, de heer ing J.H.M. Rentrop MSc
4. Gemeente Moerdijk, krachtens artikel 171 van de Gemeentewet rechtsgeldig vertegenwoordigd door wethouder mevrouw drs. W.J.M. Vissers
5. Rijkswaterstaat Zuid-Holland, vertegenwoordigd door de directeur Water, Scheepvaart en Realisatie Infrastructuur de heer dr. A.P.M.A. Vonck
6. Waterschap Brabantse Delta, krachtens artikel 95 Waterschapswet rechtsgeldig vertegenwoordigd door de dijkgraaf, de heer J.A.M. Vos

hierna tezamen ook te noemen: "partijen"

OVERWEGENDE DAT:

a. partijen op 25 mei 2007 het Masterplan Stuurgroep Duurzaam Haven- en Industrieterrein Moerdijk (DHM) 2007-2010 hebben ondertekend en zij zichzelf nog steeds conformeren aan de missie daarin gesteld, zijnde:
   - People: DHM bevordert een harmonische relatie met zijn omgeving die is gericht op een actieve, open communicatie en uitwisseling van transparante informatie (registratie-monitoring-calamiteiten-klachten). DHM streeft naar een veilige en goede kwaliteit van de leefomgeving, zowel ten aanzien van bedrijven en werknemers als ten aanzien van mensen die in de omgeving van het Haven- en Industrieterrein wonen en recreëren.
   - Planet: DHM bevordert een goede kwaliteit van milieu en veiligheid van het Haven- en Industrieterrein Moerdijk alsmede een verantwoord gebruik en beheer van natuurlijke grondstoffen en hulpbronnen. Hierbij streeft DHM ernaar dat de natuurlijke systemen kwantitatief en kwalitatief zo min mogelijk worden aangetast en daar waar mogelijk en haalbaar worden verbeterd. Dit tegen de laagst mogelijke maatschappelijke kosten. De belangrijkste potenties op Haven- en Industrieterrein Moerdijk zijn: grondstoffenbeheer, energie-efficiency en water-efficiency.
   - Profit: DHM bevordert een Haven- en Industrieterrein Moerdijk, waar optimaal gebruik wordt gemaakt van de vestigingsmogelijkheden met gebruik van verschillende modaliteiten (water, buisleiding, spoor en weg) voor (industriële) bedrijven, waaronder bedrijven met de zwaarste milieucategorie. Daarnaast streeft DHM naar een verdere optimalisatie van het ondernemen voor bestaande en nieuwe bedrijven. Hiermee wordt Haven- en Industrieterrein Moerdijk als aantrekkelijke vestigingsplaats voor bedrijven versterkt en haar concurrentiepositie verbeterd.

b. de Provincie Noord-Brabant in haar bestuursprogramma 'Vertrouwen in Brabant' en de daarvan deel uitmakende programmalijnen (waaronder 'Schoon Brabant') de ambitie heeft uitgesproken een aantal proeftuinen te realiseren;

c. één van deze proeftuinen betrekking heeft op de duurzame ontwikkeling van een bestaand bedrijventerrein, waarin het versterken van de innovatie, de verbreding van de symbiose en het versnellen van de invoering van concrete en zichtbare duurzaamheidsmaatregelen binnen de huidige bestuursperiode centraal staat;

d. de partijen gezamenlijk verkend hebben:
   - welke meerwaarde de proeftuin kan bieden in het op een hoger plan brengen van de duurzaamheidsprestatie op Haven- en Industrieterrein Moerdijk
   - hoe deze meerwaarde zich laat vertalen in gedeelde ambities ten aanzien van de fysieke, ecologische en sociaal-maatschappelijke aspecten in relatie tot de duurzame versterking van Haven- en Industrieterrein Moerdijk

e. deze inventarisatie heeft geleid tot een gedeelde visie en gezamenlijke ambities, aanpak en beoogd maatregelenpakket, als zodanig vastgelegd in de ambitiekaart 'Duurzame verbindingen Moerdijk';

f. de samenwerking voor alle partijen meerwaarde biedt. Dientengevolge partijen het wenselijk achten de intenties ten aanzien van de Proeftuin Schoon Bedrijventerrein Moerdijk over en weer naar elkaar uit te spreken.

KOMEN IN HET KADER VAN DE PROEFTUIN HET VOLGENDE OVEREEN:

Intentie 1 Doel

De partijen spreken de gezamenlijke intentie uit de duurzaamheidsprestatie van Haven- en Industrieterrein versneld en in synergie op een hoger plan te willen brengen door het uitvoeren van concrete en zichtbare duurzaamheidsmaatregelen.

Intentie 2 Ambities en resultaten

1. Haven- en Industrieterrein Moerdijk wil toonaangevend zijn en worden op het gebied van:
   - koppelingen voor reststroomuitwisseling (*duurzame koppelingen*)
   - haar hoogwaardige bedrijvigheid (*duurzame bedrijfsvoering*)
   - haar ontsluiting, gezamenlijke infrastructuur en faciliteiten (*duurzame inrichting en ontsluiting*)
   - de wijze waarop zij in harmonie met de omgeving opereert (*sociale duurzaamheid*)
   - een snelle en efficiënte uitvoering van initiatieven, inclusief de toepassing van de 1-loket gedachte
2. Haven- en Industrieterrein Moerdijk wil vooral inzetten op:
   - *duurzame koppelingen*: het sluiten van kringlopen en de symbiose voor nuttig gebruik van energie/warmte, water en reststromen, met als perspectief de realisatie van een utility centre en multicore ringleiding voor alle koppelingen, waardoor (in combinatie met een duurzame bedrijfsvoering) economische groei en milieudruk significant ontkoppeld worden
   - *duurzame bedrijfsvoering*: het toepassen van duurzame energie en realisatie van innovatieve productieprocessen binnen het individuele bedrijf, met als perspectief dit ook leidend te laten zijn bij het aantrekken van nieuwe hoogwaardige bedrijvigheid.

- *duurzame inrichting en ontsluiting*: het stimuleren van mult modaal transport, openbaar vervoer en gezamenlijke faciliteiten, met als perspectief het verminderen van de belasting door vervoer over de weg en een optimaal gebruik van de beschikbare ruimte/faciliteiten.
- *sociale duurzaamheid*: toename arbeidsparticipatie vanuit de omgeving, actieve en open communicatie naar omgeving en gedeelde voorzieningen, met als perspectief dat Moerdijk in harmonie met haar omgeving opereert conform de ISO 26000 richtlijnen voor Maatschappelijk Verantwoord Ondernemen

3. De resultaten van de proeftuin, mede bestaande uit ervaringen en ontwikkelde werkwijze, zullen zowel gedurende als na afloop van de proeftuin door partijen ter beschikking worden gesteld aan belangstellenden om die resultaten ook op andere plaatsen in praktijk te kunnen brengen;
4. De partijen zullen gezamenlijk tussentijdse monitoring inrichten om zicht te houden op de vorderingen en het realiseren van de ambities.

Intentie 3 Provincie Noord-Brabant

1. De Provincie Noord-Brabant wenst de samenwerking met betrokken partijen op Moerdijk te profileren als Brabantse proeftuin en zal het proces, waarmee de duurzaamheidsprestaties op Moerdijk op een hoger niveau gebracht worden, faciliteren, door:
   - zorg te dragen voor het aantrekken van deskundigheid en expertise voor kennis, inspiratie en doorgeven van ervaringen van elders;
   - het laten uitvoeren van onderzoek gericht op ondersteuning van vragen van bedrijfsleven en overheid op het gebied van duurzaamheid en toepassing van innovatieve concepten; daarbij kan het zowel gaan over fysieke ecologische als om sociaal-maatschappelijke aspecten;
   - het benutten van de ervaringen in dit proces t.a.v. de versterking van de samenhang van ecologie en economie voor de ontwikkeling van werklocaties van de toekomst;
   - het verzorgen van verbindingen tussen de relevante beleidsvelden en besluitvormingsprocessen bij overheid en bedrijfsleven voor het oplossen en wegnemen van belemmeringen bij uitvoering van projecten en regelgeving; het in dit kader ook samen met de andere betrokken partijen zorg dragen voor de invulling van de 1-Loket gedachte om het proces van vergunningverlening te optimaliseren;
   - het tot stand brengen van innovatieve allianties; dit vooral door middel van de bundeling van krachten op de terreinen energie, milieu, water en vervoer, zoals innovatieve oplossingen voor uitwisseling van water, energie en reststromen (utility centre en multicore ringleiding);

Intentie 4 Bedrijvenkring Industrieterrein Moerdijk (3IM)

1. De Bedrijvenkring Industrieterrein Moerdijk zal, via de haar ter beschikking staande faciliteiten, bewerkstelligen dat bedrijven actief benaderd en ondersteund worden in hun streven te zoeken naar mogelijkheden voor een duurzame bedrijfsontwikkeling. Hiervoor zullen onderwerpen die verband houden met duurzaamheid en duurzame ontwikkeling als vast onderdeel in werkgroepen en bijeenkomsten aan de orde gesteld worden.
2. De Bedrijvenkring Industrieterrein Moerdijk zal, als vertegenwoordiger van bedrijven op het industrieterrein Moerdijk, participeren in het overleg met andere belanghebbenden en hierin aandacht vragen voor de specifieke situatie en mogelijkheden van bedrijven. Deze rol zal erop gericht zijn om

bedrijven actief te betrekken en samen te brengen in hun streven naar realisatie van projecten die de geformuleerde duurzaamheidsdoelstellingen kunnen bewerkstelligen.

3. De Bedrijvenkring Industrieterrein Moerdijk zal zich inspannen om een groep van bedrijven, welke op het industrieterrein gevestigd zijn, te formeren en te presenteren die zich, middels harde, individuele afspraken, zullen inzetten om duurzaamheidsdoelstellingen uit te werken en te realiseren. Deze doelstellingen zullen betrekking hebben op energieverbruik, restwarmtebenutting en synergiemogelijkheden met betrekking tot de uitwisseling van reststromen tussen andere bedrijven . Deze "kopgroep" van bedrijven zal een inspiratiebron en kennisbank vormen voor andere bedrijven in hun streven naar duurzame ontwikkeling.

Intentie 5 Havenschap Moerdijk

1. Het Havenschap Moerdijk wil een regie- en faciliterende rol vervullen naar het op het industrieterrein Moerdijk gevestigde bedrijfsleven. Zij wil daarom het bedrijfsleven ook faciliteren bij het daadwerkelijk realiseren van de verschillende duurzaamheidsinitiatieven op het terrein door de inbreng van kennis, ervaring en contacten met onder andere de vergunningverlenende instanties.
2. Ten aanzien van de beoogde leidingen voor reststroomuitwisseling geldt dat het Havenschap Moerdijk haar grond ter beschikking wil stellen voor het aanleggen van de leidingen en dat zij desgewenst bereid is te participeren in een beheerorganisatie voor het leidingennetwerk.

Intentie 6 Gemeente Moerdijk

1. De gemeente Moerdijk is bereid om op bestuurlijk niveau te participeren in de verschillende initiatieven rondom de duurzame versterking van het industrieterrein Moerdijk.
2. Door de gemeente Moerdijk wordt relevante ambtelijke kennis en ervaring ingebracht ten behoeve van de realisatie van de benoemde duurzaamheidsdoelstellingen. Specifieke expertisegebieden die hierbij benoemd kunnen worden zijn planologie en ruimtelijke ordering, vergunningen, mobiliteit, werkgelegenheid en milieu.
3. De gemeente Moerdijk zorgt, samen met de andere betrokken partijen, voor de invulling van de 1-Loket gedachte om het proces van vergunningverlening te optimaliseren en spant zich daarnaast in voor het zoeken naar planologische oplossingen voor de snelle invoering van interessante duurzaamheidsinitiatieven.
4. De gemeente Moerdijk is bereid een regie- en faciliterende rol te vervullen bij duurzaamheidsinitiatieven die een koppeling hebben met andere gemeentelijke projecten.
5. De gemeente Moerdijk zal zoeken naar mogelijkheden voor het versterken van de sociale duurzaamheid op het industrieterrein.

Intentie 7 **Rijkswaterstaat Zuid-Holland**

1. Door Rijkswaterstaat Zuid-Holland wordt relevante ambtelijke kennis en ervaring ingebracht ten behoeve van de realisatie van de benoemde duurzaamheidsdoelstellingen; daarbij stelt Rijkswaterstaat Zuid-Holland zich ook open voor innovatieve oplossingsrichtingen rond het waterbeheer in het haven- en industrieterrein Moerdijk.
2. Rijkswaterstaat Zuid-Holland zorgt samen met de andere betrokken partijen voor de invulling van de 1-Loket gedachte om het proces van vergunningverlening te optimaliseren.
3. Rijkswaterstaat Zuid-Holland spant zich in om samen met het waterschap Brabantse Delta tot een eenduidige visie te komen over de lozingen van bedrijven op het haven- en industrieterrein Moerdijk.

Intentie 8 **Waterschap Brabantse Delta**

1. Het waterschap Brabantse Delta wil haar rol als waterautoriteit actief inzetten ten behoeve van het verduurzamingsproces op Moerdijk. Dit onder andere door:
   - integraal zorg te dragen voor voldoende oppervlaktewater van goede kwaliteit en veiligheid tegen overstroming;
   - optimaliseren waterketen tegen laagst mogelijke maatschappelijke kosten;
   - het meewerken aan het sluiten van kringlopen, waaronder hergebruik van afvalwater (eventueel na zuivering) en het op termijn nuttig inzetten van alle effluent bij (zoet)watervoorziening en hergebruik;
   - het actief participeren bij de ontwikkeling van nieuwe technologieën voor de afvalwaterketen;
   - het actief samenwerken met ketenpartners, bedrijven en leveranciers;
2. Het waterschap Brabantse Delta zorgt samen met de andere betrokken partijen voor de invulling van de 1-Loket gedachte om het proces van vergunningverlening te optimaliseren.
3. Het waterschap Brabantse Delta spant zich in om samen met Rijkswaterstaat Zuid-Holland tot een eenduidige visie te komen over de lozingen van bedrijven op het haven- en industrieterrein Moerdijk.

Intentie 9 **Communicatie**

1. De partijen werken gezamenlijk mee aan het opstellen en uitvoeren van een communicatieplan gericht op de versterking van het duurzaamheidsmerk Moerdijk.
2. De partijen stemmen de gezamenlijke communicatie over de proeftuin met elkaar af, zowel gedurende als na afloop van de proeftuin.
3. De partijen treden bij markerende punten gezamenlijk op in communicatie-uitingen.

Intentie 10 **Afspraken over de uitwerking van deze intentieovereenkomst**

Per project maken partijen c.q. betrokken bedrijven nadere afspraken over financiële, juridische en organisatorische aspecten.

Ondertekend op 2 april 2009 op het Haven- en industrieterrein Moerdijk te Moerdijk.

PARTIJEN:

Provincie Noord-Brabant,

Namens deze:

O. Hoes, gedeputeerde Ecologie

Bedrijvenkring Industrieterrein Moerdijk (BIM),

Namens deze:

Mr. Ing. J.E.J.M. Peters, voorzitter

Havenschap Moerdijk,

Namens deze:

Ing. J.H.M. Rentrop MSc, plv. directeur

Gemeente Moerdijk,

Namens deze:

mevrouw drs. W.J.M. Vissers, wethouder

Rijkswaterstaat Zuid-Holland,

Namens deze:

dr. A.P.M.A. Vonck, directeur Water, Scheepvaart en Realisatie Infrastructuur

Waterschap Brabantse Delta,

Namens deze:

J.A.M. Vos, dijkgraaf.

11.3. Possible savings on Moerdijk

11.4. Possibilities investigated by DWA (2008)

Case	Omschrijving	Bedrijven	Resultaat	Omvang	Vervolg	Techniek, complexiteit, innovatie
R1	Benutting stoom nieuwe afvalverbrandingsinstallatie Sita naar Sensus	Sita, Sensus	Wordt onderzocht door Sensus	Groot	Door Sita en Sensus te onderzoeken, afwachten resultaten onderzoek Sensus.	
R2	Benutting heet water vanaf nieuwe afvalverbrandingsinstallatie Sita naar omgeving, Sensus, Fransis, Philips, bedrijven, gemeente	Sita, Sensus, Fransisc, Philips, bedrijven, gemeente	Potentie ingeschat, separate notite beschikbaar	Zeer Groot 2,5 PJ	Uitwerking ondergebracht in de subsidieaanvraag Pieken in de Delta ZW cq. OP Zuid.	Net, AKM
R3	Biomassa Agro Food cluster gecombineerde biomass vergisting	Agro Food cluster Suikerunie, Sensus, Groen, Delta	Niet haalbaar	nv.t.	Actiepunten tussen partijen worden besproken.	Complex
R4	Water Suikerunie, Sensus,	Water Suikerunie, Sensus,	Niet haalbaar	n.v.t.	Actiepunten tussen partijen worden besproken.	Waternet
R5	Restwarmte benutting PKF Palletfabriek, uitbreiding installatie naar naastgelegen bedrijven	PKF, Borchwerf II	Niet onderzocht	klein	Bedrijfsbezoek afleggen	
B1a	WKK Theodorushaven, Sabic, Cargill, Nuplex, Lamb Weston	Sabic, Cargill, Nuplex, Lamb Weston	Uitgewerkt in paragraaf 7.1.4	Zeer Groot 20MWe	Verdere ondersteuning onder regie van provincie, BOM of REWIN	Ombouw
B1b	Stoomnet Theodorushaven, Sabic, Cargill, Nuplex, Lamb Weston	Sabic, Cargill, Nuplex, Lamb Weston				Stoomnet
B2	Restwarmte Theodorushaven, Sabic, Cargill, gemeente	Sabic, Cargill, gemeente		Groot 0,25 PJ		net
B3	inzet WKC Essent, Essent, Philip Morris, provincie	Essent, Philip Morris, provincie		Groot	Verhelpen "spagaat energiebedrijven", zie rapport SER-Brabant.	contract
B4	WKK Philip Morris, Essent, Lievensberg zkh, gemeente (8MWe)	Philip Morris, Essent, Lievensberg zkh, gemeente		Groot	Door Philip Morris te initieren	
B5	Water, Sabic, Cargill, Nuplex, Lamb Weston, Philip Morris	Sabic, Cargill, Nuplex, Lamb Weston, Philip Morris	Uitgewerkt in paragraaf 7.1.5	Groot	Overwegen actie te ondernemen zodra interne besparingen zijn uitgevoerd en reststromen bekend zijn.	Zuivering en net
I1	Interregionaal: Uitbreiding OCAP netwerk CO2 van Rotterdam naar Antwerpen	OCAP, Shell, Glastuinbouw		Zeer Groot	Vervolgonderzoek	
I2	Interregionaal: Restwarmte koppelingen Moerdijk, Amercentrale, Etten Leur, Breda	Essent		Zeer Groot	Inventarisatie reststromen West-Brabant Oost (nu in aanvraag OP-Zuid)	

tabel VII.1

Case	Omschrijving	Bedrijven	Resultaat	Omvang	Vervolg	Techniek, complexiteit, innovatie
M1a	HD (100+ bar) stoomlevering van AZN (via Essent) aan Shell	Shell, AZN, Essent	Onderzoek bij huidige 4e verbrandingslijn, mogelijkheid bij het ontwerpen vijfde verbrandingslijn AZN. Bedrijfszekerheid voor Shell is van groot belang.	Zeer Groot 2 PJ	Uitwerken in combinatie met M2 en M3 in project PTSB door de bedrijven.	Duiker-leiding onder de haven
M1b	HD-/MD-stoomlevering van AZN, aan nieuwe bedrijven cluster 1, vrije kavel	Idem+ nieuwe bedrijven	Voorwaarde: mogelijkheid bij het ontwerpen vijfde verbrandingslijn AZN, bedrijfszekerheid is van groot belang. Vestiging nieuwe bedrijven (bv. vrije kavel) moet op korte afstand mogelijk zijn.			
M1c	HD-/MD-stoomlevering van AZN aan turbine WKK toekomstige glastuinbouw	Idem + glastuinders	Voorwaarde: vijfde lijn AZN, glastuinbouw. Is pas relevant wanneer grootschalige glastuinbouw in de regio Moerdijk toegestaan is, én het potentieel restwarmte (zie M4a) is benut.		Actie zodra sprake is van grootschalige nieuwe glastuinbouw in regio Moerdijk. Eerst case M4 uitvoeren.	Nieuw
M2	MD-stoom/WKK cluster 1: AZN, SNB, BMC, Kolb, Basell, Shell, Essent	AZN, SNB, Essent, BMC, Kolb, Basell, Shell	Uitgewerkt in paragraaf 7.1.1	Groot 0,22 PJ 7 MWt	Actie ondernemen zodra duidelijkheid bestaat over optie M1 c.q. als duidelijk is hoeveel MD-stoom daarna nog resteert.	
M3a	Lagedrukstoomkoppelingen, cluster 1 tussen AZN, WKC, Ardagh en GCA, Coatex, Basell, Shell, gemeente	AZN, Essent, SNB, Ardagh, GCA, Coatex, Basell, Shell, gemeente	Voorwaarde: economie, voldoende schaalgrootte, gebiedontwikkeling		Door bedrijven verder uit te werken, als mogelijk vervolg op M3b.	Stoom net
M3b	Lagedrukstoomkoppeling tussen AZN en GCA	AZN, GCA	Wordt in "Proeftuin Schoon Bedrijventerrein " door AZN, GCA, Havenschap Moerdijk, BMD verder uitgewerkt.	Midden 0,03 PJ	Uitwerking in PTSB	
M4a	Heetwaterkoppelingen cluster 1 naar omgeving AZN, WKC, Shell, gemeente, glastuinbouw	AZN, WKC, Shell, gemeente, glastuinbouw	Uitgewerkt in paragraaf 7.1.2	Groot 1 PJ 59 MWt	Integreren met resultaat Shell Global Solutions. Energievisie te ontwikkelen gebied vastleggen.	
M4b	Koppelingen Spiepolder, omgeving				Uitwerken als Pilot Project	
M5a	MD-stoom/WKK cluster 2 : ATM, WSN, Labee, Tetrapak, Orcem	ATM, WSN, Labee, Tetrapak, Orcem	Uitgewerkt in paragraaf 7.1.3	Groot 0,6 PJ 18 MWt	Uitwerking in PTSB[18]	Turbine, stoomnet,AKM
M5b	WKK, stoom en heetwater cluster 3: Bewa, Bolsius, Tref Ego, Algeco.	Bewa, Bolsius, Tref Ego, Algeco.	Wordt in "Proeftuin Schoon Bedrijventerrein" door Bewa, Bolsius, Tref Ego, Havenschap Moerdijk, BMD verder uitgewerkt.	Midden 0,03 PJ	Bedrijven i.s.m. Havenschap	Turbine, stoomnet,AKM
M6	Waterkoppelingen SNB, Waterschap, Brabant Water, AZN.	SNB, Waterschap, Brabant Water, AZN.		Groot	Uitwerking ondergebracht in de subsidieaanvraag Pieken in de Delta ZW cq. OP Zuid.	Flash techniek nieuw
M7	CO_2-koppelingen, Omya, Shell, SNB, Ardagh, glastuinbouw, Ocap	Omya, Shell, SNB, Ardagh, glastuinbouw, Ocap	Wordt in "Proeftuin Schoon Bedrijventerrein " door Omya, Ardagh, Havenschap Moerdijk, BMD verder uitgewerkt.	Groot	Uitwerking in PTSB	Leiding-tracé
M8	Stoomgedreven perslucht compressor/ generator	Ardagh	Niet onderzocht	Klein	Door Ardagh te onderzoeken	Leverbaar-heid
M9	Koppeling NH3 (vervuild) van SNB naar AZN	SNB, AZN	Niet onderzocht	Klein	Overleg tussen SNB en AZN is gestart/ Uitwerking in PTSB	
M10	Koppeling kalk van Omya naar AZN of SNB	Omya, AZN, SNB	Niet onderzocht	Klein	Door Omya/SNB/AZN te onderzoeken / Uitwerking in PTSB	
M11	Levering parafine GCA aan Labee	GCA, Labee	Niet onderzocht	Klein	Door GCA en Labee te onderzoeken / Uitwerking in PTSB	
M12	Onderzoek mogelijkheden nieuw te vestigen en uitbreiding bestaande bedrijven	Heijmans, Schütz, Kolb, Orcem, Caldic	Niet onderzocht	Klein	Inventarisatie vraag matchen met aanbod reststromen. / Uitwerking in PTSB	
M13	Inzet stortgas Essent bij verhuizing Caldic	Essent, Caldic	Niet onderzocht	Klein	Overleg met partijen, zoeken nabijgelegen gasgebruiker	

[18] PTSB: Proeftuin duurzame bedrijventerreinen Schoon Brabant

11.5. Interview with ing. Jacco Rentrop MSc

Dit interview met het Havenschap Moerdijk gaat over bestaande en potentiële reststroom-koppelingen én de intermediaire functie van het Havenschap op het industrieterrein Moerdijk. Dhr. Ing. Jacco Rentrop MSc zal antwoorden namens het Havenschap Moerdijk.

Bestaan er enkele koppelingen van reststromen tussen bedrijven op het industrieterrein Moerdijk?

"Op het industrieterrein zijn enkele koppelingen betreffende reststromen tussen bedrijven. Er is een koppeling tussen AZN en de energiecentrale Essent, waarbij stoom van de AZN wordt doorgeleverd aan Essent die vervolgens daar stroom van maakt en dat weer doorlevert. Daarnaast is er een koppeling tussen een slibverwerkingsbedrijf en een kalkverwerkingsbedrijf die wisselen CO_2 uit. Verder zijn er voornemens vanuit het bedrijf BEWA (recyclingbedrijf) om warm water te leveren aan derden."

Heeft het groot industriële bedrijf Shell Moerdijk ook koppelingen op het terrein?

"Als we (Havenschap Moerdijk, red.) over Shell spreken gaat het vooral om productmatige koppelingen. Ethyleen leveren ze aan nabijgelegen bedrijven. Dat is niet van "uw afval mijn grondstof". Ze leveren ook CO_2 aan het kalkverwerkingsbedrijf. Shell Moerdijk is een bedrijf dat dus verschillende vertakkingen heeft naar bedrijven op dit industrieterrein, waarbij uitwisseling plaatsvindt. Dat kan dus in de productmatige of reststromen-sfeer."

Worden deze stromen voornamelijk door pijpleidingen getransporteerd en is er een netwerk van pijpleidingen op het terrein?

"De stromen op het terrein worden voornamelijk getransporteerd door pijpleidingen. Er is hier ook een netwerk van pijpleidingen, echter niet in de reststromen-sfeer maar meer in de productmatige sfeer die de bedrijven nodig hebben, zoals stikstofpijpleidingen. We hebben

hier de nationale pijpleiding, waarbij Shell gebruik maakt van die leiding tussen Rotterdam en Antwerpen."

Kunnen reststromen via deze nationale pijpleiding worden getransporteerd?

"Dat zou eventueel kunnen, maar daar is niet voldoende vraag naar. Het kost nog al wat. Ook zien we dat er hier een behoorlijke hoeveelheid restwarmte aanwezig is, maar de afstand bepaalt of je het nuttig kan toepassen. Op dit industrieterrein zijn momenteel deze afstanden naar andere bedrijven dusdanig excessief hoog, dat het niet economisch haalbaar is om dit uit te voeren.
Daarnaast bepalen wet en regelgeving dat niet alles kan. Bedrijven kunnen niet zomaar afval aan een ander bedrijf geven, dus moet het bedrijf een daartoe geschikt bestemde bedrijf afvoeren."

Maakt het Havenschap Moerdijk werk van de huidige situatie met betrekking op de huidige wet en regelgeving?

"We hebben hier wel aandacht voor binnen het Havenschap, maar aangezien we maar met twintig personen, kunnen we onmogelijk maanden met dat soort zaken ook nog bemoeien. We signaleren het probleem, rapporteren dit en het is aan de gemeente en de provincie wat ze met de huidige situatie doen op het gebied van wet en regelgeving."

Om een koppeling te realiseren, moet er aan enkele voorwaarden voldaan worden. Welke voorwaarden zijn moeilijk te voldoen op dit industrieterrein?

"Vooral wet en regelgeving, want technisch is het goed uitvoerbaar. Het moet wel voldoen aan bepaalde voorwaarden qua veiligheid, opbouw, hoogte en enzovoorts, maar wat veel belangrijker is hoe de overheid bijvoorbeeld omgaat met de situatie wanneer er een storing is. Juridische problemen bij de Wet milieubeheer en bestemmingsplan aspecten zorgen ervoor dat er niet zo gemakkelijk gekoppeld wordt."

Zijn er naast dit juridische aspect nog andere voorwaarden die moeilijk te voldoen zijn?

"De kosten van een dergelijk koppeling en de aanzienlijke afstanden tussen de ondernemingen op het terrein zijn voorwaarden die ervoor zorgen dat er minder gemakkelijk koppelingen plaatsvinden. Infrastructuur is geen struikelblok, want op het terrein liggen behoorlijk wat leidingen en is er nog genoeg ruimte voor nieuwe leidingen."

De reeds bestaande koppeling zouden eventueel uitgebreid kunnen worden. Is daar op dit moment sprake van op het terrein of blijft het bij de huidige situatie?

"Als het aan ons ligt niet, als er mogelijkheden zijn voor een netwerk van koppelingen zullen we dat zeker actie ondernemen. Wij stimuleren bijvoorbeeld in het proces bij BEWA of je vanuit dit bedrijf meerdere koppelingen kan creëren."

Speelt het Havenschap Moerdijk een sleutelrol in dit proces van deze nieuwe koppelingen?

"Het Havenschap vervult zeker deze sleutelrol. Wij verzorgen faciliteiten op het terrein maar zijn tevens eigenaar. Het Havenschap kan dus in bepaalde mate wat afdwingen op het terrein. Daarom hebben wij de commissie "nieuwe vestigingen" in het leven geroepen, waarin ook verschillende overheden zitting hebben. Deze partijen krijgen al in een vroeg stadium inzicht op de situatie van de nieuwe vestigingen op het industrieterrein. Zo kunnen deze partijen, dus ook de vergunningverstrekkers, zien welke mogelijkheden er zijn op het terrein met deze nieuwe vestigingen."

De thesis gaat over de vraag in hoeverre de realisatie van reststroom-koppelingen haalbaar en wenselijk zijn met het oog op een duurzame versterking van de lokale economie van de gemeente Moerdijk.
Wat zijn, volgens het Havenschap Moerdijk, de voordelen voor de gehele gemeente Moerdijk om reststroom-koppelingen aan te leggen tussen bedrijven?

"De gemeente zal niet direct profiteren van deze koppelingen, maar ik denk wel dat het imago van de gemeente zal verbeteren. Wellicht zouden de koppelingen ervoor kunnen dat de leefomgeving profiteert van de verminderde uitstoot."

Ziet het Havenschap Moerdijk verder geen voordelen, zoals extra werkgelegenheid, voor de lokale economie?

"De link tussen reststroom-koppelingen en extra werkgelegenheid zie ik niet. De gevestigde bedrijven vertrekken bijna niet, gelet de kosten en infrastructuur. Maar verder zie ik ook geen andere voordelen voor de gehele gemeente Moerdijk."

De beschikbaarheid van informatie en kennis is van essentieel belang voor het realiseren van een reststroom-koppeling. Onderhoudt het Havenschap Moerdijk contacten met

universiteiten, hogescholen, andere kennisinstellingen of projecten om kennis te verzamelen over dit onderwerp?

"Niet zo zeer onderhouden we contacten met kennisinstellingen, maar wel via de provincie en het REWIN halen we voor ons relevante informatie en kennis. Vanuit het Havenschap Moerdijk zien we kansen, maar bedrijven moeten die kansen eerst vinden. Bijvoorbeeld wanneer een bedrijf zich op het terrein vestigt en een bepaalde reststroom zou willen aanbieden aan een andere onderneming. Dit bedrijf kan dit melden bij het Havenschap Moerdijk, want wij nemen de taak op ons om uit te zoeken of er mogelijke vragers zijn van deze reststroom in de omgeving van het nieuwe bedrijf. De potentiële vragende ondernemers zullen we dan benaderen met de vraag of deze bedrijven interesse hebben in deze mogelijke reststroom-koppeling. Pas daarna gaan beide partijen rond de tafel zitten.
Een direct contact met een universiteit of andere kennisinstellingen heeft het Havenschap niet en contacten met projecten, zoals het Biopark Terneuzen, is er eveneens niet."

Is er ook geen contact gezocht met universiteiten of andere kennisinstellingen?

"Nee, het Havenschap Moerdijk heeft geen contact gezocht met universiteiten of andere kennisinstellingen, maar er hebben ook geen universiteiten hier gemeld. We hebben in het verleden wel gebruik gemaakt van een duurzaamheidscan-model van de Technische Universiteit van Eindhoven, maar daar is het wel bij gebleven. Het is vooral een praktisch verhaal. Het Havenschap Moerdijk waakt voor de overvloed van onderzoeksinspanningen met een teleurstellend resultaat. Wij houden ons vooral heel praktisch met deze zaken bezig."

Heeft het Havenschap een kaart of database beschikbaar over de eventuele vraag en aanbod van reststromen op het industrieterrein en is deze informatie ook beschikbaar voor de gevestigde bedrijven?

"We hebben een database met daarin output en inputvraag van reststromen beschikbaar. Bedrijven die informatie willen verkrijgen over de output of inputvraag van een andere onderneming, moeten zich eerst bij het Havenschap melden. Pas wanneer de wederpartij toestemming geeft om deze informatie vrij te geven aan de andere partij zal dit ook daadwerkelijk gebeuren. Bedrijven willen onderling geen informatie vrijgeven over deze zaken, op dit terrein zijn de bedrijven kien op de vertrouwelijkheid van informatie."

Maar denkt u niet dat door het ontbreken van een dergelijke openbare kaart of database het creëren van een reststroom-koppeling moeilijker wordt?

"Voor ons wordt het niet moeilijker. Concurrentie is op het terrein behoorlijk, daarom willen bedrijven deze informatie alleen in strikt vertrouwen aan ons geven. Wanneer we dit niet doen, zullen de bedrijven in het vervolg niet meer met ons meewerken."

Wordt vanuit het Havenschap toch enige informatie of kennis verspreid op het gebied van reststromen aan bedrijven op het terrein?

"Hierover wordt vanuit het project milieumonitoring gerapporteerd (Havenschap Moerdijk, 2003: 24). Er wordt op dit industrieterrein niet echt iets verspreid wat met dit onderwerp te maken heeft, wel hebben we in het verleden een werkgroep "reststromen" in het leven geroepen. Echter, vanwege onvoldoende toegevoegde waarde van deze werkgroep is deze opgehouden met bestaan. We hebben voldoende initiatieven genomen op dit terrein betreffende reststromen, maar telkens vormden wet en regelgeving en financiën een struikelblok."

Het terrein is verdeeld in meerdere thematische clusters. Zo zijn het Industrial Park en het Ecopark interessante clusters voor het aanleggen van reststroom-koppelingen. Kunt u aangeven in welke mate binnen deze twee clusters bedrijven met elkaar samenwerken en netwerken?

"Er wordt beperkt samengewerkt binnen deze twee clusters. De meeste bedrijven lopen hier niet echt warm voor, enkel de grote bedrijven, zoals Shell en Essent, zouden graag meer willen samenwerken op het terrein. Echter, deze grote industriële ondernemingen lopen tegen andere zaken vast."

Is er ook tussen deze twee clusters een vorm van samenwerking aangaande het onderwerp "reststromen"?

"Er is geen sprake van een vorm van samenwerking tussen beide clusters. Wel zijn er enkele reststroom-koppelingen tussen deze twee verschillende clusters."

Belangrijk voor een industrieterrein is de komst van nieuwe bedrijven. Nieuwe bedrijvigheid zorgt namelijk voor nieuwe impulsen en dynamiek op het terrein. Wanneer een nieuwe ondernemer zich meldt bij het Havenschap Moerdijk voor een plaats op het terrein, vindt er vanuit het Havenschap een selectie plaats op basis van de activiteiten die het bedrijven zal gaan uitvoeren?

"Bedrijven kunnen zich niet zomaar ergens vestigen, wij zullen nieuwe ondernemers plaatsen op de juiste locatie. Echter, het Industrial Park en het Ecopark biedt beperkte ruimte meer voor nieuwe bedrijvigheid."

In de stuurgroep Duurzaam Haven en Industrieterrein Moerdijk (DHM) hebben enkele partijen zitting, zo ook het Havenschap Moerdijk. In deze groep wordt ook over reststromen gesproken, maar kunt u vertellen wat dit precies inhoudt en kunt u tevens voorbeelden geven over resultaten die het DHM reeds geboekt heeft die betrekking hebben tot het onderwerp "reststromen"?

"Het is geen structureel agendapunt voor de stuurgroep. Wanneer er mogelijkheden zijn voor koppelingen zullen we dit zeker bespreken, maar het is niet direct wat ons constant bezighoudt. In deze stuurgroep houden we ons vooral met andere zaken bezig, zoals milieu en veiligheid op terreinniveau in relatie tot omgevingsaspecten en dergelijke."

In een interview met Dennis de Vogt (Brabant Business, maart 2005) zei u het volgende: "Vaak is het toch zo dat bedrijven opzien tegen de berg aan regels die er bestaan als het gaat om afvalverwerking. Op Moerdijk gaat het ook nog eens om behoorlijk complexe processen. Om warmte, water en andere afvalstoffen van elkaar te gebruiken, moeten de neuzen dezelfde kant op staan en dient er nauw overleg gepleegd te worden met de betrokken instanties. Een duidelijke overlegstructuur is hierbij van groot belang."
In hoeverre staan nu deze "neuzen" dezelfde kant op?

"Neem als concreet voorbeeld de biomassacentrale. Samen met het bevoegde gezag, in dit geval de provincie, moeten ondernemers kijken in hoeverre de plannen ook producttechnisch te organiseren valt. Dat bedoel ik met de "neuzen" dezelfde kant op. Bedrijven en het Havenschap kunnen een plan willen uitvoeren, maar het moet dus ook juridisch juist geregeld worden. Op dit moment is de samenwerking met de provincie overigens goed."

Hoe wordt er vanuit het Havenschap gedacht over het toekomstperspectief voor koppelingen tussen ondernemingen op het industrieterrein Moerdijk?

"Als het Havenschap Moerdijk een bijdrage kan leveren om onderlinge stromen mogelijk te maken, zullen we dat zeker niet nalaten. Ik voorzie als bepaalde stromen duurder worden, er meer koppelingen in de toekomst ontstaan op dit terrein. Vereiste is een

economische trigger van een dergelijke koppeling. Dit heeft bijvoorbeeld te maken met conjunctuur, maar ook de wil van ondernemers om koppelingen aan te gaan.
Echter, veel koppelingen zijn bij productiebedrijven en niet bij overslagbedrijven. Aangezien het terrein Moerdijk een zeehaven bezit zijn er veel overslagbedrijven op het terrein gevestigd. Koppelingen moeten vooral gezocht worden bij productiebedrijven en dan met name energiestromen zijn interessant. Wanneer energie duurder gaat worden, zal de afstanden tussen ondernemingen ook steeds minder een rol spelen."

REFERENTIES

Havenschap Moerdijk (2003), *Monitoringsrapport 2002, Haven- en Industrieterrein Moerdijk*
Vogt, D. de (maart 2005), *Ondernemers Moerdijk voorlopers hergebruik*, Brabant Business

12.Interview mister Herman de Boon

Dit interview met Dhr. Herman de Boon (Programmamanager Biopark Terneuzen) gaat over de ontwikkeling van Biopark Terneuzen.

Hoe is het Biopark Terneuzen project gestart?

"De 'Biopark'-gedachte is twee jaar geleden begonnen, waarbij de mogelijkheid kwam via een zogenaamd programma 'Transforum'. Op basis van geïntegreerde projecten probeert Transforum in de praktijk wetenschappers, kennisinstellingen, overheid, maatschappelijke organisaties en bedrijfsleven bij elkaar te brengen om te kijken of ze duurzame ontwikkeling kunnen stimuleren. Dit programma is een publiekprivaat programma, waarbij de helft van de middelen wordt ingelegd door de overheid en de andere helft door het bedrijfsleven. Men probeert door het clusteren van activiteiten een bijdrage te leveren aan duurzame ontwikkeling. En binnen dat kader is het onderwerp 'agro-parken' aan de orde, hoe kan je dus in de agro-sector hoogintensieve en hoogproductieve activiteiten dichter bij elkaar brengen en clusteren. Wanneer je dat in een regionale context doet, kan het een bijdrage aan de regionale ontwikkeling leveren. In Terneuzen was er dus de gedachte 'Goh, we hebben hier een aantal activiteiten dat reststromen overheeft of kan gebruiken. Kunnen we deze vragers en aanbieders met elkaar koppelen?'. Enerzijds was het koppelen tussen reeds bestaande bedrijven en anderzijds was het aantrekken van nieuwe bedrijven die dus passen binnen de regio. Dat was de aanleiding geweest voor het starten van dit project en is opgemaakt als een geïntegreerd project binnen Transforum. Hiervoor zijn middelen beschikbaar gesteld en daar is men ook gestart onder de titel 'Biopark Terneuzen'."

Zijn er al resultaten geboekt binnen dit project?

"De afgelopen twee jaar zijn nodig geweest voor het organiseren van samenwerkingsverbanden. Samenwerken is een moeilijk proces en bestaat meestal uit een aantal fases. Heb je elkaar wat te bieden, hoe liggen we elkaar en wat zouden we samen kunnen doen? Na deze fases is het een kwestie van bestuderen, onderzoeken en calculeren.

Uiteindelijk kom je in de fase dat je het plan moet oppakken. Zo zie je dus op dit moment de biomassacentrale en een afvalverwerkingcentrale samen aan het investeren zijn en dat Nedalco een nieuwe fabriek gebouwd heeft op het terrein van Cargill om zo de reststromen te gebruiken van Cargill. En uit de nieuwe fabriek komt weer een reststroom uit die weer terug gaat naar Cargill. Een soort kringloopsysteem dus. Zo zijn er wel een aantal bilaterale koppelingen ontstaan, maar de meest uitdagende is op dit moment de warmte die Yara als kunstmestfabriek over heeft en de CO_2, zowel van Yara als Nedalco, om die naar het glastuinbouwcomplex te geleiden. Daarnaast kan de biomassacentrale gietwater leveren aan de glastuinbouwcomplex. Dit verkeert nog in de planfase en is gepositioneerd in polders die op dit moment bijna geheel verworven zijn. Dit betekent dat nu het aantrekken van de tuinders kan gaan plaatsvinden. Er is intussen een warmtebedrijf opgezet. Het opzetten van zo'n bedrijf, een vennootschap, met aandeelhouders, met financiering et cetera, kosten allemaal tijd. Dat is nu zover dat de businesscase en plannen op detail zijn uitgewerkt en dat men zeer binnenkort kan beginnen met het werven van de tuinders, zodat het complex van de grond kan komen."

Hoe wordt de leefbaarheid van de omgeving gewaarborgd binnen het project?

"Een van de eisen die binnen Biopark gesteld wordt is dat de inpassing van dit soort activiteiten in de omgeving goed geregeld moeten worden. Er zit een soort 'Triple P'-benadering achter. Het gaat dus niet alleen om 'profit', maar ook om 'planet', dus duurzaamheid- en leefbaarheidcomponenten, en de 'people'-component, want als het goed is moet er ook een stuk werkgelegenheid gecreëerd worden. Daarnaast zijn we samen met de Provincie Zeeland aan het bekijken of op basis van de energie- en biomassacascade[3] nieuwe bedrijvigheid aan kunnen trekken, die past bij de gedachte van 'als we biomassa toch aanlanden, kunnen we dan bedrijvigheid ontwikkelen, waarbij we in eerste instantie de halve toegevoegde waarde, de producten die in de biomassa zitten sturen naar de farmaceutische en chemische industrie en dan vervolgens kijken we of er warmte/ elektriciteit uithalen en dan kunnen we uit de laatste reststroom ten slotte biobrandstoffen maken."

Zijn de geplande koppelingen technisch-economisch haalbaar?

"Ja, de koppelingen tussen warmte en CO_2 zijn helemaal geregeld. Je kunt je voorstellen dat het ingewikkelde berekeningen zijn. Ten tweede spelen commerciële aspecten

[3] Reststromen via cascademodel: "Eerst de hoogste toegevoegde waarde producten (ingrediënten voor food, farma, chemie) dan de productie uit de resten van biogas en lokale energievoorziening en ten slotte uit de dan resterende stroom biobrandstoffen genereren (Brabantse Ontwikkelingsmaatschappij)."

een rol. Als het te lang duurt, dan ben je niet meer interessant voor de tuinbouw dus je moet een optimum zoeken, zodanig dat er een 'win-win'-situatie gecreëerd wordt. Dat is heel lastig. Verder moet je heel goed nadenken over de risico's die je neemt door activiteiten aan elkaar te koppelen. Je creëert daarmee afhankelijkheden. Het kan niet zo zijn dat één van de bedrijven niet kan leveren, dat dan de rest ook stilstaat. Je moet dus ook goed kijken naar het risicomanagement, hoe je omgaat met die risico's en wat voor voorzieningen getroffen moeten worden om de risico's te mijden."

Hoe is de opzet van dit project; juist een paar projecten laten lopen en de resultaten afwachten of zoveel mogelijk participanten binnen het project direct onderbrengen?

"Je moet proberen juist het laaghangende 'fruit' te plukken. Wat heel ingewikkeld is, moet je goed over nadenken. Ik denk dat voornamelijk de koppelingen rondom het glastuinbouwcomplex het meest ingewikkeld zijn. Het zou verstandig zijn om eerst te kijken hoe dit uitpakt, voordat je verdere stappen maakt. De visie is ook om op middellange termijn nieuwe bedrijvigheid aan te trekken. Wat we nu aan het doen zijn, is min of meer gebaseerd op datgene wat er al is. Het enige wat daaraan ontbreekt, is het glastuinbouwcomplex. Maar dit is nu in een zodanige fase dat binnen twee à drie jaar het allemaal geregeld moet zijn. Wat wel duidelijk moet zijn, is dat we geen nieuw park opzetten. Er is namelijk bestaande bedrijvigheid en vanuit deze activiteiten wordt gekeken naar mogelijke koppelingen."

Welke rol speelt Zeeland Seaports binnen dit project?

"Zeeland Seaports is een belangrijke partij die kan zorgen voor verbindingen, onderzoeksfinanciering en die ook op zoek gaat naar instrumenten om bepaalde zaken te stimuleren."

Hoe worden de bedrijven op de hoogte gehouden van de ontwikkelingen en plannen binnen Biopark Terneuzen?

"Bedrijven zoeken elkaar automatisch op. Daarnaast komt er een ondernemersplatform dat de betrokken bedrijven, Provincie Zeeland, gemeente Terneuzen en Zeeland Seaports bij elkaar brengt. Het platform kan zowel zorgdragend als disciplinerend werken. Het ondernemersplatform is dus erg belangrijk. De cirkel van het platform kan worden uitgebreid met bijvoorbeeld kennisinstellingen of andere partijen, zodat je alle energie en ideeën, kennis en kunde, en beschikbare netwerken kunt gebruiken."

Hoe kwam het idee van Biopark Terneuzen tot leven bij het bedrijfsleven?

"Als je restwarmte over hebt en die dump je op het water dan zou je kunnen zeggen 'moet je daar zorgen over maken?'. Kost niets, maar nu is er de mogelijkheid om de restwarmte te verwaarden. Het wordt ineens waardevol, doordat een ander er iets meekan. Dan zijn de bedrijven geïnteresseerd. Verder is in de maatschappij ook iets gaande is. De bezorgdheid die we met elkaar hebben om Moeder Aarde is groeiende en zeker de laatste jaren. Los van de discussie over de 'Global Warming', is het verstandig zorgvuldig met grondstoffen om te gaan en met de reststoffen. En bevordert de innovatie, er is namelijk een enorme innovatiegolf gaande nu om dit soort ontwikkelingen vorm en inhoud te geven."

Er was tussen de betrokken partijen al een vrij hecht netwerk, alvorens het project Biopark gestart werd. Maakt dit de samenwerking voor reststroom-koppelingen gemakkelijker?

"Samenwerken is niet zo gemakkelijk. Wanneer je vlug wil gaan, moet je het alleen doen. Samenwerken is toch ingewikkelder, het is geven en nemen. Het ligt dus niet zo voor de hand om zaken samen te doen. Binnen Biopark Terneuzen zijn er momenteel de omstandigheden, dat naast de efficiencyslagen die binnen de bedrijven gemaakt kunnen worden, ook gekeken wordt of er binnen deze clusters nog meer uit te halen is."

Hoe is de kennis verworven binnen dit project?

"Je hebt verschillende soorten kennis. Technologie biedt vele mogelijkheden en technische kennis is heel bruikbaar, maar als je de partijen wil laten samenwerken, komen heel andersoortige processen aan te pas. Het gaat niet alleen over de 'hardware', of de 'software', maar ook de 'orgware' is belangrijk. Binnen Transforum werken we samen met Wageningen Universiteit, Universiteit van Tilburg, TU Eindhoven en de Universiteit Utrecht. Dit Transforum-project is een voorbeeld van een interactieve kennisontwikkeling tussen bedrijfsleven en kennisinstellingen en daar lopen heel veel trajecten, vooral op de 'orgware'-achtige kennis gericht. Ook de Hogeschool Zeeland levert haar kennis."

Ziet u Biopark Terneuzen als een soort toonbeeld?

"Ik vind wel een mooi voorbeeld van een project, dat wat verder is ontwikkeld. Er worden namelijk heel veel concepten bedacht en heel mooie plannen gemaakt, maar het eindigt vaak met een masterplan. Met wat geluk volgt er nog een businessplan. Het aardige

aan Biopark is dat daar een basis is waaruit je kunt werken en dat is toch wat anders dan wanneer je vanuit het niets moet opbouwen."

Welke rol moet de overheid spelen binnen dit project?

"Ik ben erg voor een overheid dat zorgt 'dat ', en niet zorgt 'voor'. De overheid moet zorgen dat bepaalde ontwikkelingen kunnen gebeuren. Dat ondernemende mensen initiatieven kunnen nemen, en de overheid deze faciliteren en ondersteunen, mits ze het algemene belang dienen. In die zin speelt de overheid een belangrijke rol in het ontwikkelen van condities en het mogelijk maken van activiteiten. De overheid moet barrières overwinnen en ruimte creëren voor initiatieven. Dit moeten de overheid in nauw overleg doen met het bedrijfsleven. De overheid moet niet alles 'dichtregelen' en ook niet een jaar wachten op het geven van een antwoord op een vraag. Overigens heb ik de indruk dat Provincie Zeeland en gemeente Terneuzen weldegelijk een heel positieve houding hebben ten opzichte van Biopark."

Welke factoren kunnen fataal zijn voor een dergelijk project als Biopark Terneuzen?

"Er wordt onvoldoende nagedacht over de risico's van een project en er wordt alleen georiënteerd op de kansen. Dan stuit je uiteindelijk toch op de risico's tijdens het proces, en soms haken er partijen af en kan het gehele plan zelfs in elkaar zakken. Een tweede factor kan zijn dat je er procedureel niet door komt, bijvoorbeeld dat de omgeving het plan niet wenst."

Welke factoren zijn essentieel voor Biopark?

"Het creëren van 'win-win'-situaties en de chemie tussen de betrokken partijen."

Samenwerken is samen sterk. Geldt dit ook voor het Biopark -project?

"Als je het goed doet wél, maar het kan óók belemmerend werken. Er moet een chemie aanwezig zijn tussen de betrokken partijen en ook de juiste doelstellingen moeten binnen een samenwerking gesteld worden. Zo niet, dan gaat het mis. Het is bekend uit de organisatietheorie van allianties en samenwerkingsverbanden dat er net zoveel mislukken als lukken."

REFERENTIES

Brabantse Ontwikkelingsmaatschappij (BOM), www.bom.nl

13. Questionnaire

The questionnaire is carried out by making use of Google Documents, this way quickly a clear view arises which shows the answers given.

1. Wat zijn voor u motivaties geweest om deel te nemen in de Proeftuin Duurzame Verbindingen Moerdijk?
    a. Reclame/imago
    b. Verantwoordelijkheidsgevoel t.o.v. het milieu
    c. Verantwoordelijkheidsgevoel voor onze nakomelingen
    d. Maatschappelijk verantwoord ondernemen
    e. Klanten eisen het
    f. Verbetering van het milieu
    g. Kosten reductie
    h. Anders, nl…

1. Mocht in bovenstaande tabel niet uw juiste motivatie vernoemd zijn, kunt u deze dan hieronder beschrijven?

2. Kunt u uw beeld/visie op de Provincie beschrijven die u had voordat u deelnam aan dit project?

3. Is dit beeld positief/negatief of niet veranderd gedurende het project?

4. Heeft de provincie hier volgens u, positief of negatief aan bijgedragen?

5. Wat voor rol heeft de provincie daarin vervuld?

6. De provincie wil haar leer ervaringen met de proeftuin, Duurzame Verbindingen Moerdijk graag uitrollen naar andere bedrijventerreinen in Brabant. Wat zijn volgens u, aspecten die beter of anders aangepakt zouden moeten worden door de Provincie?

14.Summary

THE INDUSTRIAL CONTRIBUTION TOWARDS AN ENERGY NEUTRAL ENVIRONMENT
An investigation on how to initiate a transition

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Abstract
This paper deals with the topic of the stay away of an energy transition. Investigations are carried out, the environmental discussion is increasing but real substantial actions seem to stay away. Trias-Energetica, an important term in the sustainability sector contains two important actions; (1) making use of renewable/sustainable energy sources and (2) decrease your energy demand. Since the energy use on industrial areas is substantial as well as the upcoming restructure processes of these areas, the investigation focused hereon. How can industrial areas deliver their contribution towards an energy neutral environment? Which actions have to be undertaken? A method for increasing the efficiency is Industrial Symbiosis which could be carried out by applying Strategic Niche Management as well as a mutual gains approach to create mutual support. This investigation focuses on the actions to be undertaken to initiate the transition, and the contribution of the Province of Noord-Brabant hereon. Literature study, interviews and the Moerdijk case study clarify the issues

Keywords: Energy-neutral, industrial symbiosis, Strategic Niche Management, Mutual Gains Approach, Transition.

Introduction
Currently there are lots of theories and predictions of the exhaustion of all oil stocks (resulting in the current price rises), climate change whether or not by human activities, the carbon problem and other environmental based issues. However, amongst other things based hereon the municipality of Eindhoven is aspiring to be an energy neutral municipality around the year 2035 to 2040. This means that the upcoming 30 years significant, wide scaled changes have to take place. This changes will occur on technological scale as well as on the management level.

A first arising question on above description is 'what does energy neutral means?' Does it mean that there is no energy use anymore? Or all needed energy has to be produced within

the municipality borders of Eindhoven, etc. etc. To be clear in this aspect, at the beginning of the thesis, an assumption is made in the definition of the concept of energy neutral.

The main subject of the thesis is 'energy neutral'. However, to obtain this ambition Trias-Energetica is an important and useful tool which is actually based on two major actions: (1) make use of sustainable/renewable energy sources and (2) minimize your energy demand. The thesis will deal with the minimization of the energy demand on the level of industrial areas because this is seen as the first important step towards the energy neutral environment.

The structure of the thesis will be as follows. First the problem definition will be discussed, what is the problem nowadays? Why focus on the level of efficiency on industrial areas? Once the problem is described and defined, a research question will follow. To give a solid answer on the main question sub questions are defined, this way a structured approach will be reached.
Following on the problem definition a theoretical framework is set up. This framework contains the subjects of Industrial Symbiosis which represents the exchange of residual flows (water, heat, waste streams, etc.) at industrial areas. This could be a method to increase the efficiency on area level. However, to make an approach like industrial symbiosis successful and widely supported a transition has to take place. Second in the theoretical framework the subject of Transition Management will be discussed. What has to happen, which knobs have to be turned on or off to initiate a transition in the energy sector? Third I will focus on Strategic Niche Management, an approach which provides possibilities and creates protected areas wherein innovations can develop and grow without being pushed over by the dominating regime. At last the Mutual Gains Approach will be discussed. Mutual Gains Approach is a method which has the main goal to create mutual profits. By creating mutual supported ambitions, all involved parties will support actions to fulfil these ambitions because of the mutual advantages.
For the practical approach in the thesis current situations within an existing industrial area is studied. The industrial area of Moerdijk is used as a so-called Proeftuin for the Province of Noord-Brabant with respect to sustainable development. Also DWA (a consulting firm) carried out a research on the residual flows in existing companies settled on the industrial area of Moerdijk as well as the opportunities to link these residual flows. Interviews are carried out and literature containing representative interviews are also studied.
Once all data is collected, it will be processed and analyzed to verify if all questions in the thesis can be answered correctly and well funded. When this analysis is done, a chapter with conclusions and recommendations will follow. The conclusion part will exist of the answers on the sub questions and the recommendations part will give advice for the development or the trip to an energy neutral environment on the background of industrial areas. Also recommendations will be given for further investigations, due to this investigation new questions have emerged with regard to the main topic.

Time is spent but transition stays away

The purpose of the thesis is to contribute in a major investigation into energy-neutral environment. This contribution will be in the sense of a focus on the industrial sector and point at the industrial areas. As described in the introduction Trias Energetica plays an important role in the preservation of our environment, trias energetica is an important instrument in the development of more sustainability regarding the energy aspect. The two main streams in this trias energetica are the use of renewable energy sources and reducing your energy demand. An important step in reducing your energy demand is the focus on efficiency. When the efficiency increases, demand will be reduced.

The energy use at industrial areas appears to be significant when compared with this use at urban areas. Research by among others DWA shows that there are significant amounts of energy getting lost at companies in the form of by products. The settled companies have troubles with getting rid of these residual flows, for these companies this flows are not useful anymore. As a result hereon, these flows end up in the air or water, which results in extra costs for this companies for example due to their duty to cool down these flows.

Steps could be set on a higher level, area based. The increase of efficiency could take place at the level of industrial areas. Companies who cannot get rid of their energy surplus should map the possibilities of delivering these residual flows in the sense of energy, to (for instance) their neighbouring companies. There are opportunities for these companies in the sense of cost reduction. Also this method can deliver a substantial contribution to Trias Energetica and finally also in the trip to an energy neutral environment.

However despite all possibilities and a confirmation by DWA a major transition stays away. There are lots of technologies for sustainable energy (re-)claiming, the society is talking about it and more and more this society is expecting companies to make use of these technologies. However a real transition seems to stay out, a certain turning point isn't yet in sight. What has to be done, which knobs have to be turned on or off and who has the duty to undertake these actions?

Problem definition

Despite all effort a transition towards the use of sustainable techniques and methods seems to stay away. There is a movement in the development but a real turning point is currently not in sight.

Research question

Which steps have to be taken to approach the turning point of an energy transition, and who is the right party or are the right parties to initiate here in?

Subquestions

Above question will be investigated and the answers/outcomes should arise by answering the sub questions drawn up with regard to the theories and techniques regarding the subject. The sub questions to be answered are the following:

- How can Industrial Symbiosis/ecology contribute to an energy transition?
- Who is 'problem' owner?
- Who are the actors and how do/can they influence?
- What is nowadays the position of companies towards energy neutral developments?
- What are the preconditions for companies to join in a symbiosis network and how are

they influenced?

- What could be the role of the Province of Noord-Brabant here in? How can they deliver a desirable contribution in initiating a certain transition?
- What are possible process techniques to initiate a transition?

Approach

To answer all sub questions and finally the main question, investigation is done by studying literature, case studies, field research and interviewing and carrying out questionnaires. The practical side of the research is carried out at the industrial area of Moerdijk, the Netherlands. The Province of Noord-Brabant has initiated the so called project 'Proeftuin Duurzame Verbindingen Moerdijk' in English: '*Experimental garden Sustainable links Moerdijk*'. The Province stimulates herein sustainable developments by bringing together different actors, delivering knowledge and expertise, taking away barriers, etc. This project has also resulted in a successful heat loop system between four companies. One company has an energy residue and the three others have an energy demand which is satisfied by the producing company. This technique is based on Industrial Symbiosis or Industrial Ecology which shortly means, the exchange of residual products in the sense of heat, water but also waste.

The theoretical framework of the investigation focuses on this industrial symbiosis, what does it exactly mean, is it already applied widely and what are experiences and is it promising? If this technique is promising, why isn't it implemented widely nowadays? Or what has to happen, which actions have to be undertaken to start a transition?

Transition management is another topic which is discussed in the theoretical framework. Furthermore techniques which could initiate or stimulate a transition are studied. The so called Mutual gains approach which focuses on mutual ambitions and finally mutual advantages which should be broad supported by all stakeholders. When an innovation or other new technique arises, very often the prevailing regime will blast it away or in any case will make it rather difficult to break trough. Strategic Niche Management is a method which creates niches (protected environments) where in the new technique can grow and develop until it is strong enough to survive the 'real world'.

Boundaries

For creating an investigation space which is synoptic, boundaries are drawn up. Boundaries for this investigation are categorized in technological, geographical and system boundaries and discussed here:

Technological:

The thesis focuses on the technology of exchanging residual flows based on Industrial Symbiosis. Solely it is hardly possible to investigate the development of a total energy neutral environment in this time period. My idea is that saving energy by creating more efficiency is one of the first steps in creating an energy neutral environment. When the demand decreases, the supply will automatically decrease which results in the need of less renewable energy sources.

Geographical:
The main CME study is focusing on the topic of 'Eindhoven energy neutral in 2040', however the thesis will investigate methods, approaches and techniques which are primarily not area bounded. However a sharpening is made by focussing on the industrial area of Moerdijk which, in the view of the 'proeftuinen' project of Noord-Brabant is seen as a best case. Expert talks pointed out that on the level of industrial areas the energy demand is significant higher in comparison with the rest of the built environment. Industrial areas have a great energy demand for their production processes as well as their main demand in the sense of office light, computers, etc. In my opinion there is a lot to save or win at the level of industrial areas as a geographical boundary.

System:
Regarding the current and upcoming restructuring projects at abandoned and/or neglected industrial areas, the thesis will focus on these as well as other existing areas because this restructuring projects can form an opportunity for implementing new systems. Also the erection of new areas will decrease. In the case of new areas, they will be developed taking substantial sustainable techniques more and more into account. Most of the time existing areas are traditionally supplied in their energy demand and suffer with a substantial energy surplus.

Theoretical approach
Consulting scientific literature, as well as conversations with the provincial experts and developments which can be picked up in the society and news sources, a conclusion can be made that the development of renewable energy sources is going rather slow in comparison with the effort which one is putting in. A result of transition into an energy neutral environment stays at low level, notwithstanding that the topic is discussed rather often in the society. The idea that sustainable energy is only interesting when subsidies and grants are given away or projects are initiated is rather frightening because this could be a sign that the techniques are still **not strong enough** to survive upon the **current regime** of traditional energy claiming. (Rotmans, 2003) However it can also mean that private parties or companies are not yet willing or interested to pick up developments. Motivations for not being interested can be the **current financial situation**, first there is no investment capital available and second, when there is investment capital available, one is not willing or **afraid** to invest in a new technique where useful information, experiences and knowledge is rather difficult to find. Thereby, why switch to another energy system when the **current system fulfils all demands**? The current system or regime, is reliable, stable and affordable.

The theoretical framework discussed a number of topics, like the developments on the level of industrial areas, the mismatch between supply and demand. Governmental initiatives in braking development of new areas and restructuring existing (abandoned) ones.
Secondly the aspect of sustainability is spoken. Sustainability is a very wide interpreted subject, however to structure this subject. SenterNovem (recently it is called AgentschapNL) introduced the **Trias Energetica**, three steps to take in the road to a more sustainable environment. This trias energetica can fulfil an important role in the road to an energy neutral environment by two major aspects: (1) Making use of **renewable energy** sources and (2) **decreasing your energy demand**. Decreasing your energy demand can be obtained by focussing on energy efficiency.

When looking at the energy use in the built environment it is clear (experts talks also pointed this out) that energy use at company level is far the highest. Lots of energy use means that, when creating more efficiency the demand as well will decrease. DWA investigated these energy uses in the situation of **Moerdijk** and concluded that companies have lots of energy residues where they cannot get rid of. The report shows the possibilities for residual flows and the exchange of it. So efficiency on the company level could be well done when focusing on their primary processes in the sense of low energy use. But in despite of the energy efficient processes, lots of energy disappears in the sense of heat, steam and water. However, the level up, at **industrial area** view there are possibilities to improve efficiency. The residual energy flows could be exchanged applying **Industrial Symbiosis** (or Industrial Ecology). This Symbiosis is based on the exchange of each other by products with the objective to increase efficiency and deliver a substantial contribution on the level of sustainability.

Though, in despite of these opportunities (techniques as well as figures which prove the possibilities), **nothing happens**, no actions are undertaken. A certain **transition** which is needed for implementing such a method is staying away.
An interesting example which is seen by many scientists as a (or the) best case in industrial symbiosis is Kalundborg Denmark. This industrial area started the symbiosis based approaches in the early 60's and expended since then bit by bit an evolutionary way towards, what it now is. This is a sign that implementing such a symbiosis based technology will not occur from one day to another. It is based on the evolution of a number of **bilateral relationships**, the stimulation of **intercompany relationships** and also the formation or the presence of a **business network**. Thereby pro-active participation of different stakeholders is crucial as well as starting small scaled initiating less risk projects. This way, **mutual trust** can be created which is a crucial factor in the initiation of symbiosis based projects. (Konz & vd Thillart, 2002)

The implementation of new energy regime is seen as a transition based on a technical as well as a social innovation process. Transitions are seen by Rotmans (2003) as structural changes which take a lot of time, at least one generation (20-25 years). A transition can be seen as a system of social **wheels amplifying each other.** However in the case of the thesis, the question is **which wheels** have to turn faster or slower to stimulate this transition? Aspects which slow down the transition are for example the lack of need for a new system, the market provided by a reliable proven energy system, why change? Also the small scale of the sustainable techniques nowadays results in a **lack of ambassadors** to promote the use of it. This results in major **uncertainties** for techniques. Because the ambassadors are missing, there is **less feedback from sales to R&D**. This situation can be simplified shown by the circle of blame which should be turned around in the circle of engagement.
Industrial symbiosis as well as the transition towards this symbiosis is based on relationships between all actors. In the case of good, well funded **relationships** and mutual knowledge, a transition towards industrial symbiosis will be stimulated. An interesting approach to stimulate this transition into industrial symbiosis is the method of **Mutual Gains Approach** (MGA). This approach is based on thinking in **shared benefits** instead of solely standpoints. When all benefits are clear a mutual ambition can be drawn up which should be broad supported. The goal of a **mutual ambition** is to enlarge the pie which will be divided when it is large enough. Because every actor delivers its contribution to the same pie, everybody's

benefit will be affected which results in collective profit. (Evers & Susskind, 2006)

The last topic discussed in the theoretical framework is **Strategic Niche Management** (SNM). This SNM is a method which creates **opportunities for innovations** to grow on the background of **prevailing regimes**. A niche can be seen as a protected area wherein a new technology or innovation can grow. Protection can be carried out by governmental instances in supporting the new technology in the sense of supporting knowledge, connecting actors, subsidies or other financial means. The niche creates possibilities for these techniques to grow and develop (by small scaled implementation and/or experiments). Due to this protected area the techniques can develop to be strong enough to take away **uncertainties** and survive the world of a prevailing regime. (Raven, 2005)

Practical approach

After investigating on literature level there was a need for sharpening the topic by a practical approach. The practical approach of the thesis consist of an investigation on the industrial area of Moerdijk by interviews, questionnaires, expert talks and a part of a research review. The purpose of the practical approach is to map issues (on the background of the proeftuinen project) for companies to participate in symbiosis based networks, what are reasons to participate and what are reasons not to participate? What are the advantages of the collaboration with the province and what are its disadvantages, etc.

An important outcome of the practical approach is the confirmation of the feasibility of symbiosis at Moerdijk. 26 pieces of residual flow connections are found out which have a saving potential of 7PJ. As a reference, the total energy demand of the investigated companies is for about 42PJ.

Another outcome of this practical approach is a list of preconditions drawn up by companies for participating in a symbiosis network. A main list of preconditions is mapped by the consulting firm of DWA. The questionnaire also mapped the value of these preconditions which resulted in the following most important preconditions:

- Not too much mutual dependence;
- No interest differences;
- Guarantee of continuity, quality and scale size;
- Enough personnel available for design and realization;
- Clear appointments;
- The maintenance has to be arranged properly;
- Limited risks and uncertainties by mutual trust.

Besides the preconditions, other outcomes of the practical approach are that despite of the upcoming CSR developments, the financial aspect is still the most important motivation to join in a symbiosis project or other actions in the sustainable area.
The availability of a company association is rather important because its interconnectivity capacities as well as it can play an initiating role. The same applies to the Province of Noord-Brabant which plays an initiating role which works stimulating for the settled companies. The initial ideas about the province where not that positive, in the sense of the official ‘mill’ which should be problematic. However the companies changed their thoughts and experienced the province as a stimulating party. However on the level of legislation and permits steps could be made: some companies are willing to invest in a company expansion

with a focus on sustainability but due to the permit issues this plans are frustrated.

Conclusions and recommendations

Despite all effort a transition towards the use of sustainable techniques and methods seems to stay away. There is a movement in the development but a real turning point is currently not in sight.

This problem definition resulted in the following research question:

Which steps have to be taken to approach the turning point of an energy transition, and who is the right party or are the right parties to initiate here in?

To answer this question, investigation is carried out by drawing up sub questions which are answered by performing literature studies sharpened by a practical approach in the sense of a case description, interviews, a questionnaire and expert talks.
Main outcomes of the investigation are that, regarding the two most important aspects of Trias Energetica; use of sustainable energy sources and the decrease of energy demand. Focussing on decreasing the energy demand by efficiency is an important first step in developments towards an energy neutral environment. Since energy use on industrial area level is significant and individual companies suffer with an energy surplus, opportunities are seen; creating more energy efficiency on area level. An interesting method for obtaining energy efficiency on area level is to implement Industrial Symbiosis. Industrial Symbiosis (also called industrial ecology) means the inter company exchange of rest and by products in the sense of heat, water, steam and other products which are non-useful for one company but at least such useful for other companies. However, in despite of these possibilities and opportunities also indicated by the consulting firm DWA, company initiatives stayed away.
Since the moment when the Province of Noord-Brabant started the Proeftuinen project of 'Duurzame Verbindingen Moerdijk' companies got interested and started thinking about possibilities. Interviews and questionnaires have pointed out that there is no real lack of willingness on company level to participate in these projects. Obviously the companies have a need for an initiating party who invites actors to join conversations and finally exchange or symbiosis projects. The province as well as company associations and park managers could deliver a substantial contribution here on. Another recommendation: since the government is focusing nowadays on the restructuring of existing industrial areas a great opportunity (in the sense of a time course) arises for implementing industrial symbiosis. Implementing or introducing these techniques are timing sensitive, when a company has just settled at an area and all processes are running, he willingness to invest in a new energy system will be none, however when a total area is being restructured, this willingness will be much higher.
An interesting and useful method to stimulate these collaborations is Mutual Gains Approach (MGA). Mutual Gains Approach (MGA) is a strategy with the objective to create solutions which result in mutual gains. The focus lays on making the pie as large as possible, due to input of all stakeholders. A MGA is based on the input of all stakeholders which have mutual trust, and are willing to take co-responsibility. (de Graaf, 2007). When the pie is big enough and pleased all interests as much as possible, it can be shared/divided to all stakeholders. Instead of focusing on a stakeholder his standpoint MGA focuses on the interests of a stakeholder. In a MGA it is crucial to have all stakeholders around the table, when this takes place, the conversation part can begin where in the important factor is to create mutual trust

and then ambitions, ambitions which are supported by all stakeholders. When all stakeholders agree this ambitions, they will support the implementation of it. The chance of success is rather big and next projects will also run better with less barriers.
Once Mutual ambitions are drawn up, the execution of a project can start. However in the case of Moerdijk industrial symbiosis as an innovative technique has to be implemented. Industrial symbiosis is a rather radical energy system when comparing with the traditional methods. Implementing innovations or new techniques on the background of a prevailing regime can be stimulated by applying Strategic Niche Management (SNM). SNM is the creation of a niche where in a new technique or an innovation can develop and grow until this technique is strong enough to compete the dominating regime. '*Strategic niche management is an instrument to steer a transition in its first phase.*" (Hermkens, 2006) The niche is a protected environment where in the innovation or new technique gets the possibilities to grow and develop. In fact it can be seen as an area where in experiments can be carried out to raise the new technique so far that it gets strong enough to survive the regimes first punches. SNM is a method which is useful when the accent of an initiative lies on the level of success instead of project size.
The projects with reference to the Proeftuin Duurzame Verbindingen Moerdijk are partly based on the techniques of Mutual Gains Approach, focusing on mutual advantages. Spending time and effort on the preparation phase of a project, by intensively mapping the benefits of all stakeholders and creating mutual supported ambitions (enlarging the pie) will result in broad supported actions which avoids problems in the sense of harmed stakeholders. An ideal MGA results in total support of all stakeholders.

Though, the proeftuinen project in Moerdijk is also very suitable for applying the Strategic Niche Management approach. By means of the Proeftuin, the Province can create a protected area (niche) to implement the symbiosis techniques. By a small scaled approach, the projects can get an experimental character, where cases are likely to fail, one can directly intervene and undertake actions or changes in the approach. When applying small scaled projects, the chance of success is much higher, when projects are successful more support and interest in the new technique will occur which then results in more actors interested and finally more as well as larger projects which should stimulate a transition.
Further investigation should be done on establishing a 'utility-centre' and the business plan of such an organization. The utility centre can take care of the stability and supply certainty of the symbiosis network. This way the attractiveness will rise. However the questionnaire pointed out that benefits of this company never may flow away, since the financial aspect is seen as rather important by the companies, investigation should be carried out on the aspect of the ownership of this centre. When the companies have it's share in this centre, more transparency will occur. Also more investigation should be carried out on the level of emission targets. In a symbiosis based network, company A can profit the residual flows of company B. Though the individual targets may not be fulfilled in despite of the sustainable contribution to the symbiosis network. Possibilities of mutual emission targets or leveling of the fulfilled targets should be investigated.

References:

Evers, F. Susskind, L. (2006) *Het kan wel! Bestuurlijk onderhandelen voor een duurzaam resultaat,* MGMC Haarlem

Graaf, H.J. (2007) *Een win-win aanpak voor het oplossen van maatschappelijke vraagstukken,* Centrum voor milieuwetenschappen Leiden

Hermkens, J.J.P.P. (2006) *Een inventarisatie, selectie en aanbevelingen tot beleid door middel van Strategisch Niche Management*, Eindhoven – University of Technology, the Netherlands

Konz, W. van den Thillart, C. (2002) *Industriele symbiose op bedrijventerreinen*, Eindhoven - University of Technology, the Netherlands

Raven, R. (2005) *Strategic Niche Management for Biomass, a comparative study on the experimental introduction of bioenergy technologies in the Netherlands and Denmark*, Eindhoven - University of Technology, the Netherlands

Rotmans, J. (2003) *Transitiemanagement: sleutel voor een duurzame samenleving*

ING. F.J.M. SCHOENMAKERS

'I have experienced the last months as a very interesting time with lots of interesting discussions, learning moments and a friendly atmosphere at the Province of Noord-Brabant and the TU/e.'

Education

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